2021 PANHANDLE WATER PLAN

VOLUME II. APPENDICES.

2021 PANHANDLE WATER PLAN

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AGRICULTURAL WATER DEMAND PROJECTIONS

2021 Irrigation Demand Methodology
Panhandle Water Planning Area

Thomas Marek, Steve Amosson and Charles Hillyer

The proposed Texas Water Development Board (TWDB) methodology for estimating irrigation demand is based on using the past 5-year running average irrigation demand from each county which is summed for the regional total. Data used in the running average computations was from values provided by the TWDB and was solicited for consideration going forward in terms of estimates. However, it is known that the five prior years values had record drought conditions with four of the five years having below average rainfall enveloped in that data range.

The impact of the aforementioned drought years in a 5-year running average computation cannot be overstated, particularly as it relates to the initial baseline or starting point projected out for the next 50 years. Reviewing Amarillo weather (www.weather.gov/ama/201) in 2011, only 7.01 inches occurred (13.35 inches below normal) and was reported as “the driest year on record”. Rainfall received in the first four months of 2011 amounted to only 0.25 inches; thus, no preseason moisture was received for filling of the soil profile. In 2012, 5.32 more inches were received over that in 2011 but still was over 8 inches below normal rainfall. Year 2012 also proved to be the second warmest year on record, thereby increasing annual crop ET demand. In 2013, while more rainfall occurred than in each of the prior two years, it was still 5.16 inches below the normal rainfall average. If the 3-year deficient rainfall sequence was not damaging enough for crop producers, rainfall in 2014 was also slightly below normal (1 inch); however, with a dry profile entering the year coupled with a dry spring and below average rainfall in the critical growing months of July and August water use mimicked that of a much more extreme drought year. Thus, as proposed by the TWDB, the 5-year running average would include the driest year of record plus be computed with 4 out of 5 drought or drier-than-normal data years. Using such an inflated starting point for a 50-year projection appeared illogical and unacceptable from a normal expectation and representation perspective.

The regional agricultural committee determined that the 5-year running average was too greatly influenced by the drought years to be used as a starting point (or 2021 beginning baseline) value projected out over the next 50-year horizon. Thus, in this fifth planning cycle, there was a desire by the regional agricultural committee to pursue an investigation into an alternative methodology approach that would more generally reflect expected or nominally based irrigation demand conditions and represent a more realistic baseline for projecting irrigation water use over the next 50 years.

Three potential estimation methodology approaches were developed and proposed for consideration by the regional agricultural committee. They were:

a) water balance model,
b) a longer term running average approach, and
c) a selected average year approach (without inclusion of extreme values).

The benefits and deficiencies of each approach were discussed with the regional agricultural committee and are detailed in the following sections.

Water balance type model

In all prior plans of the Region A planning cycles, the TAMA (Texas A&M -Amarillo) irrigation estimation demand model had been used for determining the irrigation demand values. The model was shown to be representative of nominally based county and regional irrigation demands but strongly depends on accurate data inputs. However, the inputs of accurate acreages and crop distribution have become more difficult to readily obtain as changes in reported governmental statistics continue to show significant differences due to a variety of reasons. The number of producers not reporting irrigated acreages to federal support programs continue to increase and the number of crop categories continue to diversify recently due to the relatively low rate of commodity return, particularly of late with recent cereal grain production. The crop distribution is further being altered by the increase in animal diversity and composition within the region.

It was recommended that accurate data regarding water balance type models was becoming increasingly difficult to obtain and that Groundwater Conservation District (GCD) data would be required to monitor annual crop acreages for adequate and acceptable model inputs. This challenge was viewed as an additional effort that possibly not all GCD's could adequately conduct without additional resources. Furthermore, it was viewed that for a model to be accurate, local knowledge of non-Farm Service Agency (FSA) acreage, the crop distributions (known to change due to demand and economics) and producer cultural production practices were required across the region. It was viewed that TWDB personnel would not have the needed degree of information for adequate use representation with such models. Thus, this type model was not viewed as a viable, long term TWDB methodology unless a firm and sustained commitment was made to secure such annualized and representative data within the region.

Longer term running average approach

The second methodology approach was similar to that proposed by the TWDB but with the use of a longer (10 year) running average rather than a 5-year average. The intent of using a 10-year running average was to mitigate the influence of extreme stochastic events (such as drought or conversely excessively wet years) in the nominal estimation value. Longer terms were not considered because of accuracy issues associated with farther back in time use estimations. It was recognized and acknowledged that a 5-year running average was particularly influenced by the 2011, 2012, 2013 and 2014 (drought) irrigation demand years and would not represent well the initial baseline data value to be used with the longer term (50 year) projections. Although increased demand pumping did occur during those years by irrigated producers, the average using those dry years as proposed by the TWDB, would not representatively reflect irrigation demand extrapolated out over the next 50 years. Thus, a longer period of computation (10 year) was considered in that extreme event values would be "better averaged" and a "more balanced" demand value would be representative of irrigated demand conditions by regional crop producers.

Selected average year approach (without inclusion of extreme values)

The third methodology of consideration was that of a selected year average pumping approach. This approach was used in the TAMA models "average years" demand values of crop ET and irrigated crop pumping estimates. The primary issue with this approach was that it does not include any increased or decreased pumping demand due to extreme years (as recently experienced). The method also may or may not agree well with actual Groundwater Conservation District (GCD) metered or reported values within the region where extreme or "non-average" type years occur. This method approach could also include a statistical probability approach, or a probability based expected value of choice (i.e. a 60% or 75% occurrence type demand value).

Data Accuracy

As previously indicated, data accuracy is essential for demand value representation, particularly regarding the initial starting point (i.e., the baseline value) that is used as the basis for making water use projections out over the next 50 years. In a comparison of the regional conservation water districts use values, there appears to be significant differences in values as reported by some districts and the TWDB provided data values for methodology consideration. Thus, it is necessary that the annual differences be reconciled before final settlement of a 50-year regional baseline value. As the North Plains Groundwater Conservation District (NPGCD) generally accounts for approximately 85% of the entire regional demand, accuracy and agreement of pumped values is viewed as essential in determining the baseline irrigation water use within the region. Within the NPGCD, five counties account for the majority of the district's irrigation demand (and crop production); thus, accurate values in Dallam, Hartley, Sherman, Moore and Hansford counties is paramount for accurate regional demand representation. Illustrative examples of some of the differences are presented in Figures 1 and 2.

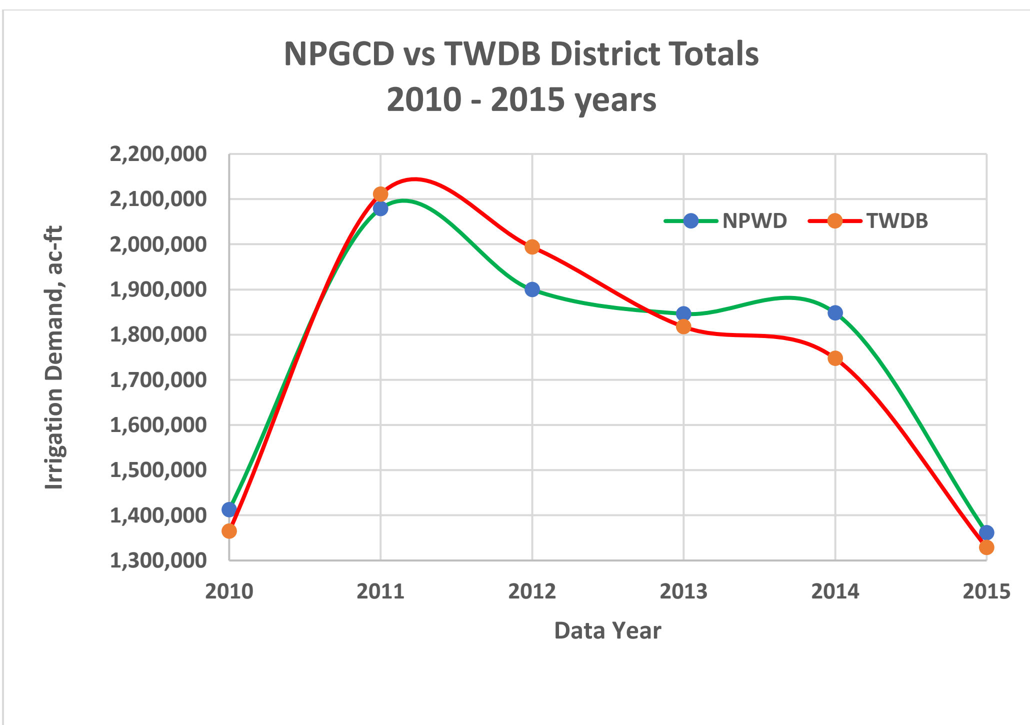


Figure 1. Comparison of NPGCD irrigation county totals versus TWDB data for years 2010 – 2015.

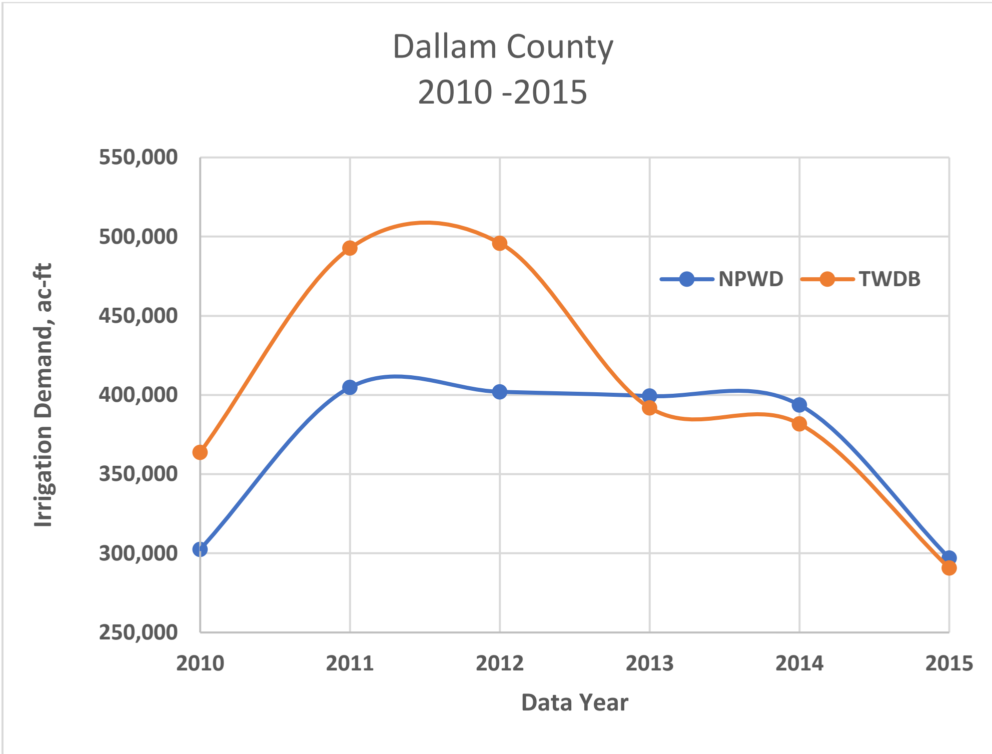


Figure 2. Comparison of NPGCD Dallam county irrigation value versus TWDB data for years 2010 – 2015.

It is further realized that accurate, complete 10-year values do not exist for all counties within Region A. Estimates of the past derived by other than reliable metered program records such as user survey or average efficiency derived use values may not reflect actual or accurately pumped values. Thus, the accuracy of documentable use values going forward should improve with improved monitoring methods, particularly with well managed and well-maintained metering programs.

<u>Recommended Methodology and Results</u>

The regional agricultural committee was presented with the three methodologies and voted to investigate a 10-year running average methodology approach. Annual metered pumpage data values as provided by the NPGCD were used in the 10-year running average county based computations for the NPGCD counties. As there was concern regarding Dallam county where part of the county irrigated acreage was outside the NPGCD boundaries for two years of the 10-year record, an (increased) pumping adjustment was made for the years of 2011 and 2012 to reflect that Dallam county acreage (non-NPGCD) demand. The remaining 5-year TWDB county values were then used with a percentage modifier to adjust the respective non-NPGCD county 5-year values to 10-year values. The computational process included using a reduction for the (non-NPGCD) TWDB 5-year county values by dividing the TWDB 5-year value by the average value. An analysis comparing each individual county reduction was also conducted and resulted in about a 1,000 ac-ft. difference for the region total and thus the average reduction value was used instead. It should be recognized that the “proportioning modifier” (being based on the last five years TWDB provided values) would likely overestimate the actual demand used in those (non-NPGCD) counties for a 10-year period. This is due to the inclusion of the drought years in the 5-year data period.

It is also recognized that the 10-year running average methodology approach would result in a deviation (increase) from the prior SB4 estimates due to the drought years not being included in the prior TAMA estimations. It should also be recognized that it will require another 5 years (assuming no further extreme drought year events occur in the next 5-year time frame) before the impacting drought year values are eliminated from the 10-year running average mathematically and “settle” or revert to a more nominal and expected irrigation value (i.e., demand level). However, the strength of a running year average approach does provide reflection on what was actually incurred (pumped) in prior years and thereby indicates actual irrigation usage that can be used in available water resource management decisions going forward. This should be of particular interest to the conservation water districts dealing in state water policy and also be attractive to associated water management personnel.

The 10-year running average county based values as computed using the aforementioned process is presented in Table 1, as well as, a comparison of these estimates to the Region A Senate Bill 4 (SB4) and the 2021 TWDB projections.

Table 1. 2021 Region A Irrigation demand estimates based on a 10-year running average method compared to SB4 and TWDB 2021 estimates.

County	Irrigation. Demand, ac ft.	SB4 Estimates, ac ft.	SB4 Difference, %	TWDB Estimates, ac ft.	TWDB Difference, %
Armstrong	**6,244**	4,194	48.9	7,096	13.6
Carson	**87,289**	55,702	56.7	95,796	9.7
Childress	**14,142**	7,308	93.5	15,794	11.7
Collingsworth	**47,471**	17,943	164.6	53,226	12.1
Dallam	**343,830**	369,864	-7.0	425,233	23.7
Donley	**30,910**	24,080	28.4	34,426	11.4
Gray	**32,289**	21,291	51.7	35,702	10.6
Hall	**31,792**	10,134	213.7	35,192	10.7
Hansford	**171,900**	134,902	27.4	198,260	15.3
Hartley	**406,990**	345,365	17.8	429,592	5.6
Hemphill	**5,679**	1,907	197.8	6,653	17.2
Hutchinson	**59,910**	40,008	49.7	64,017	6.9
Lipscomb	**40,870**	20,009	104.3	44,862	9.8
Moore	**200,550**	143,028	40.2	219,326	9.4
Ochiltree	**84,460**	57,243	47.5	93,177	10.3
Oldham	**4,721**	3,937	19.9	5,368	13.7
Potter	**3,176**	3,427	-7.3	3,702	16.6
Randall	**17,720**	18,000	-1.6	21,471	21.2
Roberts	**8,543**	5,958	43.4	9,523	11.5
Sherman	**304,360**	220,966	37.7	332,308	9.2
Wheeler	**16,224**	8,203	97.8	17,728	9.3
10-year running average*	**1,919,070**	1,513,469	26.8	2,148,452	12.0

*10-year running average.

The total 10-year running average regional irrigation demand value is 1,919,070 ac-ft. That value again is above the prior estimated SB4 regional value of 1.53 million ac-ft. annually using a non-extreme event year's average. It is below the TWDB estimate that include the drought years in a shorter term 5-year computation. The percent TWDB differences are not as large as that of the SB4 values since the TWDB and 10-year running average computations both contain the drought years values.

As depicted in the 10-year running average values, the five major irrigated NPGCD counties alone account for over 74% of the 10-year running average regional demand total with those five NPGCD counties accounting for 88% of the NPGCD demand total. The reported “all available years” (long term average value) of the NPGCD irrigation pumping records is 1.56 million ac-ft. (data provided by NPGCD-Walthour, 2017). Thus, the NPGCD represents the largest irrigation water demand district in the region. Regionally, the 10-year running average value of 1,919,070 ac-ft. represents a 26.8 % increase from that of SB4. It also represents a 12% reduction from that of the proposed TWDB calculation.

The concerning issue of whether some Region A counties could increase irrigation pumpage in drought type years, particularly of the counties in the southern portion of the region, due to either well capacity (i.e., aquifer limitation) or the number of well limitations was investigated. If existed, it would limit producer pumpage capability to readily address a drought condition year. Annual pumpage records indicated that while some (lesser irrigated) county limitations were existent in a few southern counties, irrigation pumpage rates were significantly increased in the drier years to maintain production profitability. As to whether this condition can be consistently met going forward later in time (if another extreme event occurs) remains a production and conservation issue.

<u>Summary</u>

Identification of a realistic baseline irrigation demand is imperative since it serves as the starting point for projecting water use over the next 50 years, thus errors in the baseline are compounded. It can be concluded that a longer term 10-year running average represents the regional irrigation demand more representatively than that of a shorter 5-year term (as proposed by the TWDB) particularly as to when the calculations contain extreme annual rainfall event levels. The current 5-year period contains multiple drought event years including the region’s lowest rainfall year in history and is viewed to result in a computationally inflated demand value. The 10-year running average is advocated for adoption due to the demand representation aspect and in consideration of the length of accurate available records by some GCD’s and possibly of the TWDB. It is also stressed that data sets be accurate and representative of actual encountered county (and regional) conditions and nominally agree with well-managed GCD metered county use values.

Furthermore, it is recognized that once the current “series of drought years” (2011-2014) are “outside” the computational 10-year period going forward in time, the regional irrigation demand value will revert to a demand value below the current computed 10-year running average level of 1,919,070 ac-ft.

2021 Regional Water Plan: Region A Livestock Water Use

Steve Amosson, Thomas Marek and Charles Hillyer

The Agricultural subcommittee of the Region A Water Planning Group met on July 26, 2017 to review the Texas Water Development Board (TWDB) draft projections of livestock water use in the Region for the 2021 planning cycle and the analysis of those estimates prepared by Texas A&M AgriLife personnel. The TWDB projections for 2020 – 2070 were within 1% of the 2016 Regional Water Plan estimates for the same time horizon, Table 1. However, county level water use estimates varied as much as 49% between the two projections. In addition, there were differences between the water use per species as well as the delineation of species water use that had been developed over previous water planning efforts in Region A which were necessary to accurately reflect the livestock Industry composition in the region. Also, changing conditions warranted reexamination of the future potential growth/contraction of the various livestock enterprises. Based on the information/analysis presented, the Agricultural subcommittee charged Texas A&M AgriLife to redo livestock water use using methodology developed in the previous regional water planning efforts.

Table 1. Comparison of 2016 RWP and TWDB 2021 RWP Draft Water Demand Projections - Livestock (in acre-feet)

	2016 Region A WP Projections						2021 TWDB RWP Draft Projections						% Change from TWDB 2021 to 2016 RWP					
County	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
ARMSTRONG	645	649	652	656	659	663	425	428	430	432	434	437	-34%	-34%	-34%	-34%	-34%	-34%
CARSON	692	696	700	704	709	713	556	559	563	566	570	573	-20%	-20%	-20%	-20%	-20%	-20%
CHILDRESS	490	493	495	497	500	503	267	269	270	271	273	274	-46%	-45%	-45%	-45%	-45%	-46%
COLLINGSWORTH	600	603	605	608	611	614	431	433	435	437	439	441	-28%	-28%	-28%	-28%	-28%	-28%
DALLAM	4,437	4,669	4,920	5,191	5,485	5,803	5,644	5,939	6,258	6,603	6,977	7,381	27%	27%	27%	27%	27%	27%
DONLEY	1,330	1,332	1,333	1,335	1,337	1,339	895	897	897	899	900	901	-33%	-33%	-33%	-33%	-33%	-33%
GRAY	1,352	1,378	1,407	1,438	1,473	1,511	1,839	1,874	1,914	1,956	2,004	2,055	36%	36%	36%	36%	36%	36%
HALL	336	337	339	340	341	343	327	328	330	331	332	334	-3%	-3%	-3%	-3%	-3%	-3%
HANSFORD	3,432	3,574	3,724	3,881	4,046	4,219	4,596	4,786	4,987	5,198	5,418	5,650	34%	34%	34%	34%	34%	34%
HARTLEY	6,498	6,977	7,498	8,066	8,684	9,359	6,932	7,443	7,998	8,604	9,263	9,984	7%	7%	7%	7%	7%	7%
HEMPHILL	1,275	1,279	1,284	1,289	1,295	1,302	1,170	1,173	1,178	1,183	1,188	1,195	-8%	-8%	-8%	-8%	-8%	-8%
HUTCHINSON	847	873	903	935	971	1,010	441	454	470	486	505	525	-48%	-48%	-48%	-48%	-48%	-48%
LIPSCOMB	947	969	993	1,020	1,050	1,083	758	776	795	816	840	867	-20%	-20%	-20%	-20%	-20%	-20%
MOORE	3,676	3,906	4,155	4,424	4,716	5,032	3,082	3,274	3,483	3,709	3,953	4,218	-16%	-16%	-16%	-16%	-16%	-16%
OCHILTREE	4,216	3,632	3,729	3,832	3,942	4,058	2,165	1,865	1,915	1,968	2,024	2,084	-49%	-49%	-49%	-49%	-49%	-49%
OLDHAM	1,229	1,231	1,234	1,237	1,240	1,243	1,148	1,150	1,152	1,155	1,158	1,161	-7%	-7%	-7%	-7%	-7%	-7%
POTTER	481	482	484	486	488	491	651	652	655	657	660	664	35%	35%	35%	35%	35%	35%
RANDALL	2,654	2,665	2,677	2,690	2,704	2,719	3,270	3,283	3,298	3,314	3,331	3,350	23%	23%	23%	23%	23%	23%
ROBERTS	369	369	370	371	372	373	335	335	336	337	338	339	-9%	-9%	-9%	-9%	-9%	-9%
SHERMAN	3,449	3,631	3,825	4,034	4,257	4,497	4,041	4,254	4,481	4,726	4,987	5,269	17%	17%	17%	17%	17%	17%
WHEELER	1,577	1,680	1,682	1,684	1,687	1,689	1,271	1,354	1,356	1,357	1,360	1,361	-19%	-19%	-19%	-19%	-19%	-19%
Region Total	**40,532**	**41,425**	**43,009**	**44,718**	**46,567**	**48,564**	**40,244**	**41,526**	**43,201**	**45,005**	**46,954**	**49,063**	**-1%**	**0%**	**0%**	**1%**	**1%**	**1%**

A Livestock Industry focus group met at The Texas Cattle Feeders Association on August 30, 2017 to discuss the 2021 regional water plan. Representatives from the fed cattle, dairy and swine confined livestock operations as well as producers, water district and TWDB personnel were in attendance. The group reviewed and provided guidance on inventory, water use by species and what the future may look like for the various livestock water user groups. Results of this meeting were incorporated into the development of the revised livestock water use estimates for the 2021 water plan. The remainder of this memorandum is delineated into five sections: revised inventory estimates; water use by species; future growth/contraction; results; and summary & conclusions.

Revised Inventory Estimates

County determination of livestock numbers is vital to the accurate estimation of water use. Livestock inventories by species were updated/estimated for each county of Region A. As in previous efforts, eight livestock water use groups were evaluated. They include fed beef, beef cows, summer stockers, winter stockers, dairy cattle, equine, swine and poultry. The procedure developed in previous planning efforts was utilized to develop the estimates of 2017 county level inventories by species.

In the 2021 Regional Water Plan (RWP), updated inventory projections were estimated and utilized to replace the inventory projections made in the 2016 RWP to improve the accuracy of the baseline for making future projections. The information obtained to update inventory estimates came from several different sources including; Texas Agricultural Statistics Service (TASS), the 2012 Census of Agriculture, Milk Market Administrator records, Extension Agents and Specialists, and Commodity Associations were used to refine/improve county level estimates.

Fed Beef

Neither TASS nor the Census provides estimates of fed beef inventories at the county level due to disclosure concerns. In the past water planning efforts, Texas Cattle Feeders Association (TCFA) personnel made the Region A county level fed cattle estimates. For the 2021 RWP, TCFA personnel again updated county level feedlot inventories via secondary data and personal communications with feedlot managers.

Beef Cows

TASS inventory estimates of 2017 beef cow numbers by county were utilized to update the 2010 inventories used in the 2016 RWP. However, inventories for six counties (Carson, Gray, Lipscomb, Moore, Sherman and Wheeler) were not provided due to disclosure policies. The beef cow inventory in these counties was estimated by applying the percentage change (2017 vs 2010) in the known counties to the 2010 inventories in these counties.

Summer Stockers

The procedure for estimating the number of summer stockers remained the same as was developed in previous Region A water plans. The amount of permanent pastureland per county available for grazing was estimated from the Census of Agriculture. The total acres available for grazing was augmented by adding in cropland used for grazing assuming the carrying capacity of these improved pastures was double that of the native pasture. This total acreage available for grazing was reduced by the acreage required to support the beef cow inventory in the county, the remaining acreage was available for summer stockers. The number of potential summer stockers was then derived by dividing the available stocker acres by the estimated stocking rate. Stocker estimates were reduced 10% to allow for frictional losses in inventories associated with under stocking. The typical stocking rates for both beef cows and summer stockers used in the analysis were determined by county in consultation with the Texas A&M AgriLife Beef Cattle Specialist for the area.

Winter Stockers

In consultation with the Texas A&M AgriLife Beef Cattle Specialist the percentage of irrigated and dryland wheat acreage on average grazed in a typical year was set at 50% and 25%, respectively. This represented a slight change from the previous planning effort that was determined from a survey of county Agents in the major wheat producing counties (changed from 60% to 50% and 20% to 25%). A previously done survey of 300 producers was utilized to estimate the stocking rate per acre for irrigated and dryland wheat. In the 2021 RWP, winter stocker numbers were adjusted to reflect a new wheat crop acreage base (2012 – 2016 average) using Farm Service Agency (FSA) recorded planted acreage. These changes in winter stockers were reflected in the 2017 estimated inventory.

Dairy Cattle

The methodology for determining the number of dairy cows per county was changed in order to improve the accuracy of estimates. In previous planning efforts, County level dairy inventories were identified through TASS. In counties with less than three dairies which are not reported in TASS data, residual dairy cows not accounted for were divided evenly between counties where dairies exist. In the current effort, Milk Market Administrator (MMA) records were used to estimate the number of dairy cows per county. In counties with less than three dairies which are not reported in MMA statistics, Texas Department of Health records were utilized to identify the dairies and County Agents with knowledge of those operations or the dairies were contacted directly to determine the number of dairy cows.

Equine

Currently, the Census of Agriculture is the only source of county level equine inventories. The 2007 Census of Agriculture estimates used in the 2016 RWP were updated to the inventories reported in the 2012 Census of Agriculture for the 2021 effort. In addition, the equine inventory was expanded to include burrows, mules and donkeys.

Swine

A number of large confined hog operations exist in Region A. Due to disclosure limitations the location and size of these operations is not available through TASS or Census data. The methodology for estimating these operations by county and by type (farrowing, nursery or finishing) were similar to previous water plans. These companies were surveyed directly with the assistance of the Texas Pork Producers Association and county Agents to determine the actual inventories to use in the 2021 RWP effort. The 2012 Census of Agriculture was utilized to estimate inventories in counties without commercial scale operations. Total Inventory estimates were back checked for accuracy via current and past TASS records.

Poultry

Virtually no poultry currently exists within Region A. In the 2016 RWP, county level inventories were identified through the 2007 Census of Agriculture. For the current water planning effort these inventories were updated based on the 2012 Census of Agriculture.

Livestock Water Use by Species

Significant time and effort were made in the 2011 Regional Water Plan (RWP) to form advisory committees consisting of industry experts to review water use estimates by species. The estimates developed by the committees were implemented in the 2016 RWP. A livestock advisory committee reviewed these species water use numbers for the current water plan and with an exception of dairy decided these estimates were still appropriate; therefore, they were used in developing livestock water use projections in the 2021 RWP, Table 2.

Categories of livestock water use do vary considerably with those proposed by TWDB due to unique composition of livestock operations in the region which the rest of the state as a whole does not have. Failure to consider these differences distorts water use estimates especially on the county level. The composition of the region's beef industry which consists of large inventory of fed beef followed by summer and winter stocker operations both of which have smaller water requirements per head than beef cows. In addition, there are relatively fewer beef cow herds in the region compared to the rest of the state which makes it necessary to separate these user groups. Hog water use groups were separated into three categories (farrowing, nursery and finishing) rather than the one proposed by TWDB. This was done in order to improve county level water use estimates as some of the counties just have finishing operations, some just nursery, some just farrowing and some a combination. The other major variation in species water use is in the dairy industry. Basically all the dairies in the region are relatively new (less than 20 years) thus have modern facilities that focus on water reuse, therefore, based on studies that have been conducted and expert opinion have lower water use (65 gal/day) than traditional dairies which is reflected in the difference in water use versus

TWDB estimates (75 gal/day). However, the 65 gal/day is actually an increase in water use per dairy cow used in the previous planning effort (55 gal/day). This adjustment in water use was made after results of more studies became available.

Table 2. Region A 2021 RWP daily livestock water use estimates per animal.

Species	2021 RWP (gal/day)	TWDB 2021 (gal/day)
Beef - All	----	15
Beef Cows	20	----
Fed Beef	12.5	----
Summer Stockers	10	----
Winter Stockers	8	----
Dairy Cattle	65	75
Equine	12	12
Poultry - All	0.09	----
Poultry: Hens	----	0.086
Poultry: Broilers	----	0.077
Swine - All	----	11
Swine: Sows	17.5	----
Swine: Nursery	2.5	----
Swine: Finishing	5.0	----

Projected Future Growth or Contraction of Livestock Sector

The Livestock Industry focus group reviewed the 2016 RWP projected growth/contraction of the various livestock user groups. After review, the focus group recommended changes in the projected growth for seven of the eight categories, Table3. The fed beef projections remained unchanged with expected 5% decadal growth occurring in Dallam, Hansford, Hartley, Moore, Ochiltree and Sherman counties starting in 2030. The focus group felt that as water availability decreases more emphasis will be placed on the cattle industry. Beef cows, summer stocker and winter stocker inventories are expected to grow at a 0.5% annually throughout the planning horizon. The dairy industry is expected to grow 2.0% annually up to 2030 then 1.0% annually thereafter.

The observed decreases in equine inventories across the state led the focus group to flat line any projected growth in this industry within the region. The committee still believes the poultry industry will be coming to the region because of the same environmental reasons that have brought other confined livestock operations to the area; however, their arrival was delayed from 2020 to 2030. Changes in ownership of some of the swine operations have created volatility in inventory numbers during recent years. However, the focus group felt like the situation had stabilized and no future growth is anticipated at this time with the exception of Ochiltree County where a 0.05% annual grown rate was assumed. This was based on a recent change in ownership and the potential for increases given the capacity of the operation that exist.

Table 3. Region A 2016 RWP and 2021 RWP projected livestock inventory growth by species, 2020 – 2070.

Species	2016 RWP	2021 RWP
(---------- Projected Growth Rates ----------)		
Beef Cows:		
2017 – 2070	0.00%	0.50% annual growth rate
Fed Beef:		
2020 – 2070	5% growth per decade starting in 2030 in Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties. No growth in other counties.	5% growth per decade starting in 2030 in Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties. No growth in other counties.
Summer Stockers:		
2017 - 2070	0.00%	0.50% annual growth rate
Winter Stockers:		
2017 - 2070	0.25%	0.50% annual growth rate
Dairy Cattle:		
2017 - 2030	In 2020, 60,000 cows allocated to Dallam, Hartley, Moore and Sherman Counties based on percentage of TCEQ permits	2.00% annual growth rate in all dairy counties.
2030 - 2070	1.00% annual growth rates in all dairy counties.	1.00% annual growth rates in all dairy counties.
Equine		
2020 - 2070	1.00%	0.00%
Poultry:		
2020 - 2070	In 2020, add 1,000,000 capacity operations in Armstrong, Carson, Childress, Collingsworth, Gray, Oldham, and Wheeler Counties. No other growth is assumed.	In 2030, add 1,000,000 capacity operations in Armstrong, Carson, Childress, Collingsworth, Gray, Oldham, and Wheeler Counties. No other growth is assumed.
Swine:		
2017 - 2070	Dallam County inventory scaled up to reflect new operation. 0.00% growth in other counties	Ochiltree County inventory scaled up (0.05% annually) to reflect new operation. 0.00% growth in other counties

Results

A summary of the impacts of changes in livestock inventories and future projections utilized in the 2021 RWP compared to the 2016 RWP is presented in Table 4. In this table, a comparison of inventories is made between the two projections during 2020 and 2070. The 2020 inventories were updated in the 2021 RWP to reflect current inventories that were estimated based on 2017 data. Projected growth rates were altered to account for changing industry conditions based on the recommendations of the Industry focus group. The 2020 inventories for fed beef, dairy cows and equine were similar between the two plans. Beef cow numbers were down somewhat reflecting the lingering effects of the drought, however, that freed up more acreage for grazing leading to an increase in projected summer stocker inventory. A change in the regional cropping patterns resulted in less wheat being planted which lowered the number of stockers being placed on winter wheat pastures. The variance in the 2020 poultry inventories was due to the focus group delaying the arrival of poultry operations in the region until 2030 (versus 2020) in the 2021 RWP. Changes in ownership of two of the major hog operations primarily accounted for the differences in 2020 inventories, as well as, resulting in a change in direction with respect to planned expansion vs contraction substantially affected the projected 2020 inventories.

Table 4. Region A 2020 and 2070 livestock inventories by species for 2016 and 2021 RWPs.

Species	2016 RWP 2020	2021 RWP 2020	2016 RWP 2070	2021 RWP 2070
	(---------Number of Head---------)			
Beef Cows	251,000	236,649	251,000	303,673
Fed Beef	1,312,739	1,302,964	1,591,960	1,562,908
Summer Stockers	338,965	380,312	338,965	488,027
Winter Stockers	255,924	226,441	289,955	290,576
Dairy Cattle	119,100	112,155	195,881	203,552
Equine	17,713	16,802	29,131	16,802
Poultry	6,005,951	6,267	7,005,739	7,006,267
Swine	519,957	552,259	431,557	610,621

Region A annual livestock water use projections by county for selected years during the 2021 RWP over a 50-year horizon are presented in Table 5. Overall, water use in the Region A livestock sector is predicted to increase 35.1% from 38,499 ac-ft. usage in 2020 to 53,700 ac-ft. in 2070. While this increase is significant, it still will only represent less than five percent of the total agricultural water use within the region during 2070. Six counties (Hartley, Dallam, Moore, Sherman, Hansford, and Ochiltree) account for 67.7% of the livestock water use in the region during 2020 climbing to 70.2% by 2070. These six counties are characterized by extensive fed beef operations in conjunction with significant sized dairy and/or swine operations.

Table5. 2021 RWP Livestock Water Use by County in Region A, 2020 – 2070, Ac-ft.

County	2020	2030	2040	2050	2060	2070
Armstrong	332	449	467	485	504	524
Carson	315	430	446	462	478	496
Childress	342	460	478	497	517	538
Collingsworth	459	583	607	633	660	688
Dallam	4,521	4,860	5,115	5,390	5,686	6,006
Donley	971	994	1,019	1,046	1,073	1,102
Gray	1,895	2,148	2,246	2,352	2,469	2,596
Hall	340	357	375	394	414	435
Hansford	4,030	4,204	4,388	4,580	4,783	4,995
Hartley	6,589	7,375	7,924	8,519	9,165	9,866
Hemphill	1,117	1,146	1,177	1,210	1,244	1,280
Hutchinson	600	636	666	699	734	771
Lipscomb	605	631	658	688	718	750
Moore	5,414	6,192	6,698	7,251	7,855	8,515
Ochiltree	2,801	2,962	3,120	3,286	3,462	3,647
Oldham	1,110	1,239	1,268	1,299	1,332	1,366
Potter	510	530	552	575	600	625
Randall	2,663	2,705	2,741	2,778	2,819	2,862
Roberts	383	402	422	444	466	490
Sherman	3,576	3,813	4,006	4,212	4,432	4,669
Wheeler	1,186	1,321	1,358	1,396	1,436	1,479
Total	**39,756**	**43,440**	**45,732**	**48,196**	**50,847**	**53,700**

A comparison of Region A projected livestock water use from the 2016 Regional Water Plan and the revised 2021 plan for the 2020 -2070 is illustrated in Figure 1. In 2020, projected water use between the two projections was within 2.0% with higher use being projected in the 2016 RWP despite revising dairy cow water use upwards 10 gal/day for the 2021 RWP projections. The relatively higher expansion rates anticipated by the focus group in dairy, swine, beef cow, summer stocker and winter stocker water user groups led to annual livestock water use in 2070 being projected 10.6% higher in the revised 2021 plan compared to the 2016 RWP estimates.

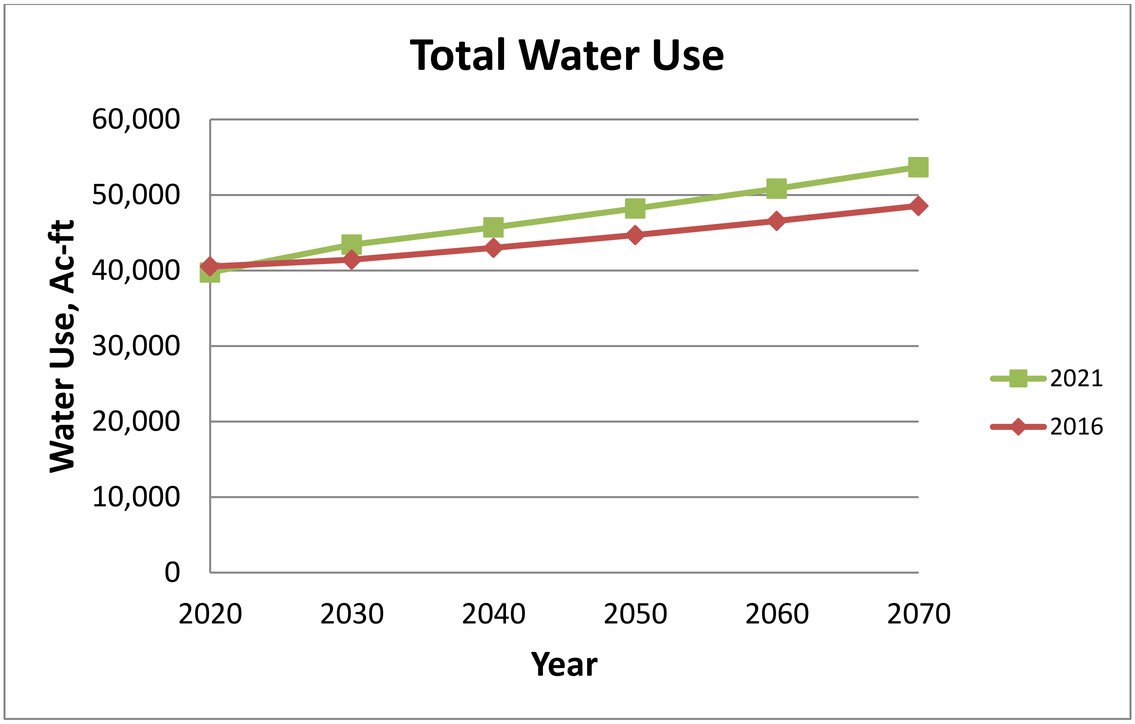


Figure 1. Region A comparison of estimated livestock water use between 2016 RWP and 2021 RWP for selected years.

Projected water use by the various Region A livestock water user groups for selected years is presented in Table 6. All the livestock sectors except equine are expected to see moderate growth over the planning horizon. The largest livestock water use group is projected to be the fed cattle industry with an annual usage of 21,884 ac-ft. per year by 2070 followed by the dairy industry (14,821ac-ft. per year). These two user groups account for 68.4% of projected livestock water use in 2070. Overall, confined livestock operations (fed beef, dairy and swine) accounted for 76.8% of the livestock water use. Beef cows, winter & summer stockers and swine are all projected to use more than 4,500 ac-ft. per year with estimated demand of 6,803, 4,729 and 4,531 ac-ft., respectively. Poultry and equine accounted for slightly less than two percent of the projected livestock water consumption in 2070.

Table 6. Region A 2021 RWP livestock water use by species for selected years in Ac-ft.

Species	2020	2030	2040	2050	2060	2070
Fed Cattle	18,244	18,903	19,594	20,321	21,083	21,884
Beef Cows	5,302	5,573	5,858	6,157	6,472	6,803
Stockers	3,686	3,874	4,072	4,280	4,499	4,729
Dairy Cows	8,166	9,954	10,996	12,146	13,417	14,821
Swine	4,132	4,204	4,280	4,359	4,443	4,531
Equine	226	226	226	226	226	226
Poultry	1	706	706	706	706	706
Total	39,756	43,440	45,732	48,196	50,847	53,700

Summary and Conclusions

Texas A&M AgriLife was charged with reviewing and analyzing the agricultural water use estimates for Region A proposed by the Texas Water Development Board (TWDB) for use in developing the 2021 Region A water plan in order to determine the acceptability of the TWDB estimates or if modifications needed to be recommended. The results of the analysis were presented to the Agricultural subcommittee of the regional water planning group on July 26, 2017. The review of the proposed TWDB livestock water use estimates revealed that on a regional basis their estimates were within 1.0% of the projections made in the 2016 plan, however, the variation in county level estimates was extreme (+36.0% to -49.0%). Given the county level variation, the committee decided the livestock water use estimates needed to redone using the methodology specifically developed for the region due to its unique characteristics in previous water plans.

The process to revise livestock water use for the 2021 plan included: updating livestock inventories by county, reviewing/revising water use by species and reviewing/revising where warranted projected growth/decline of the various livestock categories over the planning horizon. An Industry focus group consisting of representatives from the various livestock user groups was established that provided guidance on water use estimates per animal and determined projected changes in the livestock Industry that will occur during the planning horizon. In addition, representatives of the confined livestock operations were instrumental in developing inventory estimates by county which are not available at that level of detail from published sources.

In the revised 2021 estimates, water use in the Region A livestock sector is predicted to increase 35.1% from 39,756 ac-ft. usage in 2020 to 53,700 ac-ft. in 2070. Confined livestock operations (fed beef, dairy and swine) accounted for 76.8% of the livestock water use.

Compared to the 2016 plan annual water use estimates increased 10.6% (48,564 ac-ft. vs 53,700 ac-ft.) by 2070. The relative projected increase in water use can be traced to increasing the estimated water usage of dairy cows from 55 gal/day to 65 gal/day and a greater increase in growth from the previous water plan in the beef cow, stocker, dairy and swine sectors.

It can be concluded that due to the unique characteristics of the livestock industry in the region that water use estimates should be made through the regional water planning effort rather than at the state level for the current as well as future water planning efforts. The region's livestock water use is dominated by confined livestock operations which due to disclosure reasons the location, type and size of these operations is difficult to obtain on a regional basis and virtually impossible to delineate on a county level from public data sources. Firsthand knowledge of the region and the confined livestock operations is paramount in making accurate assessments of inventories at the regional and county levels as well as identifying changing conditions within these operations that will potentially affect water use in the future. Furthermore, the unique composition of livestock enterprise types within the region requires additional delineation of water use per animal not currently considered in TWDB estimates to accurately estimate livestock water use within the region.

APPENDIX B

ANALYSIS FOR SURFACE WATER AVAILABILITY

ANALYSIS FOR SURFACE WATER AVAILABILITY

SUBJECT: Documentation of Canadian River and Red River WAM Analyses for PWPA Water Availability

DATE: October 22, 2019, Updated August 14, 2020

PROJECT: PPC16440

This memorandum documents the datasets and processes used in the Water Availability Model (WAM) analyses for the Panhandle Water Planning Area (PWPA). The memorandum is organized into four sections: discussion of the modeling for 1). Lake Meredith, 2). Greenbelt Reservoir, 3). Palo Duro Reservoir, and 4). run-of-river supplies in the Canadian River and Red River Basin. In a letter to the Panhandle Water Planning Group (PWPG) dated February 28, 2018, the Texas Water Development Board (TWDB) approved the PWPG's request to use the following modifications to water supply assumptions for the purpose of determining surface water availability:

1. Use of reservoir operation model(s) with extended hydrology through 2017 for Lake Meredith and extended hydrology through 2016 for Greenbelt Reservoir.
2. Use of the Texas Commission on Environmental Quality's (TCEQ) WAM with extended hydrology through 2004 for Palo Duro Reservoir and run-of-river water rights in the Canadian River basin.
3. Use of a one-year safe yield.

The following table lists each major reservoir in Panhandle Water Planning Area (PWPA), including pertinent data relative to the water availability modeling.

Table B-1 Summary of Reservoir Water Right Information

Reservoir	Water Right	Priority Date	Diversion (Ac ft/yr)	Authorized Impoundment (Ac ft)
Meredith	CA 01-3782	Jan 30, 1956	151,200	904,000[1]
Palo Duro	CA 01-3803	Apr 23, 1974	10,460	60,900
Greenbelt	CA 02-5233	Aug 11, 1958	16,030[2]	59,100

[1] The interstate Canadian River Compact limits the conservation storage in Lake Meredith to 500,000 ac-ft.

[2] of which 4,030 ac-ft/yr is authorized diversion from Lelia Lake Creek run-of-river and 250 ac-ft/yr diverted directly from Salt Fork of the Red River.

1.1 Lake Meredith

Lake Meredith is a key component of water supply in the Texas Panhandle region. As such, estimation of the yield and reliability of Lake Meredith has been a significant component of prior planning cycles for the Panhandle Water Planning Area. Prior Regional Plans have relied upon the Full Authorization Run (Run 3) of the TCEQ-approved Canadian Water Availability Models (WAMs) to assess water availability for the lake in accordance with TWDB requirements. The 2006 Regional Plan included substantial revisions to model parameters and extension of historical hydrology datasets to capture more current portions of the hydrologic record than the original WAM. The 2016 Regional Plan was written in the middle of the on-going critical drought, which made it difficult to accurately determine the reliable supply. To be conservative for regional water planning purposes, the reliable supply from the lake was set to zero. Large inflows in 2015 and 2017 allowed the reservoir to partially recover. However, even those updated WAM runs do not fully capture recent portions of the ongoing critical drought. As such, an alternative methodology is required in order to estimate Lake Meredith yield for the 2021 Regional Plan.

Due to the constraints of the current planning cycle, a major update of the WAM is not feasible. Lake Meredith yield analyses for the 2021 Plan utilize the same Excel-based reservoir model developed by Freese and Nichols for the 2016 Plan. The model incorporates hydrologic data such as inflow, net evaporation, water demands and priority releases, reservoir configuration, and other parameters to perform a monthly water balance on a single reservoir over a certain historical period. The seniority of the lake's water rights, and extremely minimal history of water rights releases supports the use of a focused, simplified model. This enables estimation of firm and safe yields for the reservoir for Regional Planning purposes.

Input parameters for the model were compiled from several sources. The Canadian River Basin WAM updated for the 2006 Regional Plan (Canadian2000 WAM) served as the primary reference, with substantial additional data from Canadian River Municipal Water Authority (CRMWA) records, TWDB records, and prior Regional Plans. The combination of sources used for the study allowed for simulation of historical hydrology for the reservoir site from 1940 through December 2017.

Development of input parameters for the model is discussed in Section 1.2 below, with model results following in Section 1.3.

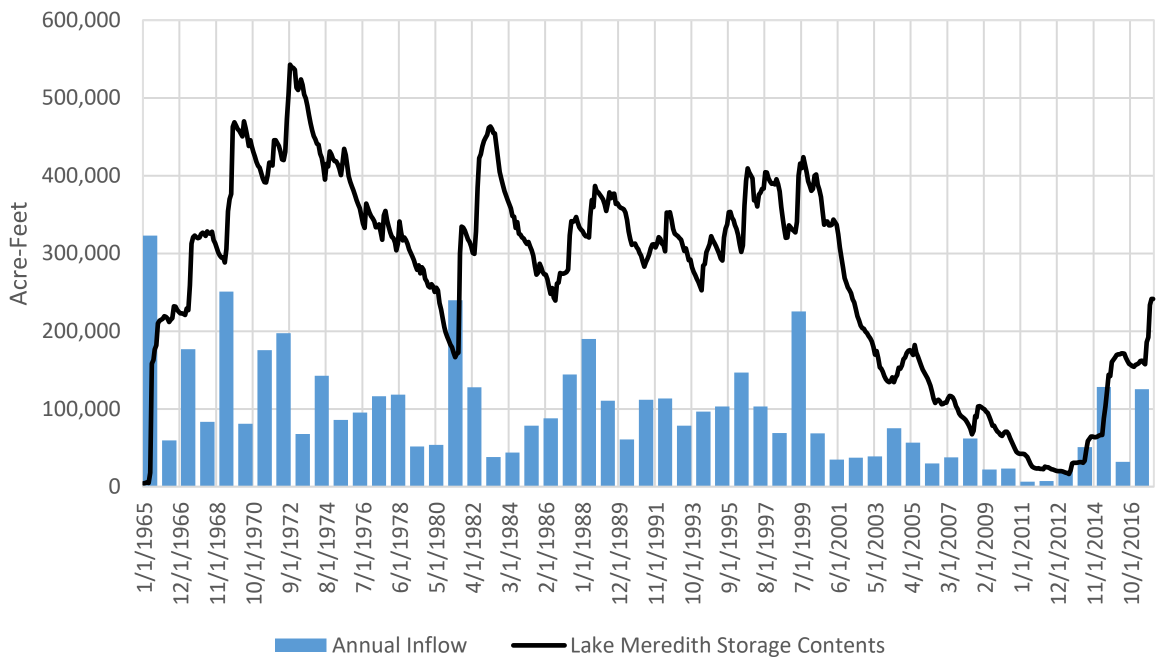
1.2 Lake Meredith Model Input Development

Inputs for the monthly time step modeling of Lake Meredith were compiled from multiple sources due to the length of the historical period of the simulation and the availability of individual references. Where possible, information from the Canadian2000 WAM was utilized as the preferred dataset; this version of the Canadian River Basin WAM was updated during a prior round of Regional Water Planning and includes improved and extended hydrology datasets relative to the TCEQ WAM Run 3. However, the effective Canadian2000 simulation period is limited to January 1940 through September 2004. Thus, alternate data sources were evaluated for later time periods.

a) ***Inflows*** – Inflows (runoff) into Lake Meredith were determined by multiple methods for different date ranges of the historical simulation period. For January 1940 through September 2004, modeled inflows into the lake were extracted from the Canadian2000 WAM and applied directly. Prior to inflow extraction, the WAM was modified to include full permitted diversion targets for Lake Meredith and the Palo Duro reservoir.

   For October 2004 through December 2011, a water balance approach was used to estimate Lake Meredith inflows on a monthly basis from CRMWA records. The procedure used to extend the hydrology through 2011 is described in more detail in Appendix C of the 2016 Regional Plan. A comparison of these extended inflows to CRMWA inflow estimates showed a good relationship (r^2 = 0.98) between estimated and observed data. For this reason, CRMWA inflow estimates were used directly to extend the hydrology through the end of 2017.

Figure B-1: Annual Inflows and Historical Storage Contents for Lake Meredith (1965-2017)



Estimated reservoir inflows from 2001 to 2013 averaged 35,000 ac-ft/yr and were substantially lower than the 1965 to 2000 average (120,000 ac-ft/yr), corresponding with declining reservoir storage and the recent critical drought (Figure B-1). Inflows greater than 120,000 ac-ft/yr in 2015 and 2017 allowed the reservoir to partially recover. Assuming critical drought conditions do not recur, a meaningful yield analysis can be conducted for the reservoir. The extended inflows used in the model are shown in Table B-2.

Table B-2: Extended Inflows to Lake Meredith (ac-ft)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	779	3,991	86	129	26,769	5,525	2,243	13,958	10,771	55	12,986	2,917
1941	2,396	3,370	2,878	2,336	419,139	371,586	321,780	174,760	480,405	424,777	54,545	28,618
1942	14,736	9,761	10,081	364,077	189,747	51,470	34,214	36,265	276,247	71,128	16,765	5,677
1943	30,109	1,687	743	1,642	2,076	177	26,671	0	0	153	324	4,754
1944	11,525	5,430	1,986	2,368	23,469	34,542	26,423	25,216	44,693	2,129	221	13,251
1945	9,567	1,822	1,103	319	36	2,495	0	23,206	4,341	10,100	54	58
1946	673	456	69	249	1,923	7,884	0	8,992	55,312	152,418	4,490	3,877
1947	5,112	388	4,714	4,890	34,846	3,385	12,067	0	96	324	247	353
1948	495	3,258	5,770	57	4,235	91,912	3,175	45,552	790	1,302	5,684	441
1949	569	2,152	1,620	2,651	119,681	97,403	70,930	32,177	16,895	2,541	2,302	655
1950	1,679	922	557	1,260	2,082	31,270	177,593	50,207	83,891	7,046	900	2,449
1951	3,554	5,503	2,245	1,115	75,406	19,480	27,017	2,794	2,313	718	3,648	1,102
1952	1,366	809	329	2,821	1,278	768	5,918	10,321	2,534	404	386	947
1953	2,874	977	793	481	277	2,117	28,598	22,447	119	13,261	956	1,137

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1954	3,186	2,126	1,643	4,246	51,596	0	34,852	9,791	0	20,591	689	433
1955	1,071	922	441	27,530	72,103	28,994	11,829	11,563	6,382	3,111	542	527
1956	765	1,487	746	501	36,215	4,941	3,776	0	346	353	428	542
1957	403	734	2,726	9,688	62,084	37,691	394	73,042	8,033	13,252	2,694	1,235
1958	3,440	3,464	8,955	6,933	13,739	18,761	192,442	61,003	65,991	1,269	1,059	1,698
1959	1,486	1,511	278	569	8,630	14,684	23,163	36,874	3,271	2,758	417	25,107
1960	11,975	10,496	4,921	659	259	67,299	209,013	60,383	22,805	53,450	2,134	6,042
1961	2,195	7,256	24,753	7,495	2,583	9,082	19,625	12,069	24,017	1,343	11,787	6,539
1962	4,527	922	347	1,862	0	9,252	9,924	32,697	3,692	1,250	964	2,274
1963	1,149	2,236	1,176	516	4,852	28,776	11,138	16,598	12,989	390	338	544
1964	892	4,699	817	173	1,302	3,016	267	2,317	22,305	438	1,770	1,629
1965	1,867	972	1,658	256	23,774	214,674	14,922	25,867	2,111	24,402	9,511	2,743
1966	995	3,761	2,305	523	612	11,133	9,290	22,054	7,365	586	367	627
1967	1,819	1,498	743	15,529	5,733	29,190	74,493	15,574	9,965	13,078	3,521	5,534
1968	6,001	3,433	1,730	423	13,889	13,058	15,190	16,694	1,088	10,682	671	722
1969	1,790	4,339	5,103	547	41,932	48,425	28,316	23,966	70,578	16,953	5,075	3,854
1970	3,927	1,648	2,735	31,264	2,250	1,053	3,849	14,773	12,194	3,963	1,907	1,262
1971	1,854	2,599	1,256	1,671	9,758	22,066	32,380	30,998	19,515	8,212	34,425	11,031
1972	7,970	3,630	1,156	582	6,235	9,152	68,159	45,470	34,116	15,921	3,096	2,037
1973	2,785	2,922	15,432	18,573	2,173	94	14,217	9,889	567	369	0	787
1974	1,989	1,375	10,499	530	7,602	4,441	2,321	51,453	19,241	37,486	3,619	2,232
1975	4,727	4,970	2,590	3,566	3,737	32,958	19,807	10,854	875	537	496	590
1976	1,074	1,016	1,606	3,117	7,779	3,304	3,606	13,599	54,603	3,228	1,123	1,106
1977	0	2,145	456	10,830	22,908	9,082	4,466	42,230	23,410	22	263	319
1978	386	1,567	1,116	499	28,944	52,901	1,401	2,697	18,805	7,702	1,546	778
1979	2,071	1,322	3,095	759	6,908	22,282	590	11,988	101	0	1,251	1,224
1980	3,417	7,020	3,414	2,678	20,986	7,149	0	5,834	2,128	0	0	1,062
1981	641	382	1,525	11	1,008	21,510	14,233	145,891	39,960	8,409	3,538	2,485
1982	2,068	2,244	2,219	1,366	6,804	37,543	44,454	9,224	6,229	6,999	2,354	6,332
1983	4,483	8,026	7,968	3,193	3,087	11,261	0	0	0	97	0	15
1984	1,191	1,164	1,459	4,139	1,765	4,343	1,125	14,184	100	6,858	2,925	4,637
1985	2,989	3,321	7,246	3,784	9,094	4,163	0	1,559	22,538	18,506	2,973	2,298
1986	2,161	4,820	2,056	258	1,228	11,776	956	15,909	26,643	7,081	12,313	2,836
1987	3,305	3,617	6,150	878	66,907	21,626	1,065	21,380	13,084	2,244	1,343	2,890
1988	6,041	2,467	12,192	11,672	31,290	35,556	38,250	5,437	40,068	3,181	531	3,495
1989	2,649	2,822	1,978	1,098	20,012	28,573	8,232	21,591	12,705	1,730	6,862	2,215
1990	4,162	6,821	5,400	4,147	2,713	302	1,185	1,955	22,991	4,653	4,668	1,686
1991	4,973	1,754	854	1,192	14,214	14,911	24,555	37,393	159	1,869	2,794	7,026
1992	9,862	3,305	1,982	2,922	5,497	51,380	13,082	16,156	4,138	286	890	3,844
1993	3,113	3,972	3,621	2,339	3,526	20,261	11,290	9,297	15,468	2,679	1,384	1,297
1994	1,136	1,114	2,731	1,149	15,775	11,253	17,884	1,300	3,640	37,023	1,325	2,025
1995	2,394	1,003	2,011	2,077	9,138	15,836	13,860	23,042	19,561	9,040	3,372	2,002

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	1,943	1,281	777	427	3,418	19,771	50,038	36,855	18,353	5,508	3,880	4,309
1997	2,983	3,066	2,065	23,147	10,534	23,073	4,912	20,814	1,432	4,487	2,564	4,146
1998	6,395	4,592	11,062	3,319	2,407	76	0	6,092	320	17,649	14,311	2,714
1999	2,708	5,949	5,499	12,618	90,013	35,063	8,067	49,066	13,182	753	333	2,242
2000	1,661	2,642	19,474	11,470	2,804	6,982	3,214	0	0	13,994	4,557	1,641
2001	5,228	6,632	10,983	4,130	5,217	1,730	496	0	0	0	592	0
2002	1,476	1,948	596	4,054	2,816	4,145	1,155	6,053	9,771	0	2,051	3,020
2003	2,545	2,525	2,130	1,472	947	15,899	1,573	81	10,010	1,056	214	547
2004	1,024	1,752	4,328	6,370	1,741	9,548	9,783	11,633	2,592	8,898	10,778	6,528
2005	7,636	6,556	5,603	4,623	4,346	19,661	1,404	2,828	3,543	0	293	0
2006	1,491	1,463	4,528	0	365	351	3,299	6,228	6,567	2,088	929	2,613
2007	3,590	4,122	7,448	8,044	4,392	4,391	2,617	1,527	0	0	1,144	442
2008	715	1,123	1,033	1,163	1,323	1,116	8,758	23,767	2,391	15,683	3,384	1,660
2009	1,622	1,787	2,264	2,810	1,788	1,296	1,163	6,215	1,104	173	1,458	341
2010	752	5,241	4,258	4,933	2,605	1,592	909	192	0	826	708	1,302
2011	447	937	900	555	565	756	1,207	242	124	5	122	440
2012	77	242	528	3,505	802	1,263	152	209	143	0	199	0
2013	64	152	237	245	368	689	124	5,033	9,907	1,776	485	791
2014	745	1,038	1,055	625	3,801	15,460	14,113	4,732	5,674	2,503	750	389
2015	1,504	1,804	2,086	1,532	23,290	17,057	22,840	24,621	3,888	19,608	5,565	4,640
2016	5,605	3,128	3,327	4,377	4,257	5,619	2,344	0	0	2,262	411	592
2017	2,118	3,156	4,092	5,020	4,790	3,076	4,959	30,306	9,843	44,486	11,207	2,359

b) ***Net reservoir evaporation*** – As with inflow data, monthly net evaporation was compiled from multiple sources. For the time period from January 1940 through September 2004, net evaporation depths were extracted from the Canadian2000 WAM. Since the Canadian2000 WAM does not include historical data subsequent to September 2004, values for the remainder of the desired simulation period were calculated from CRMWA evaporation and precipitation records; some CRMWA data was also used in development of the Canadian2000 WAM itself. The extended net evaporation is shown in Table B-3.

Table B-3: Extended Net Evaporation in Lake Meredith (feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1940	0.01	0.19	0.43	0.40	0.39	0.58	0.90	0.59	0.61	0.55	0.05	0.18	4.88
1941	0.11	0.11	0.13	0.32	-0.08	0.15	0.23	0.40	0.27	-0.21	0.23	0.18	1.83
1942	0.15	0.18	0.30	0.10	0.50	0.26	0.65	0.38	0.35	-0.08	0.40	0.13	3.31
1943	0.18	0.26	0.34	0.38	0.48	0.60	0.43	0.70	0.56	0.49	0.26	0.00	4.66
1944	0.02	0.11	0.35	0.23	0.31	0.55	0.39	0.55	0.44	0.29	0.19	-0.01	3.42
1945	0.05	0.17	0.33	0.27	0.64	0.63	0.52	0.42	0.40	0.29	0.35	0.20	4.25
1946	0.19	0.20	0.35	0.45	0.48	0.62	0.74	0.40	0.24	-0.01	0.06	0.17	3.89
1947	0.21	0.25	0.26	0.28	0.13	0.53	0.64	0.61	0.72	0.43	0.20	0.06	4.32

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1948	0.09	-0.03	0.22	0.51	0.34	0.43	0.53	0.31	0.62	0.37	0.14	0.35	3.87
1949	0.08	0.13	0.31	0.25	0.11	0.29	0.32	0.44	0.38	0.32	0.33	0.14	3.11
1950	0.26	0.19	0.40	0.38	0.49	0.34	-0.09	0.30	0.11	0.45	0.32	0.26	3.41
1951	0.10	0.16	0.33	0.44	-0.11	0.35	0.78	0.89	0.84	0.61	0.31	0.23	4.92
1952	0.24	0.29	0.33	0.27	0.47	0.80	0.79	0.86	0.88	0.81	0.36	0.21	6.30
1953	0.27	0.25	0.51	0.60	0.73	0.90	0.75	0.59	0.95	0.35	0.29	0.06	6.25
1954	0.12	0.34	0.40	0.38	0.06	0.64	0.68	0.52	0.71	0.33	0.34	0.26	4.79
1955	0.14	0.22	0.42	0.53	0.06	0.46	0.64	0.51	0.33	0.45	0.35	0.24	4.34
1956	0.16	0.06	0.49	0.57	0.53	0.65	0.52	0.64	0.73	0.48	0.31	0.24	5.38
1957	0.15	0.15	-0.01	0.09	-0.02	0.48	0.76	0.28	0.42	0.09	0.08	0.25	2.71
1958	0.03	0.07	-0.09	0.17	0.13	0.49	0.11	0.50	0.33	0.36	0.18	0.12	2.42
1959	0.14	0.18	0.36	0.37	0.09	0.47	0.33	0.34	0.52	0.14	0.20	-0.17	2.96
1960	-0.01	0.03	0.19	0.43	0.39	0.13	0.09	0.36	0.05	-0.06	0.25	0.11	1.95
1961	0.07	0.06	0.04	0.40	0.39	0.25	0.28	0.35	0.38	0.36	-0.03	0.15	2.69
1962	0.02	0.20	0.33	0.33	0.55	0.09	0.19	0.43	0.22	0.37	0.21	0.11	3.04
1963	0.06	0.15	0.47	0.64	0.36	0.41	0.64	0.38	0.36	0.46	0.30	0.06	4.28
1964	0.06	-0.01	0.30	0.57	0.48	0.58	0.79	0.60	0.31	0.45	0.10	0.09	4.33
1965	0.09	0.13	0.07	0.40	0.32	0.03	0.56	0.56	0.58	0.45	0.34	0.10	3.63
1966	0.04	0.07	0.46	0.58	0.82	0.45	0.84	0.28	0.35	0.42	0.35	0.16	4.80
1967	0.29	0.27	0.54	0.42	0.69	0.42	0.30	0.46	0.48	0.58	0.20	0.13	4.78
1968	0.07	0.12	0.27	0.56	0.43	0.32	0.46	0.43	0.61	0.38	0.18	0.11	3.94
1969	0.24	0.10	0.14	0.51	0.28	0.36	0.58	0.53	0.20	0.18	0.18	0.15	3.45
1970	0.13	0.28	0.22	0.48	0.90	0.87	0.88	0.64	0.62	0.34	0.32	0.23	5.90
1971	0.18	0.19	0.51	0.61	0.78	0.78	0.68	0.47	0.25	0.27	0.11	0.13	4.96
1972	0.25	0.27	0.58	0.75	0.46	0.46	0.40	0.57	0.53	0.29	-0.02	0.04	4.59
1973	0.09	0.15	-0.04	0.25	0.57	0.82	0.56	0.76	0.29	0.41	0.27	0.15	4.28
1974	0.09	0.31	0.30	0.70	0.63	0.73	0.89	0.06	0.34	0.00	0.23	0.08	4.35
1975	0.13	0.00	0.35	0.45	0.52	0.43	0.25	0.68	0.38	0.53	0.16	0.17	4.03
1976	0.24	0.39	0.39	0.40	0.53	0.78	0.63	0.49	-0.18	0.31	0.15	0.17	4.30
1977	0.20	0.27	0.55	0.34	0.09	0.73	0.83	0.11	0.49	0.42	0.30	0.26	4.58
1978	0.13	0.15	0.39	0.64	0.22	0.54	0.92	0.63	0.35	0.41	0.11	0.16	4.65
1979	0.18	0.22	0.30	0.41	0.18	0.32	0.70	0.42	0.45	0.39	0.22	0.27	4.05
1980	0.04	0.16	0.20	0.44	0.21	0.61	0.98	0.81	0.53	0.49	0.18	0.12	4.76
1981	0.13	0.31	0.23	0.52	0.36	0.55	0.68	0.25	0.22	0.16	0.09	0.16	3.66
1982	0.30	0.25	0.41	0.57	0.28	0.09	0.10	0.62	0.43	0.41	0.24	0.06	3.77
1983	0.04	-0.04	0.17	0.41	0.40	0.50	0.83	0.74	0.69	0.20	0.20	0.07	4.22
1984	0.09	0.25	0.24	0.46	0.74	0.61	0.83	0.25	0.54	0.10	0.17	0.04	4.31
1985	0.06	0.13	0.19	0.27	0.57	0.50	0.77	0.54	0.28	0.11	0.10	0.09	3.61
1986	0.23	0.17	0.44	0.59	0.47	0.16	0.71	0.50	0.27	0.12	0.04	0.05	3.75
1987	0.10	0.17	0.16	0.50	0.19	0.33	0.63	0.47	0.18	0.31	0.18	0.09	3.30
1988	0.14	0.23	0.34	0.30	0.38	0.48	0.39	0.43	0.08	0.41	0.32	0.21	3.70
1989	0.20	0.27	0.47	0.58	0.34	0.24	0.69	0.48	0.42	0.45	0.34	0.02	4.49

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	0.08	0.17	0.27	0.48	0.63	1.02	0.63	0.52	0.22	0.39	0.24	0.12	4.75
1991	0.05	0.33	0.49	0.60	0.42	0.39	0.24	0.42	0.35	0.43	0.07	-0.10	3.67
1992	0.09	0.22	0.42	0.26	0.36	0.11	0.61	0.07	0.54	0.47	0.13	0.04	3.32
1993	-0.02	0.11	0.31	0.42	0.49	0.46	0.48	0.63	0.57	0.41	0.22	0.21	4.28
1994	0.30	0.16	0.37	0.46	0.37	0.66	0.59	0.51	0.52	0.21	-0.21	0.16	4.09
1995	0.11	0.26	0.41	0.40	0.10	0.34	0.57	0.72	0.26	0.43	0.31	0.10	3.99
1996	0.12	0.35	0.42	0.72	0.81	0.58	0.11	0.22	0.10	0.36	0.14	0.20	4.12
1997	0.14	0.09	0.47	-0.17	0.33	0.43	0.62	0.22	0.39	0.36	0.11	0.01	2.99
1998	0.12	0.07	0.22	0.48	0.59	0.97	0.59	0.47	0.56	0.04	0.17	0.16	4.44
1999	0.08	0.36	0.18	0.22	0.11	0.54	0.57	0.53	0.45	0.36	0.30	0.16	3.86
2000	0.23	0.33	0.08	0.44	0.67	0.26	0.73	0.94	0.80	-0.05	0.12	0.07	4.61
2001	0.06	0.05	0.08	0.63	0.34	0.69	0.93	0.56	0.49	0.46	0.17	0.20	4.65
2002	0.13	0.22	0.47	0.47	0.68	0.60	0.48	0.45	0.48	-0.14	0.24	0.13	4.22
2003	0.20	0.17	0.32	0.76	0.72	0.01	0.96	0.74	0.45	0.41	0.28	0.26	5.28
2004	0.21	0.14	0.33	0.41	0.87	0.11	0.58	0.51	0.19	0.30	-0.09	0.17	3.73
2005	-0.08	0.18	0.34	0.55	0.42	0.18	0.79	0.38	0.71	0.26	0.39	0.19	4.31
2006	0.31	0.32	0.29	0.69	0.60	0.85	0.72	0.10	0.35	0.16	0.27	-0.02	4.63
2007	0.05	0.40	-0.14	0.27	0.36	0.49	0.57	0.59	0.19	0.49	0.29	0.04	3.60
2008	0.27	0.23	0.42	0.59	0.63	0.84	0.29	0.35	0.42	-0.08	0.27	0.21	4.42
2009	0.23	0.29	0.41	0.31	0.49	0.67	0.57	0.47	0.37	0.18	0.29	0.11	4.37
2010	0.06	-0.06	0.21	0.37	0.50	0.64	0.41	0.33	0.53	0.38	0.11	0.12	3.61
2011	0.11	0.18	0.43	0.72	0.91	1.12	1.12	0.67	0.60	0.40	0.27	0.00	6.50
2012	0.25	0.12	0.42	0.13	0.75	0.62	0.75	0.66	0.38	0.39	0.35	0.13	4.94
2013	0.04	0.08	0.37	0.52	0.77	0.65	0.65	0.35	0.44	0.45	0.17	0.13	4.62
2014	0.14	0.20	0.43	0.65	0.61	0.62	0.54	0.54	0.37	0.37	0.25	0.12	4.84
2015	0.05	0.13	0.34	0.33	0.36	0.20	0.29	0.32	0.62	-0.03	0.16	0.10	2.88
2016	0.14	0.27	0.46	0.34	0.37	0.63	0.86	0.19	0.42	0.46	0.29	0.23	4.67
2017	-0.12	0.33	0.41	0.34	0.53	0.63	0.87	0.09	0.24	0.22	0.30	0.19	4.03

c) ***Area-Capacity-Elevation Data*** – The area-capacity-elevation properties of the reservoir were based on the volumetric survey of Lake Meredith performed by the Texas Water Development Board (TWDB) in June 1995 and published in March 2003. Estimated area-capacity-elevation relationships were projected for the years 2020 and 2070 assuming a sedimentation rate of 0.088 ac-ft/mi^2/yr from the TWDB report and a contributing drainage area of 6,048 square miles downstream of Ute Reservoir. Table B-4 shows how the amount of contributing drainage area downstream of Ute Reservoir was calculated by assuming the non-contributing area from Lake Meredith includes the non-contributing area from Ute Reservoir and that sediment is only contributed by the incremental watershed downstream of Ute. This assumption is more conservative than assuming all of Lake Meredith's non-contributing drainage area is downstream of Ute in the sense that it results in greater losses of reservoir capacity to sedimentation.

Table B-4: Calculation of Contributing Drainage Area for the Incremental Watershed below Ute Reservoir

Watershed	Contributing Drainage Area (sq. mi.)	Total Drainage Area (sq. mi.)	Non Contributing Drainage Area (sq. mi.)
Ute Reservoir[1]	10,000	11,140	1,140
Lake Meredith[2]	16,048	20,220	4,172
Downstream of Ute and Upstream of Meredith	**6,048**	9,080	3,032

1. https://waterdata.usgs.gov/nwis/nwismap/?site_no=07226800&agency_cd=USGS
2. https://waterdata.usgs.gov/tx/nwis/nwismap/?site_no=07227900&agency_cd=USGS

The reservoir has never filled to the full permitted amount. Historical storage reached a high point in 1972 and has trended significantly downward since then. As a result, instead of the common assumption of uniform distribution of sediment, FNI assumed that the sediment distribution was based on the amount of time a particular elevation slice was inundated. The area-capacity-elevation curves for 2020 and 2070 are shown in Table B-5.

Table B-5: Lake Meredith Elevation-Area-Capacity Tables

Elevation (ft)	Published Area (acres)	Published Capacity (ac ft)	2020 Area (acres)	2020 Capacity (ac ft)	2070 Area (acres)	2070 Capacity (ac ft)
2818.0	0	0	0	0	0	0
2819.0	2	1	0	0	0	0
2820.0	32	12	0	0	0	0
2821.0	94	74	0	0	0	0
2822.0	144	192	0	0	0	0
2823.0	261	390	0	0	0	0
2824.0	367	701	0	0	0	0
2825.0	464	1,112	0	0	0	0
2826.0	563	1,627	0	0	0	0
2827.0	648	2,233	0	0	0	0
2828.0	717	2,916	0	0	0	0
2829.0	796	3,676	0	0	0	0
2830.0	899	4,519	0	0	0	0
2831.0	1,013	5,483	0	0	0	0
2832.0	1,083	6,530	23	8	0	0
2833.0	1,169	7,655	109	69	0	0
2834.0	1,253	8,869	193	218	0	0
2835.0	1,331	10,159	271	448	0	0
2836.0	1,397	11,524	337	752	0	0
2837.0	1,459	12,954	400	1,120	0	0
2838.0	1,508	14,438	449	1,545	0	0
2839.0	1,559	15,970	501	2,020	0	0
2840.0	1,636	17,570	580	2,560	79	26

Elevation (ft)	Published Area (acres)	Published Capacity (ac ft)	2020 Area (acres)	2020 Capacity (ac ft)	2070 Area (acres)	2070 Capacity (ac ft)
2841.0	1,698	19,235	646	3,173	148	138
2842.0	1,781	20,972	739	3,865	245	333
2843.0	1,865	22,797	831	4,649	341	624
2844.0	1,942	24,701	918	5,523	433	1,010
2845.0	2,020	26,680	1,003	6,484	522	1,487
2846.0	2,139	28,756	1,124	7,547	643	2,068
2847.0	2,271	30,961	1,264	8,740	787	2,782
2848.0	2,400	33,296	1,401	10,072	927	3,638
2849.0	2,560	35,773	1,562	11,553	1,089	4,645
2850.0	2,723	38,414	1,726	13,197	1,254	5,815
2851.0	2,878	41,215	1,884	15,001	1,413	7,148
2852.0	3,031	44,171	2,046	16,966	1,579	8,643
2853.0	3,181	47,278	2,199	19,088	1,734	10,299
2854.0	3,352	50,544	2,371	21,373	1,906	12,118
2855.0	3,515	53,978	2,535	23,825	2,071	14,106
2856.0	3,670	57,571	2,691	26,438	2,227	16,254
2857.0	3,829	61,320	2,853	29,209	2,390	18,562
2858.0	3,975	65,224	3,012	32,141	2,555	21,035
2859.0	4,109	69,266	3,159	35,226	2,709	23,666
2860.0	4,247	73,443	3,305	38,458	2,858	26,449
2861.0	4,370	77,751	3,432	41,826	2,987	29,371
2862.0	4,499	82,185	3,566	45,325	3,124	32,427
2863.0	4,630	86,752	3,701	48,958	3,261	35,619
2864.0	4,753	91,444	3,835	52,726	3,400	38,949
2865.0	4,875	96,259	3,962	56,625	3,529	42,413
2866.0	4,990	101,192	4,083	60,647	3,653	46,004
2867.0	5,114	106,245	4,217	64,797	3,792	49,726
2868.0	5,230	111,423	4,345	69,078	3,925	53,585
2869.0	5,326	116,701	4,450	73,475	4,034	57,564
2870.0	5,430	122,078	4,555	77,977	4,141	61,651
2871.0	5,525	127,557	4,654	82,582	4,241	65,842
2872.0	5,614	133,127	4,744	87,281	4,331	70,128
2873.0	5,702	138,785	4,841	92,073	4,433	74,510
2874.0	5,792	144,531	4,945	96,966	4,544	78,998
2875.0	5,881	150,368	5,040	101,958	4,641	83,590
2876.0	5,967	156,292	5,142	107,049	4,752	88,286
2877.0	6,052	162,303	5,249	112,245	4,868	93,096
2878.0	6,132	168,395	5,349	117,544	4,978	98,019
2879.0	6,238	174,576	5,478	122,957	5,118	103,068
2880.0	6,347	180,869	5,594	128,494	5,237	108,245

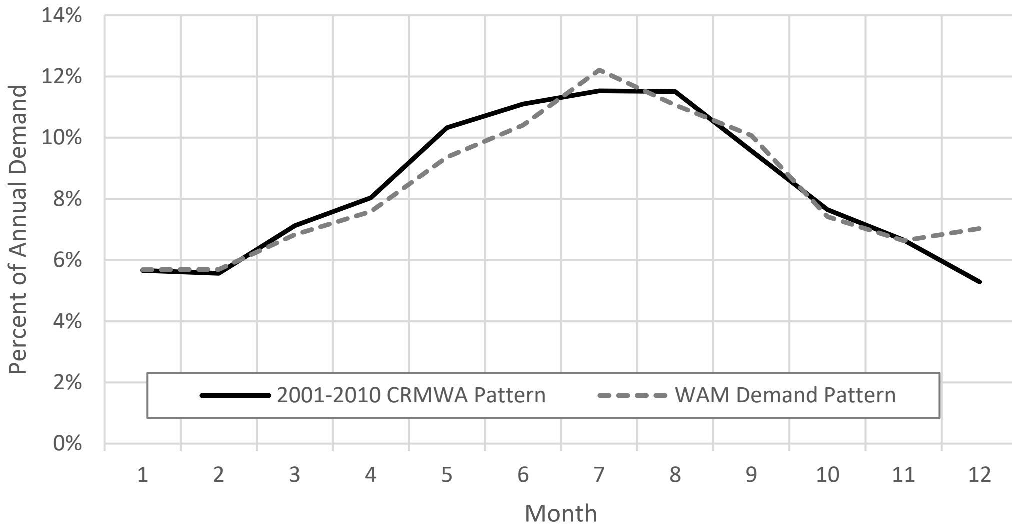
Elevation (ft)	Published Area (acres)	Published Capacity (ac ft)	2020 Area (acres)	2020 Capacity (ac ft)	2070 Area (acres)	2070 Capacity (ac ft)
2881.0	6,459	187,272	5,712	134,147	5,358	113,543
2882.0	6,563	193,784	5,825	139,915	5,475	118,959
2883.0	6,664	200,398	5,946	145,800	5,606	124,500
2884.0	6,762	207,109	6,059	151,803	5,726	130,165
2885.0	6,867	213,926	6,173	157,919	5,844	135,950
2886.0	6,971	220,841	6,282	164,146	5,955	141,850
2887.0	7,077	227,866	6,393	170,483	6,068	147,861
2888.0	7,189	234,997	6,511	176,935	6,190	153,990
2889.0	7,358	242,271	6,702	183,542	6,391	160,280
2890.0	8,307	249,704	7,664	190,719	7,359	167,150
2891.0	8,619	258,255	7,995	198,548	7,699	174,678
2892.0	8,715	266,922	8,118	206,604	7,834	182,445
2893.0	8,811	275,686	8,239	214,783	7,968	190,346
2894.0	8,907	284,544	8,360	223,082	8,101	198,380
2895.0	9,004	293,500	8,504	231,514	8,266	206,564
2896.0	9,105	302,554	8,664	240,098	8,455	214,924
2897.0	9,208	311,710	8,807	248,833	8,617	223,460
2898.0	9,313	320,970	8,944	257,709	8,770	232,154
2899.0	9,421	330,337	9,085	266,724	8,926	241,002
2900.0	10,486	339,813	10,187	276,355	10,046	250,482
2901.0	10,590	350,350	10,339	286,618	10,220	260,615
2902.0	10,697	360,994	10,466	297,020	10,356	270,903
2903.0	10,805	371,745	10,598	307,552	10,500	281,331
2904.0	10,915	382,604	10,731	318,216	10,643	291,902
2905.0	11,111	393,575	10,959	329,061	10,886	302,667
2906.0	11,227	404,744	11,111	340,095	11,056	313,638
2907.0	11,350	416,032	11,271	351,286	11,234	324,783
2908.0	11,480	427,446	11,426	362,635	11,400	336,100
2909.0	11,617	438,995	11,580	374,138	11,562	347,581
2910.0	11,796	450,683	11,770	385,813	11,758	359,241
2911.0	11,885	462,523	11,863	397,629	11,852	371,046
2912.0	11,979	474,455	11,960	409,541	11,950	382,948
2913.0	12,076	486,482	12,059	421,550	12,051	394,948
2914.0	12,177	498,608	12,165	433,661	12,159	407,053
2915.0	12,425	510,836	12,425	445,956	12,425	419,345
2916.0	12,528	523,312	12,528	458,433	12,528	431,822
2917.0	12,636	535,894	12,636	471,014	12,636	444,403
2918.0	12,750	548,586	12,750	483,707	12,750	457,096
2919.0	12,869	561,395	12,869	496,516	12,869	469,905
2920.0	13,576	574,325	13,576	509,737	13,576	483,126

Elevation (ft)	Published Area (acres)	Published Capacity (ac ft)	2020 Area (acres)	2020 Capacity (ac ft)	2070 Area (acres)	2070 Capacity (ac ft)
2921.0	13,676	587,951	13,676	523,364	13,676	496,753
2922.0	13,781	601,680	13,781	537,093	13,781	510,482
2923.0	13,891	615,516	13,891	550,929	13,891	524,318
2924.0	14,005	629,463	14,005	564,877	14,005	538,266
2925.0	14,286	643,528	14,286	579,022	14,286	552,411
2926.0	14,418	657,878	14,418	593,374	14,418	566,763
2927.0	14,561	672,367	14,561	607,863	14,561	581,252
2928.0	14,716	687,005	14,716	622,502	14,716	595,891
2929.0	14,881	701,802	14,881	637,300	14,881	610,689
2930.0	15,090	716,771	15,090	652,286	15,090	625,675
2931.0	15,219	731,925	15,219	667,441	15,219	640,830
2932.0	15,354	747,211	15,354	682,727	15,354	656,116
2933.0	15,496	762,636	15,496	698,153	15,496	671,542
2934.0	15,645	778,206	15,645	713,723	15,645	687,112
2935.0	15,859	793,928	15,859	729,475	15,859	702,864
2936.0	16,084	809,896	16,084	745,446	16,084	718,835
2936.5	16,411	817,970	16,411	753,570	16,411	726,959

d) ***Releases*** – Reservoir releases from CRMWA records total 465 ac-ft since reservoir construction, with the last release occurring in 1999. Results of the Canadian2000 WAM do not show any modeled releases for senior rights. Due to the small volume and intermittent nature of past releases, they were not included in the modeling of the reservoir. In the model, no releases are made for environmental flows.

e) ***Demand Pattern*** – The annual water demand estimated for the reservoir must be distributed in twelve monthly increments because the yield models operate on a monthly time step. The monthly water demand distribution (percent of annual demand each month) was estimated as the average monthly distribution of lakeside diversions from CRMWA records for 2001 through 2010. Year 2011 and 2012 demands were not included due to the extreme situation impacting the reservoir at that time. The demand pattern generated from this ten-year period of CRMWA records is similar to the diversion distribution already included in the Canadian River WAM (Figure B-2).

Figure B-2: Comparison of Monthly Diversion Pattern Based on CRMWA Records (used in the model) and WAM Demand Pattern



f) ***Seepage*** – Studies performed as part of the 2006 planning cycle note the potential for seepage losses for Lake Meredith. The development of the Canadian2000 WAM in the 2006 planning cycle included adjustment of naturalized flows due to seepage at the lake, which covers the period from January 1940 through September 2004. The hydrology from October 2004 through December 2011 is based on a water balance methodology and accounts for seepage loss based on CRMWA records. Hydrology from January 2012 to December 2017 is based directly on CRMWA estimates of inflow, which include adjustments for seepage.

g) ***Operating Range*** – While Lake Meredith has a substantial potential storage capacity, a minimum elevation and a maximum conservation capacity constrain the usable portion of the reservoir to a smaller volume. According to CRMWA's website, the lake's inactive pool elevation is 2,860 ft above mean sea level (ft-msl). Therefore, the model was constrained not to fall below this level during firm and safe yield estimation. Note that the 2003 TWDB Report of the 1995 volumetric survey states that the lowest gate outlet invert elevation is at elevation 2,850 ft-msl. If this additional 10 feet of storage volume becomes accessible, yield could be increased by around 10%. The different reservoir capacities and surface areas at these two elevations, and how they change through time, are shown in Table B-6.

Table B-6: Reservoir Capacity and Surface Area Corresponding to Elevations 2,850 and 2,860 ft-msl for Historical and Projected Future Conditions

Elevation (ft msl)	1995 Survey		2020 Conditions		2070 Conditions	
	Area (acres)	Capacity (ac ft)	Area (acres)	Capacity (ac ft)	Area (acres)	Capacity (ac ft)
2,850 - Dead Pool	2,723	38,414	1,726	13,197	1,254	5,815
2,860 - Inactive Pool	4,247	73,443	3,305	38,458	2,858	26,449

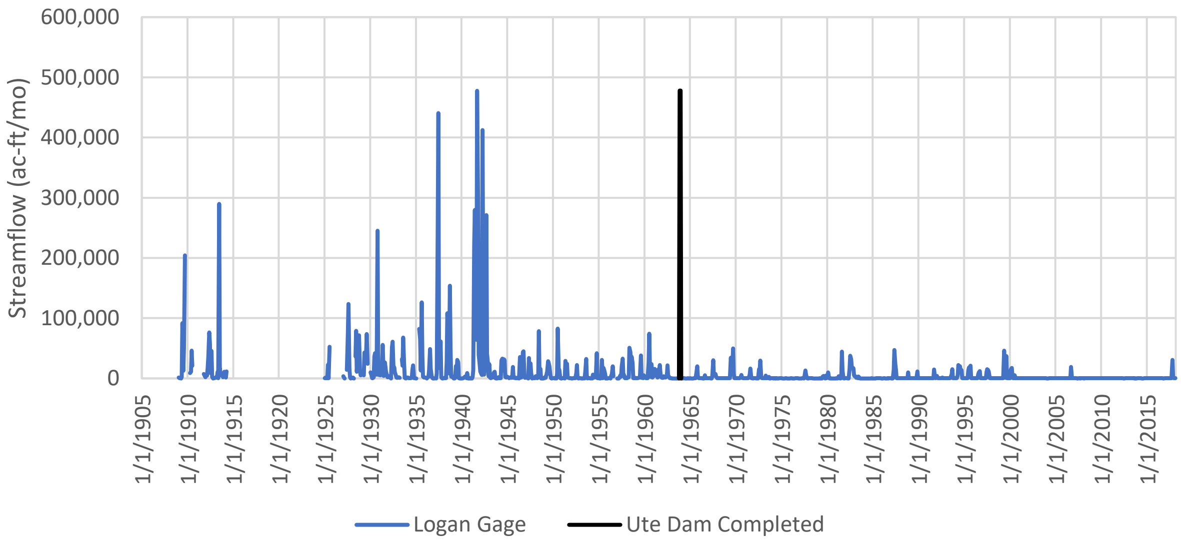
The maximum conservation volume is constrained by the interstate Canadian River Compact, which limits the right of Texas to retain water in conservation storage within Lake Meredith to 500,000 ac-ft. While the initial permitted conservation pool elevation of the reservoir (2,936.5 ft-msl) corresponds to a volume in excess of 800,000 ac-ft, all but 500,000 ac-ft is for sedimentation and inactive storage. The model assumes the usable portion of the reservoir is the first 500,000 ac-ft above the inactive pool. The elevations and surface areas corresponding to 500,000 ac-ft of conservation storage in 1995 and projected 2020 and 2070 conditions are listed in Table B-7.

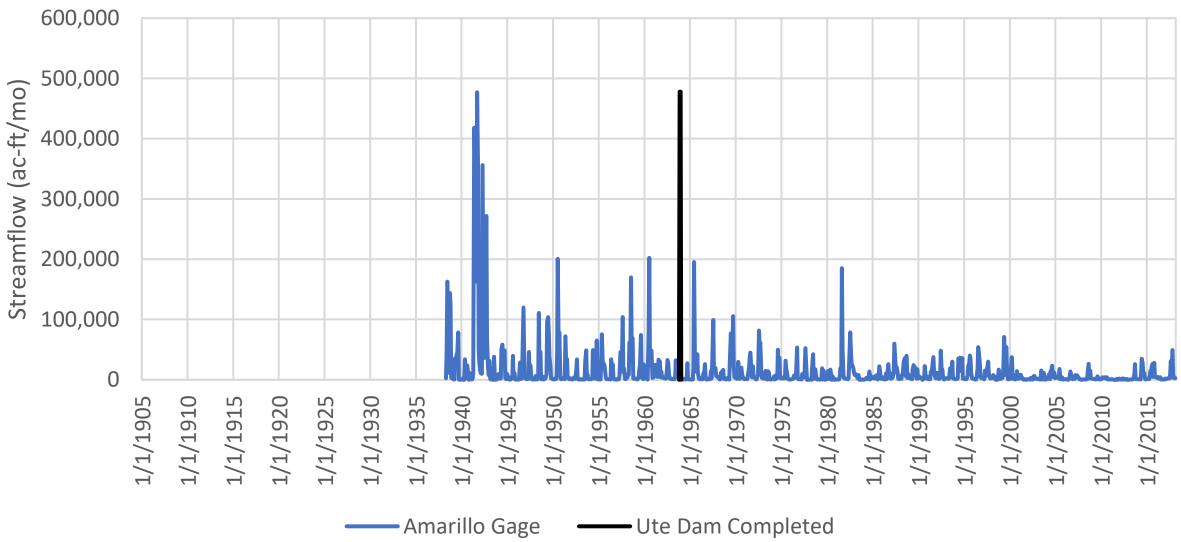
Table B-7: Reservoir Elevation and Surface Area Corresponding to a Conservation Storage Capacity of 500,000 ac-ft Above the Inactive Pool for Historical and Projected Future Conditions

Conservation Volume	1995 Survey		2020 Conditions		2070 Conditions	
	Area (acres)	Elevation (ft msl)	Area (acres)	Elevation (ft msl)	Area (acres)	Elevation (ft msl)
500,000 ac-ft	13,172	2,919.9	13,792	2,922.1	14,009	2,924.0

h) ***Upstream Reservoir Impacts*** – Ute reservoir in New Mexico is located on the Canadian River upstream of Lake Meredith and could conceivably impact inflows to Lake Meredith. The hydrology used in the model from 1940 through September 2004 was extracted from the Canadian2000 WAM, which includes full permitted diversions from Ute Reservoir. An examination of flows at the USGS stream gage at Logan, New Mexico downstream of Ute Reservoir indicated typically very low flows. There are occasional pulses, but fewer than for Lake Meredith inflows (Figure B-3). Between 2001 and 2016, there was only one significant spill from Ute Reservoir, which does not appear to have had substantial impact on Lake Meredith. In 2017, a larger spill from Ute contributed to an increase of several feet in Lake Meredith. This spill is included in the estimate of inflow to Lake Meredith. This approach is consistent with the approaches taken in the Canadian2000 WAM and the extension for the 2016 Regional Plan.

Figure B-3: Observed Monthly Streamflow at Logan and Amarillo Gage





i) ***Starting Volume*** – The Excel-based reservoir model used for this study was set to a starting volume equal to the maximum allowable storage of 500,000 ac-ft above the inactive pool. This was done to maintain consistency with the approach taken with the TCEQ WAM, which assumes that reservoirs are full at the beginning of the simulation.

j) ***Sedimentation*** – In order to assess the reservoir yield through 2070, model runs were performed for projected sedimentation conditions for years 2020 and 2070 to account for loss of storage capacity over time. Yields for intermediate years were interpolated from the yields calculated for these two years.

1.3 Lake Meredith Yield Results

Model analyses were executed for a repeat of the historical hydrology from January 1940 through December 2017. The model assumes that the reservoir starts full to the top of the usable volume, with a certain diversion target repeated for each year of simulation. This target is then adjusted until the model converges on the reservoir yield. This iterative process was used to determine both the firm yield of Lake Meredith (the maximum volume that can be diverted every year without causing a shortage) and the safe yield of Lake Meredith (the maximum volume that can be diverted every year while leaving a one year reserve in storage). In order to assess the reservoir yield through 2070, model runs were performed for projected sedimentation conditions for years 2020 and 2070 to account for loss of storage capacity over time. Yields for intermediate years were interpolated from the yields calculated for these two years. Results of the model runs for firm and safe yield are shown in Figure B-4 and Table B-8 below.

Figure B-4: Simulated Reservoir Storage Contents for 2020 Conditions

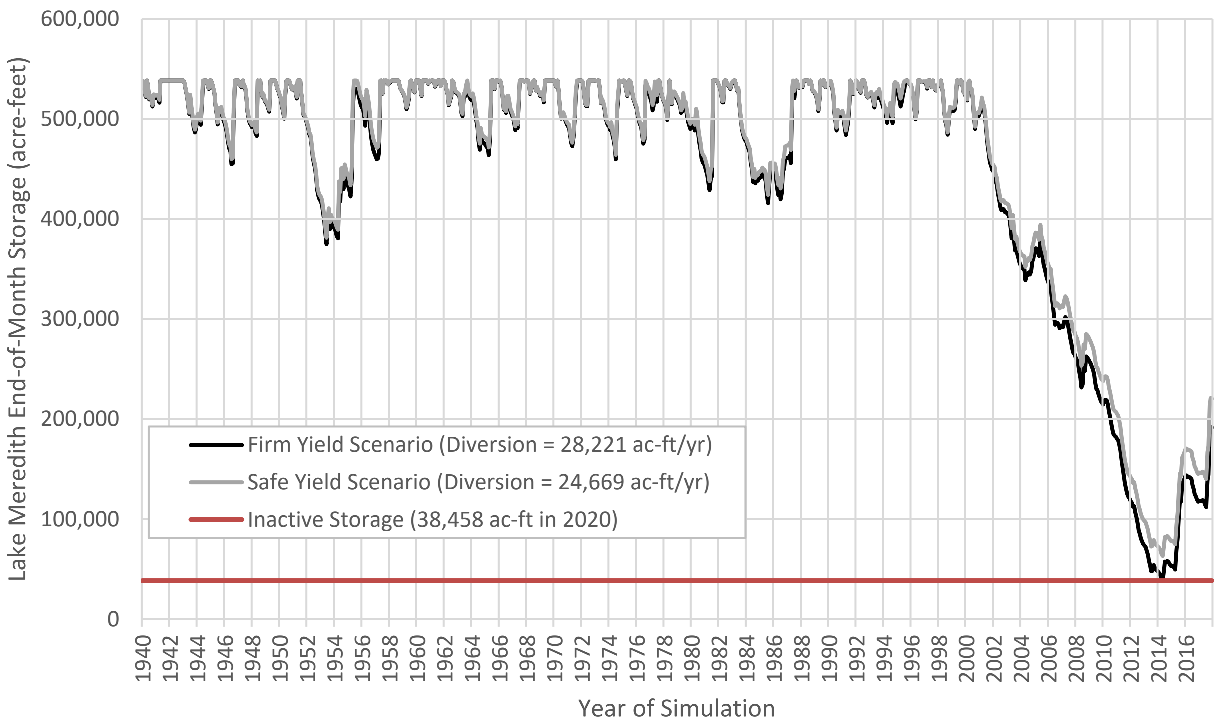


Table B-8: Estimated Lake Meredith Yield

Scenario	Yield (acre feet per year) 2020	2030	2040	2050	2060	2070
Firm Yield	28,221	28,242	28,263	28,284	28,305	28,326
Safe Yield	24,669	24,635	24,602	24,568	24,534	24,501

The model showed a slight increase in firm yield over time (Table B-8). This minor variation is due to the area-capacity-elevation relationships and the ability of the 500,000 ac-ft usable capacity to adjust in elevation over time due to sedimentation (Table B-7). The simulation results in several periods of prolonged decreases in reservoir storage volume (Figure B-4). The first of these corresponds with the drought of the 1950s, which is the drought of record for much of the state, with subsequent level drops in the early to mid-1980s. The reduced inflows and severity of the recent drought are clearly shown as storage declines drastically after the late 1990s, with the minimum reservoir content reached in May 2014. After that, simulated reservoir storage contents increase but remain well short of the top of the conservation pool.

The yields presented in Table B-8 are valid assuming reservoir storage would increase to the point of filling the conservation storage given the same diversion amount, regardless of how long it takes. The firm yield of the reservoir cannot be determined with certainty until the reservoir fully recovers in order to rule out an on-going drought, which would decrease the yields shown in Table B-8. The recommended reliable water supply to use for regional water planning purposes will be determined in conjunction with CRMWA and is dependent on the CRMWA supply allocation process.

2.1 Greenbelt Reservoir

The hydrology for the TCEQ-approved Red River WAM has a period of record from 1948 to 1998, so it does not include the on-going drought (2010 to present). Analyses of the firm yield of Lake Greenbelt using the TCEQ-approved Red River WAM would overestimate its yield. To provide a more accurate yield estimate, a reservoir operation model was used with hydrology covering a period from 1940 to 2016. This set of inflows was used instead of the WAM hydrology to assess the firm and safe yields of the reservoir.

2.2 Hydrology for Greenbelt Reservoir

Several previous yield studies have been conducted for Greenbelt Reservoir. Their results are briefly summarized in Table B-9.

Table B-9: Summary of Results from Previous Studies

Year of Study	Years of Siltation	Effective Year of Yield	Capacity (ac ft)	Safe Yield (ac ft/yr)	Firm Yield (ac ft/yr)	Source
1967	0	1967	59,800	7,900	9,400	FNI, 1996
1978	40	2007	50,300	6,800	N/A	FNI, 1996
1996	29	1996	53,300	6,371	7,760	FNI, 1996
1996	49	2016	49,160	6,055	7,457	FNI, 1996
2011	44	2011	50,892	4,530	5,487	FNI, 2011
2015	44	2011+	50,892	3,850*	N/A	2016 Region A Plan
2015	103	2070	39,122	3,440*	N/A	2016 Region A Plan

+ Reported in 2016 Region A Plan as 2020 supply.

* These studies were part of the 2016 Region A Water Plan and use a unique definition of “reliable supply” based on conditional reliability modeling.

Inflows to the Reservoir

In the 2011 study, FNI developed new hydrology for the historical period of the reservoir (9/1967 to 6/2011) using reservoir-specific data to develop estimates of inflow. For the 2021 Plan, FNI extended the hydrology through the end of 2016 using the same approach. This hydrology is based on a mass-balance analysis of the reservoir, using the most recent evaporation and precipitation from the Texas Water Development Board and updated area-capacity data. Since the 2011 update, TWDB changed evaporation records for several years including 1994 and 2000-2011. The extended reservoir inflows and extended net evaporation (= evaporation – precipitation) that were used in the model are included in Table B-10 and Table B-11, respectively.

Table B-10: Inflows to Greenbelt Reservoir (ac-ft)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1940	0	400	0	420	200	20	420	360	260	0	390	100	2,570
1941	170	580	510	4,650	13,480	22,880	2,290	1,910	1,160	6,700	1,000	1,090	56,420
1942	910	530	940	3,880	660	750	140	130	310	5,170	510	1,470	15,400
1943	970	350	270	660	1,560	460	30	0	0	0	0	400	4,700
1944	1,510	570	1,400	280	240	5,410	1,800	220	230	330	350	1,230	13,570
1945	1,030	580	1,310	1,010	140	1,480	1,230	80	0	0	0	0	6,860
1946	660	550	290	920	480	160	90	200	790	4,640	550	530	9,860
1947	720	180	620	1,530	17,060	5,060	850	10	0	140	40	80	26,290
1948	100	1,070	1,670	50	1,300	4,050	70	20	0	0	40	80	8,450
1949	580	2,620	700	490	8,870	1,890	110	130	540	290	170	440	16,830
1950	620	640	210	240	270	900	2,610	1,200	2,320	220	170	530	9,930
1951	590	400	350	330	5,050	1,330	1,770	0	20	260	160	210	10,470
1952	480	330	340	1,020	230	0	40	20	40	80	350	210	3,140
1953	170	270	370	510	160	30	9,190	940	110	1,380	320	400	13,850
1954	470	240	150	720	10,340	11,840	130	870	80	100	110	120	25,170
1955	270	300	100	80	6,050	9,730	620	160	70	1,950	130	360	19,820
1956	370	350	110	80	6,610	90	220	20	30	480	40	60	8,460
1957	100	220	780	7,610	22,510	1,260	80	2,390	270	520	690	210	36,640
1958	690	450	970	660	6,800	1,720	4,970	70	610	110	180	450	17,680
1959	570	340	110	310	5,220	910	4,330	50	840	1,630	380	1,580	16,270
1960	1,870	1,350	1,800	140	1,450	10,290	1,210	1,450	740	7,310	660	1,270	29,540
1961	730	1,140	1,280	830	540	6,290	2,860	670	390	1,960	1,640	670	19,000
1962	540	740	690	790	750	1,930	450	940	290	350	640	610	8,720
1963	300	1,300	700	300	200	500	0	3,200	1,300	500	600	700	9,600
1964	1,000	1,100	700	300	400	1,300	100	0	700	200	700	600	7,100
1965	500	400	300	300	200	7,800	200	100	300	800	300	600	11,800
1966	600	700	200	300	200	200	200	800	400	200	200	300	4,300
1967	200	200	200	700	200	200	300	100	1,000	1,414	361	407	5,282
1968	707	388	855	712	1,155	4,139	165	6,540	365	229	235	264	15,756
1969	635	518	690	525	2,469	1,304	124	782	560	504	113	533	8,757
1970	539	393	402	3,155	343	203	97	188	58	29	227	325	5,959
1971	516	484	535	357	205	245	0	754	647	1,069	1,302	474	6,589
1972	316	515	493	321	1,482	1,542	1,331	167	21	41	455	570	7,255
1973	568	574	1,265	2,384	499	1,127	335	0	1,802	317	229	279	9,380

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1974	807	653	568	482	269	383	120	589	117	478	286	432	5,185
1975	362	486	409	491	12,415	9,284	0	0	0	0	0	356	23,802
1976	296	644	378	699	591	0	35	340	1,303	38	246	476	5,047
1977	460	817	350	1,317	6,489	452	471	476	176	159	262	495	11,925
1978	423	796	532	504	4,309	1,271	170	0	387	252	431	418	9,493
1979	637	345	971	563	608	901	366	272	615	470	293	444	6,486
1980	398	638	678	1,044	723	610	256	2,712	0	0	0	0	7,060
1981	0	0	352	627	537	1,381	139	780	562	594	566	472	6,010
1982	383	497	716	593	2,267	4,502	3,997	370	105	213	435	472	14,548
1983	740	821	816	620	331	1,201	193	0	287	291	225	264	5,788
1984	769	655	700	694	233	1,180	164	0	0	0	262	699	5,357
1985	388	1,223	1,134	1,252	538	1,282	485	627	821	5,555	368	422	14,097
1986	679	788	909	476	891	748	244	745	1,176	2,781	1,762	789	11,986
1987	840	883	993	889	1,648	441	270	520	548	344	345	750	8,470
1988	792	642	903	810	733	907	250	117	545	350	392	573	7,014
1989	609	535	944	578	659	3,006	5	763	506	355	505	418	8,882
1990	629	680	616	2,061	1,349	384	0	269	359	264	305	276	7,192
1991	650	592	615	723	1,366	1,210	2,127	969	1,177	492	834	904	11,660
1992	663	778	1,080	816	557	2,042	543	122	192	378	464	748	8,383
1993	803	680	825	799	773	386	84	423	193	270	568	495	6,300
1994	640	608	892	957	805	227	197	594	0	0	124	401	5,445
1995	333	340	645	582	552	1,673	311	271	88	317	588	549	6,250
1996	563	664	491	1,047	0	583	992	1,449	851	503	622	692	8,456
1997	685	801	799	6,931	1,221	729	267	220	213	445	540	649	13,502
1998	810	777	1,560	757	704	276	225	101	110	650	712	450	7,134
1999	0	1,161	1,192	1,209	2,642	1,288	1,042	0	0	0	407	664	9,606
2000	893	594	0	1,350	189	2,118	107	0	0	112	382	517	6,262
2001	738	823	803	623	2,825	247	121	701	414	64	1,907	557	9,824
2002	567	620	585	1,002	416	531	395	328	488	1,409	499	848	7,689
2003	685	473	648	566	310	1,754	530	343	2,739	207	429	460	9,143
2004	561	742	1,096	951	283	393	298	25	124	466	544	565	6,048
2005	730	614	883	882	557	2,748	0	0	0	132	338	504	7,387
2006	620	447	619	354	420	495	286	776	367	193	398	796	5,771
2007	782	519	2,644	995	2,610	671	276	140	58	321	350	661	10,028
2008	463	539	644	569	40	339	75	744	30	483	350	446	4,723
2009	413	492	673	547	395	336	24	179	176	364	389	354	4,342
2010	451	672	647	1,345	934	374	1,337	0	173	348	414	398	7,093
2011	408	468	448	380	179	291	188	263	185	211	145	298	3,465
2012	309	351	491	225	363	725	145	140	117	131	130	123	3,249
2013	278	344	345	222	300	1,624	227	241	619	250	263	289	5,003

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2014	303	301	338	272	265	316	318	616	171	175	273	280	3,626
2015	418	354	438	397	4,147	475	505	199	197	893	564	718	9,305
2016	600	483	449	702	1,516	344	254	1,647	533	350	324	442	7,645

Table B-11: Net Evaporation in Greenbelt Reservoir (feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1940	0.07	0.14	0.47	0.31	0.42	0.60	0.96	0.57	0.63	0.51	0.05	0.18	4.92
1941	0.10	0.05	0.11	0.19	-0.12	0.02	0.42	0.40	0.35	-0.26	0.23	0.14	1.63
1942	0.17	0.21	0.31	0.02	0.48	0.35	0.67	0.39	0.32	-0.04	0.37	0.04	3.29
1943	0.21	0.30	0.33	0.35	0.23	0.58	0.53	0.94	0.59	0.48	0.28	-0.03	4.80
1944	-0.02	0.10	0.33	0.36	0.34	0.50	0.47	0.60	0.36	0.29	0.22	-0.03	3.51
1945	0.06	0.14	0.28	0.19	0.62	0.61	0.52	0.52	0.44	0.27	0.34	0.20	4.21
1946	0.12	0.18	0.32	0.46	0.46	0.52	0.80	0.56	0.18	0.04	0.14	0.15	3.93
1947	0.18	0.27	0.25	0.18	-0.04	0.57	0.76	0.79	0.81	0.48	0.17	0.12	4.55
1948	0.12	-0.02	0.21	0.50	0.37	0.45	0.56	0.42	0.65	0.40	0.29	0.36	4.32
1949	-0.09	0.12	0.26	0.20	0.03	0.32	0.52	0.49	0.37	0.28	0.36	0.17	3.04
1950	0.24	0.20	0.42	0.38	0.35	0.35	-0.05	0.34	0.05	0.50	0.38	0.24	3.41
1951	0.18	0.13	0.34	0.39	0.01	0.38	0.79	0.86	0.66	0.50	0.26	0.28	4.77
1952	0.23	0.28	0.35	0.20	0.49	0.87	0.79	0.99	0.83	0.78	0.33	0.17	6.31
1953	0.28	0.28	0.41	0.48	0.64	0.91	0.71	0.63	0.94	0.15	0.25	0.14	5.83
1954	0.14	0.34	0.38	0.29	-0.13	0.56	0.69	0.48	0.65	0.40	0.34	0.25	4.37
1955	0.11	0.19	0.41	0.58	-0.06	0.22	0.57	0.55	0.35	0.29	0.35	0.22	3.80
1956	0.17	0.08	0.50	0.57	0.30	0.64	0.60	0.73	0.71	0.45	0.31	0.22	5.29
1957	0.15	0.11	0.07	-0.02	-0.16	0.30	0.79	0.41	0.43	0.01	0.05	0.25	2.39
1958	0.03	0.09	-0.08	0.13	0.08	0.43	0.22	0.51	0.22	0.34	0.20	0.14	2.31
1959	0.16	0.19	0.40	0.33	0.03	0.27	0.28	0.48	0.48	0.08	0.23	-0.22	2.70
1960	-0.01	0.01	0.18	0.36	0.29	0.09	0.03	0.32	0.14	-0.21	0.27	0.05	1.52
1961	0.07	0.04	0.06	0.42	0.33	0.09	0.17	0.39	0.34	0.33	-0.01	0.13	2.35
1962	0.04	0.25	0.38	0.27	0.52	0.04	0.26	0.53	0.09	0.28	0.17	0.12	2.95
1963	0.06	0.18	0.46	0.55	0.32	0.28	0.66	0.36	0.32	0.46	0.25	0.06	3.96
1964	0.11	0.00	0.36	0.60	0.44	0.48	0.83	0.60	0.22	0.38	0.06	0.07	4.13
1965	0.10	0.13	0.13	0.39	0.32	-0.09	0.69	0.46	0.23	0.23	0.30	0.17	3.05
1966	0.03	-0.01	0.45	0.29	0.48	0.42	0.70	0.14	0.21	0.46	0.42	0.13	3.73
1967	0.09	0.14	0.44	0.37	0.34	0.29	0.34	0.50	0.32	0.51	0.22	0.09	3.65
1968	-0.10	-0.02	0.20	0.35	0.05	0.38	0.38	0.28	0.49	0.38	0.12	0.04	2.54
1969	0.06	0.04	0.05	0.42	0.10	0.40	0.62	0.42	0.12	0.09	0.19	0.02	2.53
1970	0.09	0.16	0.06	0.28	0.52	0.60	0.60	0.54	0.43	0.25	0.18	0.17	3.87
1971	0.24	0.14	0.34	0.45	0.43	0.46	0.55	0.30	0.06	0.17	0.11	0.04	3.31
1972	0.16	0.26	0.50	0.50	0.08	0.35	0.40	0.41	0.31	0.15	-0.01	0.19	3.31
1973	0.06	0.09	-0.17	-0.03	0.30	0.47	0.38	0.57	0.11	0.32	0.26	0.26	2.63
1974	0.19	0.36	0.26	0.54	0.34	0.58	0.87	0.19	0.03	0.04	0.17	0.10	3.68
1975	0.05	-0.01	0.18	0.34	0.11	0.35	0.17	0.46	0.27	0.51	0.06	0.16	2.66
1976	0.25	0.37	0.38	0.20	0.30	0.51	0.46	0.61	0.17	0.26	0.22	0.24	3.97
1977	0.10	0.20	0.46	0.14	-0.07	0.52	0.76	0.25	0.57	0.39	0.30	0.29	3.91
1978	0.06	0.05	0.38	0.59	-0.05	0.36	0.77	0.61	0.23	0.40	0.08	0.21	3.68
1979	0.04	0.08	0.10	0.29	0.16	0.20	0.39	0.34	0.47	0.46	0.19	0.20	2.92
1980	0.09	0.18	0.34	0.40	0.07	0.65	0.99	0.73	0.38	0.47	0.19	0.15	4.64

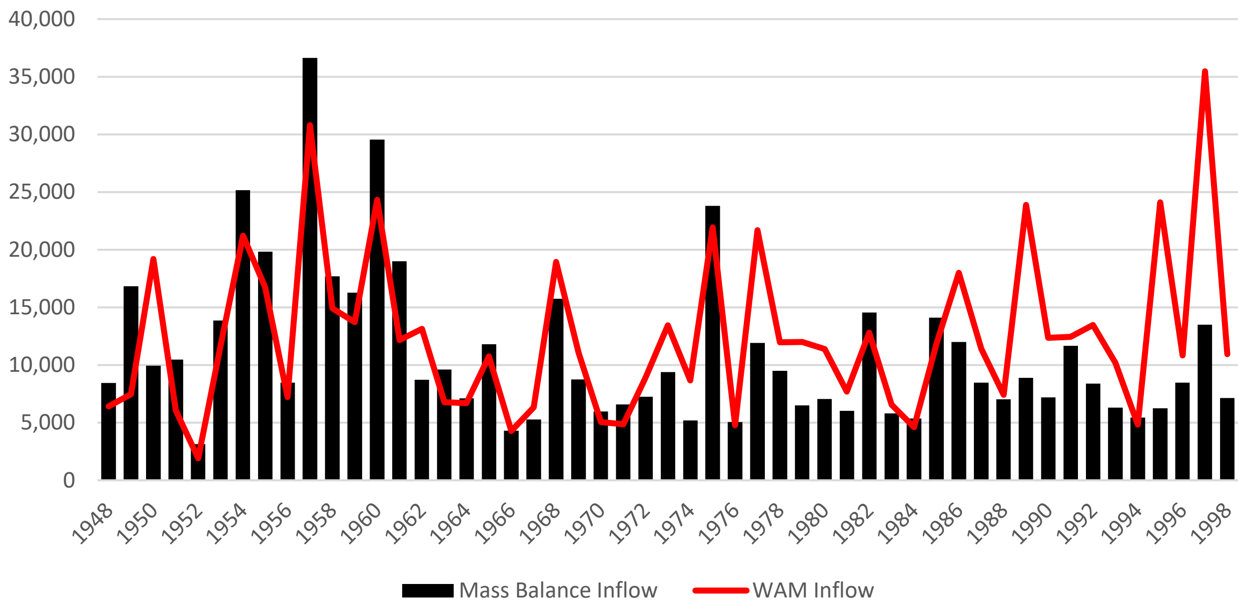
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	0.19	0.24	0.22	0.41	0.29	0.56	0.52	0.32	0.35	0.07	0.22	0.22	3.60
1982	0.19	0.16	0.40	0.48	0.04	0.09	0.36	0.60	0.53	0.45	0.22	0.05	3.56
1983	0.05	0.01	0.21	0.34	0.28	0.36	0.88	0.75	0.60	0.05	0.24	0.07	3.85
1984	0.15	0.33	0.22	0.48	0.56	0.40	0.64	0.39	0.58	0.25	0.19	-0.01	4.18
1985	0.07	0.09	0.15	0.36	0.40	0.17	0.60	0.52	0.22	0.00	0.15	0.00	2.74
1986	0.31	0.22	0.51	0.44	0.26	0.25	0.82	0.21	0.17	-0.10	0.04	0.08	3.21
1987	0.10	0.04	0.22	0.51	0.00	0.31	0.63	0.39	0.19	0.37	0.23	0.00	2.97
1988	0.09	0.21	0.19	0.27	0.37	0.43	0.40	0.52	0.13	0.37	0.31	0.26	3.55
1989	0.20	0.08	0.37	0.47	0.09	-0.03	0.58	0.27	0.27	0.49	0.48	0.17	3.42
1990	0.11	0.05	0.11	0.15	0.24	0.71	0.55	0.51	0.33	0.33	0.12	0.13	3.36
1991	0.09	0.28	0.47	0.60	0.34	0.45	0.61	0.60	0.25	0.57	0.17	0.06	4.48
1992	0.08	0.24	0.34	0.27	0.14	0.03	0.58	0.40	0.57	0.49	0.12	0.14	3.41
1993	0.07	0.15	0.29	0.47	0.40	0.56	0.69	0.65	0.65	0.48	0.32	0.25	4.98
1994	0.23	0.21	0.37	0.39	0.28	0.73	0.53	0.58	0.43	0.34	0.26	0.17	4.51
1995	0.00	0.00	0.37	0.36	0.02	0.25	0.49	0.34	0.05	0.50	0.40	0.30	3.08
1996	0.27	0.40	0.48	0.68	0.44	0.40	0.24	0.25	0.09	0.39	0.26	0.37	4.28
1997	0.22	0.09	0.56	-0.25	0.15	0.31	0.60	0.29	0.33	0.29	0.24	-0.03	2.80
1998	0.22	0.04	0.22	0.48	0.48	0.91	0.77	0.48	0.61	0.11	0.10	0.14	4.56
1999	0.17	0.29	0.15	0.29	0.15	0.38	0.64	0.52	0.32	0.46	0.44	0.33	4.13
2000	0.57	0.32	-0.01	0.22	0.34	-0.16	0.53	0.58	0.58	-0.04	0.22	0.11	3.26
2001	0.00	0.05	0.12	0.54	0.08	0.70	0.89	0.49	0.44	0.54	0.11	0.23	4.18
2002	0.18	0.22	0.40	0.41	0.48	0.61	0.47	0.57	0.41	-0.15	0.23	0.17	3.99
2003	0.26	0.17	0.31	0.45	0.47	0.06	0.89	0.64	0.36	0.25	0.31	0.24	4.41
2004	0.05	0.20	0.22	0.15	0.61	0.15	0.49	0.39	0.40	0.08	-0.19	0.21	2.77
2005	0.08	0.12	0.29	0.37	0.19	0.45	0.59	0.25	0.55	0.29	0.39	0.33	3.91
2006	0.48	0.34	0.31	0.51	0.42	0.73	0.71	0.27	0.25	0.22	0.37	-0.07	4.53
2007	0.12	0.27	-0.07	0.25	0.04	0.21	0.49	0.48	0.27	0.60	0.33	0.17	3.15
2008	0.15	0.26	0.46	0.43	0.21	0.56	0.54	0.29	0.23	0.05	0.35	0.29	3.83
2009	0.24	0.34	0.44	0.29	0.38	0.44	0.49	0.44	0.31	0.20	0.37	0.11	4.06
2010	0.07	0.14	0.33	0.14	0.31	0.57	0.18	0.47	0.45	0.38	0.38	0.26	3.67
2011	0.16	0.20	0.39	0.71	0.73	1.05	0.91	0.84	0.64	0.38	0.34	0.02	6.37
2012	0.25	0.17	0.39	0.39	0.48	0.48	0.75	0.58	0.32	0.47	0.38	0.21	4.85
2013	0.12	0.13	0.45	0.47	0.55	0.53	0.47	0.43	0.29	0.46	0.31	0.19	4.38
2014	0.33	0.16	0.47	0.56	0.36	0.31	0.40	0.56	0.25	0.37	0.23	0.15	4.15
2015	0.10	0.19	0.32	0.12	-0.48	0.31	0.27	0.37	0.58	0.08	0.20	0.16	2.21
2016	0.19	0.31	0.47	0.33	0.15	0.38	0.66	0.22	0.28	0.54	0.30	0.21	4.04

Hydrology prior to the construction of the reservoir is from previous studies (FNI, 1996) and is based on data from three gages. The 6/1960 to 9/1964 flows are from the Salt Fork of the Red River near Clarendon gage (USGS 07299850), which was a temporary gage located at the current dam site. Flows from to 7/1952 to 5/1960 and from 10/1964 to 8/1967 are based on the Salt Fork of the Red River near Wellington gage (USGS 07300000) using a relationship with the Clarendon gage. Flows from 1/1940 to 7/1952 are based on the Salt Fork of the Red River at Mangum, Oklahoma gage (USGS 07300500) using a relationship with the Clarendon gage.

The 2011 study found a fairly consistent inflow of about 4,500 to 5,000 acre-feet per year into the reservoir since the reservoir was constructed. Unlike other West Texas watersheds, flows seldom go to zero. This consistent base flow may be from springs that feed the reservoir.

FNI considered using the Red River WAM for the yield evaluations. However, there is a poor correlation between the Red River WAM hydrology and the historical mass balance hydrology (Figure B-5). The WAM hydrology is based on the naturalized flows for the Salt Fork of the Red River near Wellington gage (USGS 07300000, WAM control point B10000), which is located several miles downstream of Greenbelt Reservoir. After 1970, the WAM generally shows greater inflows. For this reason, the WAM was not used for this analysis.

Figure B-5 Comparison of WAM Inflow to Mass Balance Inflow at Greenbelt Reservoir



Area-Capacity Information

Area-capacity information is based on the original curve[1] for the reservoir adjusted for sedimentation over time assuming a sedimentation rate of 0.75 acre-feet per year per square mile of contributing drainage area[2]. The original survey and this sedimentation rate were also used in the 1996 study and the 2011 study; however, the accuracy of the survey and rate information is uncertain because there has not been another volumetric survey of the reservoir since construction. There is another survey of the reservoir available online[3], however the reported date the survey was conducted (October 1974) is suspicious because it contradicts other published information[4]. An accurate survey date is key to estimating the amount of storage lost to sedimentation. Furthermore, the survey available online tends to predict a higher storage volume for a given elevation, so to use it would be less conservative in terms of water supply. To remain consistent with previous modeling efforts, FNI chose to use the original survey for this study. The area-capacity-elevation curves from the original design, 2020 sediment conditions and 2070 sediment conditions are included in Table B-13. Reservoir storage capacities at the conservation pool elevation of 2,664 ft-msl are shown in Table B-12.

[1]Original Construction Drawings Rating Curve, Freese and Nichols, April 8, 1964.
[2] Bulletin 5912 Inventory and Use of Sedimentation Data in Texas. Prepared by USDA Soil Conservation Service (now NRCS) for Texas Board of Water Engineers (now TWDB). January 1959.
[3] https://waterdatafortexas.org/reservoirs/individual/greenbelt/rating-curve/twdb/1974-10-01
[4] TWDB Report 126. Engineering Data on Dams and Reservoirs in Texas – Part I. October 1974.

Table B-12: Original and Projected Storage Capacities for Greenbelt Reservoir

	1967	2020	2070
Capacity (acre-feet)	59,800	49,013	39,038

Table B-13: Greenbelt Reservoir Elevation Capacity Table

Elevation (ft)	Original Capacity (ac ft)	2020 Capacity (ac ft)	2070 Capacity (ac ft)
2,580	0	0	0
2,581	10	0	0
2,582	20	0	0
2,583	30	0	0
2,584	50	0	0
2,585	70	0	0
2,586	100	0	0
2,587	130	0	0
2,588	170	0	0
2,589	220	0	0
2,590	270	0	0
2,591	330	0	0
2,592	400	0	0
2,593	480	0	0
2,594	570	0	0
2,595	670	0	0
2,596	780	0	0
2,597	900	0	0
2,598	1,030	0	0
2,599	1,170	0	0
2,600	1,320	0	0
2,601	1,490	0	0
2,602	1,680	0	0
2,603	1,880	0	0
2,604	2,090	0	0
2,605	2,320	1	0
2,606	2,570	12	0
2,607	2,840	44	0
2,608	3,130	95	0
2,609	3,440	167	0
2,610	3,770	259	0
2,611	4,120	368	0
2,612	4,480	492	0
2,613	4,860	634	0
2,614	5,260	796	0
2,615	5,680	977	0
2,616	6,110	1,172	0

Elevation (ft)	Original Capacity (ac ft)	2020 Capacity (ac ft)	2070 Capacity (ac ft)
2,617	6,560	1,383	0
2,618	7,020	1,610	0
2,619	7,500	1,855	0
2,620	8,000	2,123	0
2,621	8,520	2,415	0
2,622	9,060	2,732	0
2,623	9,630	3,078	0
2,624	10,220	3,449	12
2,625	10,840	3,846	50
2,626	11,480	4,270	118
2,627	12,150	4,723	219
2,628	12,850	5,207	351
2,629	13,580	5,722	516
2,630	14,340	6,268	715
2,631	15,130	6,847	951
2,632	15,950	7,456	1,220
2,633	16,790	8,094	1,525
2,634	17,660	8,762	1,870
2,635	18,550	9,458	2,249
2,636	19,460	10,181	2,665
2,637	20,400	10,937	3,121
2,638	21,370	11,730	3,625
2,639	22,370	12,567	4,192
2,640	23,410	13,453	4,834
2,641	24,480	14,393	5,562
2,642	25,580	15,384	6,370
2,643	26,720	16,421	7,239
2,644	27,900	17,506	8,172
2,645	29,120	18,641	9,172
2,646	30,370	19,822	10,236
2,647	31,660	21,048	11,357
2,648	32,990	22,322	12,539
2,649	34,360	23,648	13,795
2,650	35,770	25,031	15,129
2,651	37,230	26,468	16,534
2,652	38,730	27,956	18,002
2,653	40,270	29,489	19,523
2,654	41,850	31,065	21,093
2,655	43,470	32,683	22,709
2,656	45,130	34,341	24,366
2,657	46,820	36,036	26,061
2,658	48,560	37,773	27,798
2,659	50,340	39,553	29,578
2,660	52,160	41,371	31,396

Elevation (ft)	Original Capacity (ac ft)	2020 Capacity (ac ft)	2070 Capacity (ac ft)
2,661	54,010	43,223	33,248
2,662	55,900	45,113	35,138
2,663	57,830	47,043	37,068
2,664	59,800	49,013	39,038

The reservoir has never filled. Historical storage reached a high point in 1975 and has trended significantly downward since then. As a result, instead of the common assumption of uniform distribution of sediment, FNI assumed that the sediment distribution was based on the amount of time a particular elevation slice was inundated. New area-capacity curves were developed for 2020 and 2070 conditions. Using the same technique, FNI also generated synthetic surveys for the years 1976, 1986, 1996 and 2011 for use in the mass balance calculation of monthly inflows to the reservoir. The 2020 and 2070 curves were used in the yield modeling.

Downstream Releases

The mass balance calculation of inflow assumes a release of approximately 0.5 cfs through the low flow outlet gate beginning in August 1980 and continuing through the end of 2016. The release amount is based on measurements by FNI during the 1996 study and varies with reservoir storage[5]. According to the 2011 study, this flow has practically ceased at times. Observations during recent droughts indicate the release is present and on-going. Currently, the yield modeling for 2020 and 2070 conditions assumes this release continues, but yields have also been estimated assuming zero releases.

Demand

A firm yield is the maximum annual diversion that can be met without incurring a shortage (100% reliability). During a simulation in which the firm yield is being diverted, the minimum storage content of the reservoir is near zero. Due to water quality concerns, infrastructure constraints, and other considerations it is often not possible or desirable to completely empty a reservoir. In parts of west Texas, it is common practice to use a safe yield instead of firm yield to determine the reliable supply from a reservoir. A one-year safe yield is defined as the amount that can be diverted from the reservoir each year while leaving a one-year supply in storage at the end of the drought of record. In other words, the minimum storage content in a safe yield run is equal to the annual diversion amount. For both the firm and safe yield analyses a demand pattern was used to distribute the annual diversion amount to monthly values. The demand pattern in Table B-14 was calculated based on the average monthly diversion from Greenbelt Reservoir from 1995-2016. The historical diversions provided by GMIWA are included in Table B-15.

[5] From 1996 Study: “At the time of our visit the flow could not be seen clearly. Our estimate was based on our limited visual observation and on listening to the flow. Obviously, it is very approximate.”

Table B-14: Demand Pattern for Diversions from Greenbelt Reservoir

Month	Demand Pattern
Jan	7.25%
Feb	6.51%
Mar	7.30%
Apr	7.80%
May	8.90%
Jun	9.55%
July	11.06%
Aug	10.53%
Sep	8.77%
Oct	8.05%
Nov	7.14%
Dec	7.14%

Table B-15: Greenbelt Municipal and Industrial Water Authority Historical Diversions from Greenbelt Reservoir (acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1995	302	272	312	334	338	372	482	456	383	343	322	317	4,231
1996	303	327	337	384	479	437	487	435	339	349	303	323	4,504
1997	310	264	321	274	304	357	485	426	402	339	289	293	4,064
1998	285	250	279	327	423	522	625	541	499	369	309	312	4,740
1999	319	271	303	325	323	361	499	550	414	368	326	302	4,361
2000	311	306	322	320	433	366	480	582	495	358	308	314	4,595
2001	312	267	293	322	359	475	610	452	354	366	307	290	4,407
2002	286	256	305	287	371	392	418	486	374	329	283	289	4,076
2003	284	256	300	349	398	348	512	531	356	341	304	280	4,258
2004	289	245	274	300	411	357	420	380	354	295	269	273	3,866
2005	269	228	270	322	355	421	473	415	409	346	331	328	4,167
2006	335	282	331	371	403	497	532	449	317	329	282	296	4,424
2007	297	266	314	297	321	321	377	415	341	354	293	270	3,866
2008	278	270	293	320	371	446	469	415	327	300	295	303	4,088
2009	285	259	286	294	296	338	424	404	314	284	261	285	3,729
2010	277	225	247	266	284	360	318	362	297	299	256	255	3,447
2011	262	271	274	313	391	432	415	360	285	252	219	223	3,697
2012	227	200	224	270	305	289	366	304	263	245	222	219	3,133
2013	224	189	216	208	230	239	258	217	191	204	176	176	2,528
2014	167	162	189	232	274	270	277	288	259	250	225	213	2,803
2015	249	210	238	242	236	270	277	292	281	250	230	236	3,011
2016	236	219	229	234	248	255	284	269	233	245	227	235	2,913

2.3 Greenbelt Reservoir Yield Analyses

Computer simulations were performed to determine the reliable supply, or yield, of Greenbelt Reservoir. These computer runs used an Excel-based reservoir operation model. The model used historical hydrologic data (inflows, evaporation and precipitation) and relevant reservoir data (area-capacity relationships, storage, and diversions) to simulate the behavior of the reservoir during a repeat of historical hydrologic conditions. The hydrology used in the studies covers the period from January 1940 to December 2016. The 2020 projected conservation storage capacity in the reservoir was estimated to be 49,013 acre-feet (this volume is less than the permitted volume due to sediment accumulation over time).

These runs determined both the firm yield and safe yield of the reservoir. Firm yield is defined as the largest diversion from the reservoir that does not result in a shortage during the simulation period. The minimum storage in the reservoir for a firm yield run is close to zero. Safe yield is a more conservative estimate of the reliable supply from the reservoir. Safe yield assumes that a minimum volume equal to one year's diversion from the reservoir is maintained throughout the simulation period.

The outlet works for Greenbelt Reservoir have been shown to unintentionally pass water through the dam. The amount of water varies with the elevation of the lake. A previous study estimated the leakage through the dam to be approximately 0.5 cfs. To better understand the impacts of this release, the yields for Greenbelt Reservoir were considered both with and without the release.

Assuming the 0.5 cfs release continues indefinitely, the firm yield is expected to decrease over 17% by 2070 compared to 2020 levels and safe yield is expected to decrease over 27% over the same time period (Table B-16). These decreases in yield are slightly less pronounced if we assume the releases do not occur (Table B-17). Without the 0.5 cfs release, yields are expected to increase by around 10% (Table B-18). Based on Table B-17, the safe yield for Lake Greenbelt in 2020 is 3,400 ac-ft/yr, which decreases to 2,539 ac-ft/yr by 2070. Storage traces for the four runs in Table B-16 are shown in Figures C-6 through C-9. Storage traces for the runs in Table B-17 are similar.

Table B-16: Firm and Safe Yields for 2020 and 2070 Conditions Assuming 0.5 cfs Release

	2020	2070
Firm Yield (ac-ft/yr)	3,964	3,276
Safe Yield (ac-ft/yr)	3,112	2,256

Table B-17: Firm and Safe Yields for 2020 and 2070 Conditions Assuming Zero Release

	2020	2070
Firm Yield (ac-ft/yr)	4,264	3,647
Safe Yield (ac-ft/yr)	3,400	2,539

Table B-18: Increase in Yield with No Releases

	2020	2070
Difference in Firm Yield (ac-ft/yr)	300	371
Difference in Safe Yield (ac-ft/yr)	288	283

Figure B-6: Storage Contents for Diversion of Firm Yield in 2020 (3,964 ac-ft/yr) Assuming 0.5 cfs Release

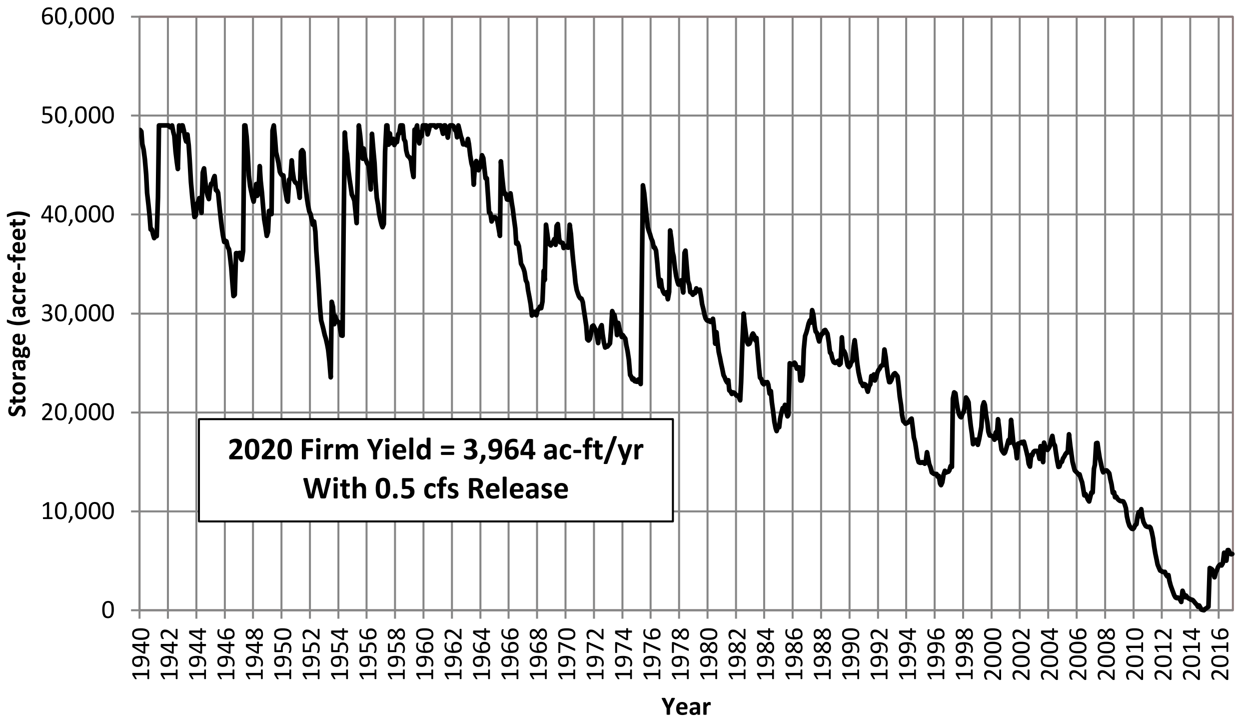


Figure B-7: Storage Contents for Diversion of Firm Yield in 2070 (3,276 ac-ft/yr) Assuming 0.5 cfs Release

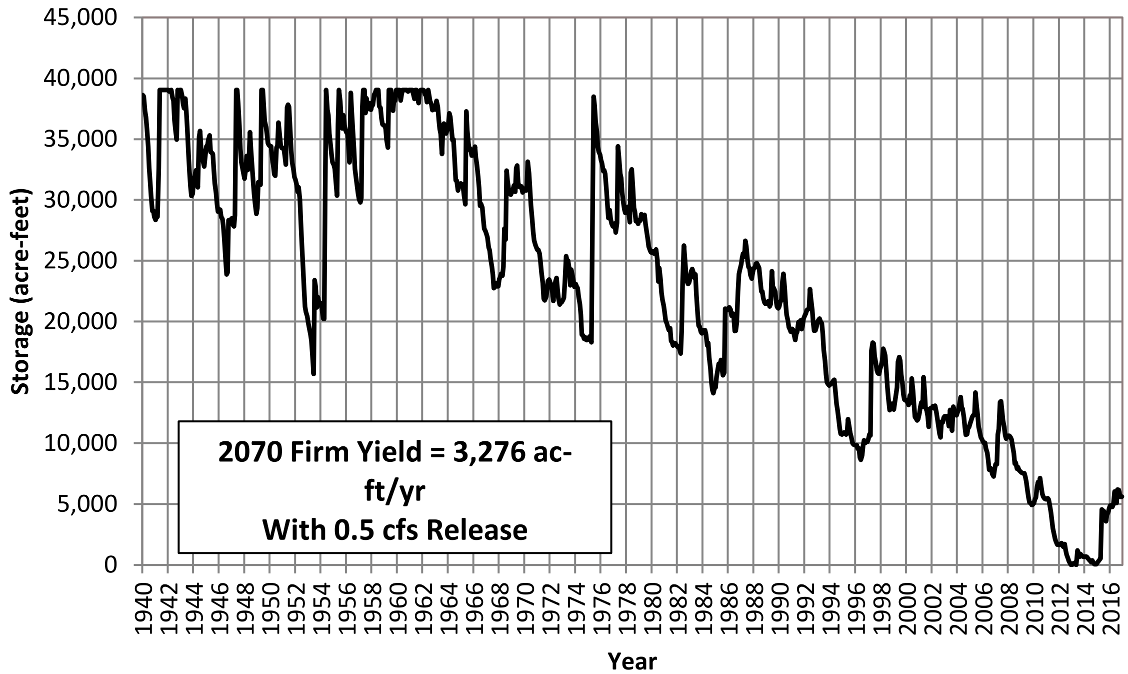


Figure B-8: Storage Contents for Diversion of Safe Yield in 2020 (3,112 ac-ft/yr) Assuming 0.5 cfs Release

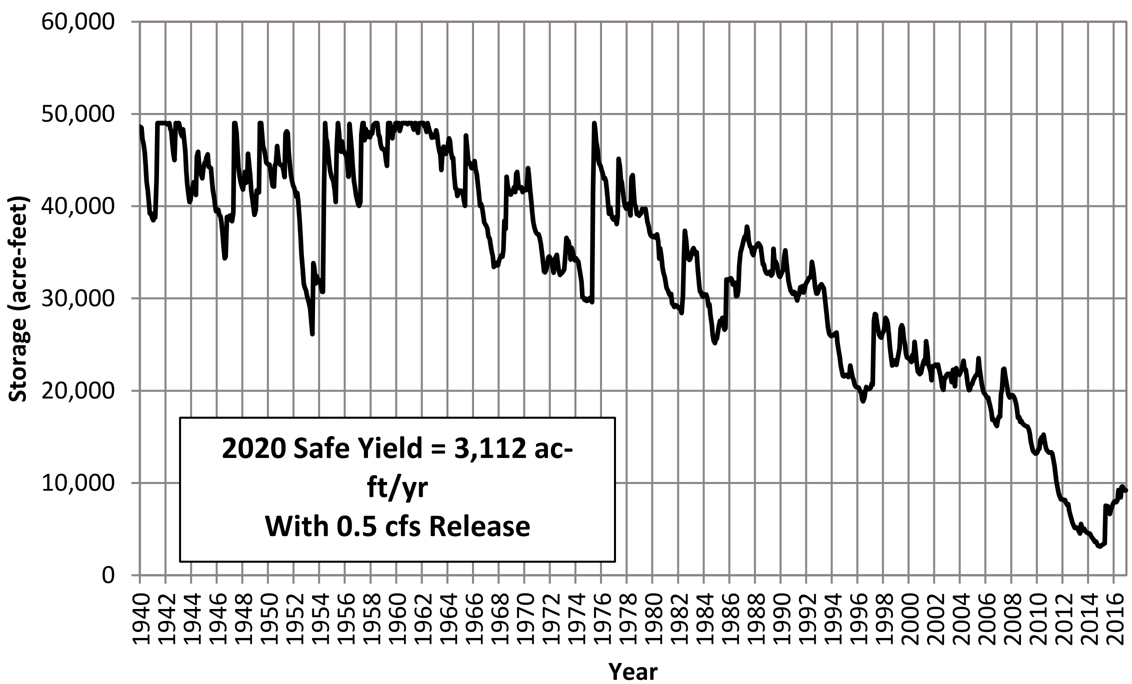
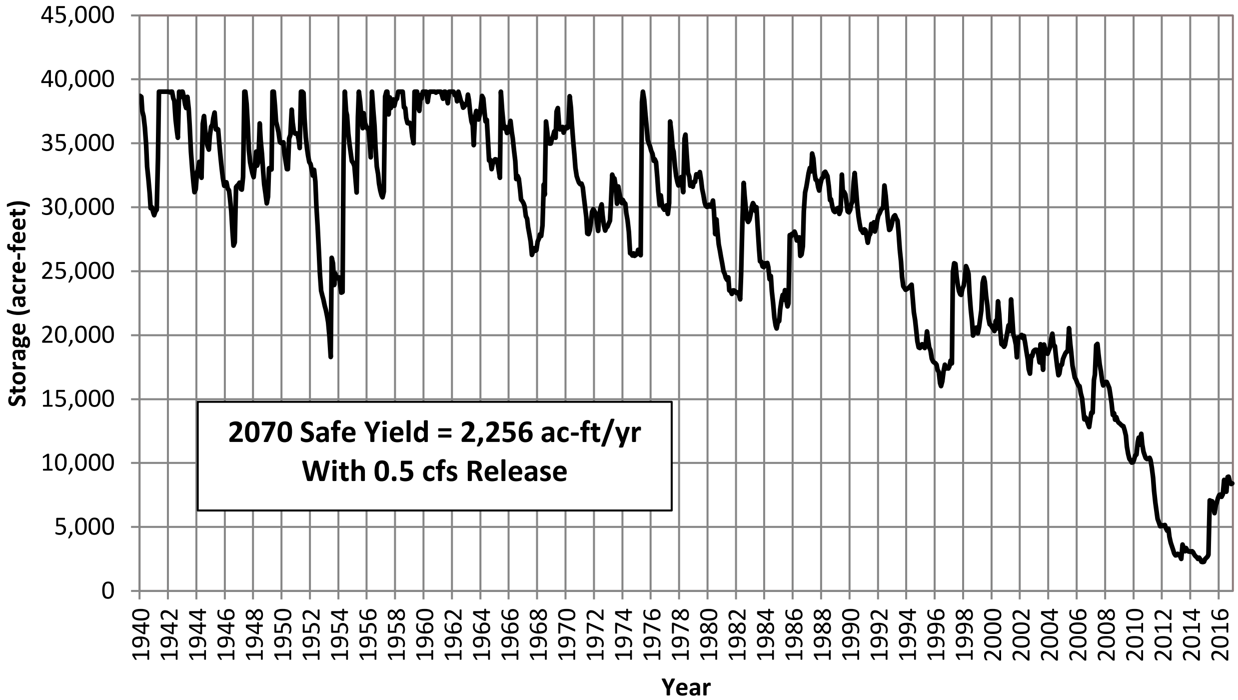


Figure B-9: Storage Contents for Diversion of Safe Yield in 2070 (2,256 ac-ft/yr) Assuming 0.5 cfs Release



3.1 Palo Duro Reservoir

The Palo Duro Reservoir located in Hansford County and is owned by the Palo Duro Water District. Palo Duro Reservoir is not currently used as a water supply but is included in the 2021 Panhandle Water Plan as an alternative strategy. For water supplies from the Palo Duro Reservoir, the yields from the 2016 Panhandle Water Plan were used since the hydrology from the Canadian WAM has not been extended and no new water rights have been granted in the Canadian Basin. The yield for 2070 was extrapolated from 2060 using a straight line interpolation of reservoir yields. The availability in 2020 is 3,917 acre-feet per year decreasing to 3,708 acre-feet per year in 2070.

4.1 Run-of-River Supplies

According to the TCEQ water rights database there are 103 run-of-river water rights permit holders in the PWPA. Run of river supplies are diversions directly from a stream or river. FNI defines the reliable supply from a run-of-river supply to be the minimum annual diversion from the TCEQ WAM simulation. The total reliable supply from these sources is 2,538 acre-feet per year.

Methodology

The annual supply for the run-of-river water rights were determined using the TCEQ WAMs, Run 3. Run-of-river supplies are reported individually for municipal water rights and irrigation and/or industrial rights greater than 10,000 acre-feet /year. Smaller non-municipal water rights are aggregated by county. In the PWPA there are no individually reported run-of-river water rights. All run-of-river water rights are aggregated irrigation water rights. The reliable supply from these rights are estimated using the minimum annual diversion reported by the WAM analysis. 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 irrigation water demand by county and an individual irrigation water right. Therefore, evaluating water reliability as if such direct relationship existed is not practical. The following subsections discuss the run-of-river rights in the PWPA by river basin.

Canadian River Basin
The run-of-river flows for the Canadian River Basin were determined by using the TCEQ WAM Run 3 downloaded October 21, 2014. The flows were determined as the minimum annual diversion from the river. Table B-19 below shows the availability by county.

Table B-19: Canadian River Basin Run-of-River Availability

County	Use	Water Rights	Permitted Diversion (ac ft/yr)	Total Run of River (ac ft/yr)
Dallam	Irrigation	3791	190	0
Gray	Irrigation	3788	4	1
Hansford	Irrigation	3792, 3800, 3801, 3802, 3804, 4297	530	22
Hartley	Irrigation	3776	0	0
Hemphill	Irrigation	3789, 3790	0	0
Hutchinson	Irrigation	3783, 3786, 3799	356	98
Hutchinson	Industrial	3784, 3785	290[1]	0
Lipscomb	Irrigation	3805, 3807	122	66
Moore	Irrigation	3780, 3781, 3793, 3796, 3797, 3798	345	7
Ochiltree	Irrigation	3806	0	0
Oldham	Mining	3777	30	0
Potter	Irrigation	3778, 3779, 4427, 4489, 5049, 5057, 5627, 5638	349	0
Roberts	Irrigation	3787	640	72
Sherman	Irrigation	3794, 3795	275	32

1. for non-consumptive uses

Red River Basin
The run-of-river flows for the Red River Basin were determined by using the TCEQ WAM Run 3 downloaded October 21, 2014. The flows were determined as the minimum annual diversion from the river. Table B-20 below shows the availability by county.

Table B-20: Red River Basin Run-of-River Availability

County	Use	Water Rights	Permitted Diversion (ac ft/yr)	Total Run of River (ac ft/yr)
Carson	Irrigation	5239, 5240, 5241, 5242, 5243	335[1]	277
Childress	Irrigation	5223	38.5	19
Collingsworth	Irrigation	4184, 4198, 4207, 5235, 5236, 5237, 5256, 5257, 5258, 5259, 5260, 5261	1,194	851
Donley	Irrigation	4576, 5232, 5234	464	166
Gray	Irrigation	5246, 5251	130	55
Hall	Irrigation	5107	101	52
Randall	Irrigation	5181, 5189, 5190, 5191, 5192, 5194, 5195	1,072	217
Randall	Municipal	5022	2	0
Wheeler	Irrigation	4130, 4193, 4194, 5247, 5248, 5249, 5250, 5252, 5253, 5254, 5262, 5264	1,048	603

1. plus 110 Ac-ft/yr authorized recapture of produced groundwater

A summary of the run of river supplies by county is shown in Table B-21. A complete listing of the water rights in the PWPA follows.

Table B-21: Total Run of the River Water Supplies by County in the PWPA (ac-ft/yr)

County	Basin Name	Reliable Supply
Carson	Red	277
Childress	Red	19
Collingsworth	Red	851
Dallam	Canadian	0
Donley	Red	166
Gray	Canadian	1
Gray	Red	55
Hall	Red	52
Hansford	Canadian	22
Hartley	Canadian	0
Hemphill	Canadian	0
Hemphill	Red	0
Hutchinson	Canadian	98
Lipscomb	Canadian	66
Moore	Canadian	7
Ochiltree	Canadian	0
Oldham	Canadian	0
Potter	Canadian	0
Randall	Red	217
Roberts	Canadian	72
Sherman	Canadian	32
Wheeler	Red	603
Total		**2,538**

List of Water Rights in the PWPA

Water Right Permit Number	Water Right Owner Name	DB22 Source Name	DB22 Source County	Permitted Annual Diversion Volume (acre feet/year)	Permitted Storage Capacity (acre feet/year)
3792	JOHNSON, WILLIAM L	CANADIAN RUN-OF-RIVER	HANSFORD	40	
3802	JARVIS, JON MATHENY	CANADIAN RUN-OF-RIVER	HANSFORD	90	
3800	HOLT, COY MILES	CANADIAN RUN-OF-RIVER	HANSFORD	120	25
3804	ETLING, WILLIAM F D	CANADIAN RUN-OF-RIVER	HANSFORD	40	46
3968	HICKS, VERA BETH MCCLELLAN, ROY L MCCLELLAN, WILSON	CANADIAN RUN-OF-RIVER	HANSFORD	240	
3786	Catharine C. Whittenburg Testamentary Trusts	CANADIAN RUN-OF-RIVER	HUTCHINSON	250	145
3799	JARVIS, JON MATHENY	CANADIAN RUN-OF-RIVER	HUTCHINSON	106	26
3784	WRB Refining LP	CANADIAN RUN-OF-RIVER	HUTCHINSON	230	221
3785	WRB Refining LP	CANADIAN RUN-OF-RIVER	HUTCHINSON	60	21
3783	WRB Refining LP	CANADIAN RUN-OF-RIVER	HUTCHINSON	540	540
3805	The Gary and Susana Frederick Living Trust	CANADIAN RUN-OF-RIVER	LIPSCOMB	102	
3807	CAIN, LULA SCOTT CAIN, WENDELL W. O. Rankin Winnell Scott Rankin Dorothy Scott Wheeler Harry Wheeler	CANADIAN RUN-OF-RIVER	LIPSCOMB	20	
3780	Roy Clark & Sons, Inc.	CANADIAN RUN-OF-RIVER	MOORE	10	60
3793	Cactus Feeders, Inc.	CANADIAN RUN-OF-RIVER	MOORE	90	4
3796	Holnam Resources Inc.	CANADIAN RUN-OF-RIVER	MOORE	195	6
3798	The Albert Jones Family Trust	CANADIAN RUN-OF-RIVER	MOORE	50	50
3781	City of Dumas	CANADIAN RUN-OF-RIVER	MOORE		696
3797	Diamond Shamrock Refining Company, L.P.	CANADIAN RUN-OF-RIVER	MOORE		56
3787	Doyle S. Smith	CANADIAN RUN-OF-RIVER	ROBERTS	638	
3787	TAYLOR, AMY LUCILE	CANADIAN RUN-OF-RIVER	ROBERTS	2	
3794	Gossetts, Inc.	CANADIAN RUN-OF-RIVER	SHERMAN	150	60
3795	GOSSETT, E M JR	CANADIAN RUN-OF-RIVER	SHERMAN	125	165

Water Right Permit Number	Water Right Owner Name	DB22 Source Name	DB22 Source County	Permitted Annual Diversion Volume (acre feet/year)	Permitted Storage Capacity (acre feet/year)
5233	Greenbelt Municipal & Industrial Water Authority	GREENBELT LAKE/RESERVOIR	RESERVOIR	16,030	59,100
3782	Canadian River Municipal Water Authority Corporation	MEREDITH LAKE/RESERVOIR	RESERVOIR	151,200	1,407,572
3803	Palo Duro Water District	PALO DURO LAKE/RESERVOIR	RESERVOIR	10,460	60,900
5243	Biggs G Horn Estate HORN, TOM D	RED RUN-OF-RIVER	CARSON	217	
5240	SANCHEZ, ELAYNE KOTARA	RED RUN-OF-RIVER	CARSON	50	200
5240	POUNDS, CECILIA KOTARA	RED RUN-OF-RIVER	CARSON	50	
5242	BRADDOCK, KAROL KOTARA KOTARA, EVANGELINE	RED RUN-OF-RIVER	CARSON	9	
5241	HOERNER, MARGARET S	RED RUN-OF-RIVER	CARSON	34	
5239	RUSSELL, AUBREY L	RED RUN-OF-RIVER	CARSON	85	
5223	STARKEY, SHARON CAMPBELL	RED RUN-OF-RIVER	CHILDRESS	39	
5259	NUNNELLEY, DONALD L NUNNELLEY, ERNEST	RED RUN-OF-RIVER	COLLINGSWORTH	34	20
5236	Henard Brothers HENARD, JOE J	RED RUN-OF-RIVER	COLLINGSWORTH	87	84
5236	HENARD, LARRY	RED RUN-OF-RIVER	COLLINGSWORTH	87	
5258	Virginia Hill Family Revocable Trust	RED RUN-OF-RIVER	COLLINGSWORTH	140	
5257	Nora Petty Estate	RED RUN-OF-RIVER	COLLINGSWORTH	23	
5257	Betty Tellman	RED RUN-OF-RIVER	COLLINGSWORTH	47	
5235	HENARD, LARRY	RED RUN-OF-RIVER	COLLINGSWORTH	108	
5260	JANES, BILL JANES, JO ANN	RED RUN-OF-RIVER	COLLINGSWORTH	100	
5261	BROWN, EDITH BROWN, JIMMY W	RED RUN-OF-RIVER	COLLINGSWORTH	59	
5256	ELM CREEK RANCH, INC.	RED RUN-OF-RIVER	COLLINGSWORTH	50	
5237	ALLRED, LOUIS E SESSIONS, BOB L SESSIONS, JAMES E	RED RUN-OF-RIVER	COLLINGSWORTH	300	336

Water Right Permit Number	Water Right Owner Name	DB22 Source Name	DB22 Source County	Permitted Annual Diversion Volume (acre feet/year)	Permitted Storage Capacity (acre feet/year)
3859	HALEY, JAN ELAINE HEWLETT HEWLETT, JAMES EDWIN MCKENZIE, JO ANN BUMPAS	RED RUN-OF-RIVER	COLLINGSWORTH	60	
3901	DAVIS, GEORGE W DAVIS, HAZEL T	RED RUN-OF-RIVER	COLLINGSWORTH	25	2
3889	DAVIS, KEITH Adolphus Andrew Hicks	RED RUN-OF-RIVER	COLLINGSWORTH	75	
5232	BRITTEN, CHRISTOPHER L BRITTEN, DEBORAH E	RED RUN-OF-RIVER	DONLEY	200	
5234	Jack L. King Rebecca B. King	RED RUN-OF-RIVER	DONLEY	184	
4265	Rio Real Estate LTD	RED RUN-OF-RIVER	DONLEY	80	1
5251	GORDON, CAROL LYNN GORDON, FREDERICK W III	RED RUN-OF-RIVER	GRAY	60	
5246	TOC Ranch	RED RUN-OF-RIVER	GRAY	70	
5107	LANE, BILLY J LANE, OLGA J	RED RUN-OF-RIVER	HALL	101	
5181	HASSAN DANA Jill Dana	RED RUN-OF-RIVER	RANDALL	8	25
5195	SCHAEFFER, STANLEY D	RED RUN-OF-RIVER	RANDALL	400	900
5189	Peckerwood Farm, Inc.	RED RUN-OF-RIVER	RANDALL	164	120
5190	HALL, SALLY LOUISE	RED RUN-OF-RIVER	RANDALL	10	
5191	Blackburn Brothers, Inc. Wagner Enterprises, Inc.	RED RUN-OF-RIVER	RANDALL	164	
5192	Taylor Foster Inc	RED RUN-OF-RIVER	RANDALL	164	
5194	Lake Tanglewood, Inc.	RED RUN-OF-RIVER	RANDALL	53	
5194	CURRIE, JOHN J JR Lake Tanglewood, Inc.	RED RUN-OF-RIVER	RANDALL	38	4,897
5022	GOLDEN SPREAD COUNCIL, INC. #562 OF THE BOY SCOUTS OF AMERICA	RED RUN-OF-RIVER	RANDALL	2	
5250	Kimberly Wheeler	RED RUN-OF-RIVER	WHEELER	33	

Water Right Permit Number	Water Right Owner Name	DB22 Source Name	DB22 Source County	Permitted Annual Diversion Volume (acre feet/year)	Permitted Storage Capacity (acre feet/year)
5253	BURT, PENNY PURYEAR MALLOT, BILLIE JEANNE PURYEAR, THOMAS G PURYEAR, THOMAS G II ROYER, RAE MARIE	RED RUN-OF-RIVER	WHEELER	319	132
5264	DOBBS, EUGENE H DOBBS, SOPHIA E FINSTERWALD, MILTON B. K. Holmes HOLMES, CLARA F K	RED RUN-OF-RIVER	WHEELER	70	503
5254	ATHERTON, RUSSELL STEPHEN	RED RUN-OF-RIVER	WHEELER	125	
5262	Kade Legett Matthews Royalty Trust	RED RUN-OF-RIVER	WHEELER	29	
5248	BLAKEMORE, FORBUS E BLAKEMORE, JAMES A	RED RUN-OF-RIVER	WHEELER	30	
5249	C C Meek Estate	RED RUN-OF-RIVER	WHEELER	10	
5252	STANLEY, DUDLEY R	RED RUN-OF-RIVER	WHEELER	20	
5247	Minco Oil And Gas, LP	RED RUN-OF-RIVER	WHEELER	100	
3891	TIFFANY J. SIMS TYE D. SIMS	RED RUN-OF-RIVER	WHEELER	132	
3877	JANE ANN CASEY TRUST E JOHN WILLIAM YOUNG TRUST E MARK W YOUNG TRUST E	RED RUN-OF-RIVER	WHEELER	90	30
3885	JANE ANN CASEY TRUST E JOHN WILLIAM YOUNG TRUST E MARK W YOUNG TRUST E	RED RUN-OF-RIVER	WHEELER	90	

APPENDIX C

AGRICULTURAL WATER MANAGEMENT STRATEGIES

2021 Panhandle Regional Water Plan Task 5 Report:
Agricultural Water Management Strategies

Steve Amosson, Thomas Marek, Bridget Guerrero and Marikate Crouch[1]

Agriculture is the primary user of water in the Panhandle Water Planning Area (PWPA). Agriculture is projected to account for 92% of the total water use in the PWPA in 2020. Counties with irrigation needs in the region are projected to reach 145,733 acre-feet (ac-ft) per year in 2020 and more than double (310,682 ac-ft per year) by 2070. Given the limited renewability of aquifers in the area, there is no readily available water supply in or near the high demand irrigation counties that could be developed to fully meet these needs. Therefore, water management strategies for reducing irrigation demands for all 21 counties in the PWPA were examined. These strategies focus on Collingsworth, Dallam, Gray, Hall, Hartley, Moore and Sherman counties, which are the counties in the region projected as having irrigation water demands that cannot be met with existing supplies. Table 1 shows the projected irrigation needs for the PWPA. It is the intent of this analysis that the use of irrigation management strategies and local groundwater rules will prolong the life of irrigated agriculture within these counties and the PWPA.

Table 1: Irrigation Needs by County Identified in the PWPA, 2020-2070.

County	Projected Need (ac ft per year)					
	2020	2030	2040	2050	2060	2070
Collingsworth	-6,858	-10,125	-9,275	-9,588	-9,735	-9,064
Dallam	-29,586	-116,358	-107,956	-91,644	-74,251	-74,251
Gray	0	0	0	0	-2,687	-2,687
Hall	-15,695	-14,391	-11,474	-8,282	-5,283	-6,565
Hartley	-84,766	-192,765	-177,587	-159,542	-141,411	-141,411
Moore	-9,208	-47,976	-49,251	-43,861	-38,281	-38,281
Sherman	0	0	-29,567	-38,831	-38,207	-38,423

Methodology

The Panhandle Water Planning Group Agriculture Committee (PWPG-AC) reviewed the agricultural water conservation strategies used in the prior regional water plan, as well as discussed strategies used in other regions, and identified seven strategies that were appropriate for implementing within the region for the 2021 plan. These agricultural water conservation strategies include: irrigation scheduling; irrigation equipment changes; change in crop type; change in crop variety; conversion to dryland; soil management; and advances in plant breeding. Water savings and implementation cost were estimated for each proposed water management strategy evaluated in the planning effort and described in the forthcoming sections.

The year 2018 was selected as the baseline for evaluating strategies. Baseline adoption rates for strategies were estimated using secondary data sources. Producer surveys (2016-2019)

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conducted as a part of the North Plains Groundwater Conservation District (NPGCD) Master Irrigator project that encompassed more than 295,000 irrigated acres were invaluable in estimating baseline values for irrigation scheduling, irrigation systems and soil management strategies. Future adoption rates from 2020 to 2070 were identified under the guidance of the PWPG-AC, Table 2. The water savings and direct cost of all strategies were evaluated over a 50-year planning horizon.

Several of the strategies identified for evaluation were crop specific including changes in crop variety, changes in crop type, and advances in plant breeding. Therefore, it was imperative to identify the irrigated crop acreage distribution by county. In previous planning efforts, a five-year average of Farm Service Agency (FSA) irrigated acreage for the region was used to establish a baseline from which effectiveness of alternative conservation strategies were measured. The region has dramatically increased irrigated cotton acreage and a corresponding increase in cotton specific equipment and processing infrastructure within the last few years. Given these changing conditions, a three-year average (2016–2018) of the FSA irrigated acreage was calculated to establish the 2018 baseline acreage by county and by crop. The three-year average dampened distortions resulting from acreage shifts between crops caused by volatile crop prices. Baseline acreage estimates were adjusted to account for irrigated acreage by known producers who choose not to report to FSA. Irrigated acreage and water availability were assumed to remain constant in measuring the impact of the various water conservation strategies.

Implementation costs were defined as the costs that could be borne by producers and/or the government associated with implementing a strategy. The savings in pumping cost takes into account the variable cost savings from the reduced irrigation. The variable cost of irrigation is assumed to be \$8.35 per acre-inch (ac-in) (Texas A&M AgriLife Crop and Livestock Budgets, 2018). All costs were evaluated in 2018 dollars. A more detailed description of the method utilized for each strategy follows.

Table 2: Estimated Potential Water Savings and Future Adoption Percentage of Water Conservation Strategies, 2020-2070

Strategy	Annual Regional Water Savings (% of irrigation or ac inch/ac/yr.)	Assumed Baseline Use 2018	Goal for Adoption 2020	Goal for Adoption 2030	Goal for Adoption 2040	Goal for Adoption 2050	Goal for Adoption 2060	Goal for Adoption 2070
Irrigation Scheduling	10%	65%	70%	75%	80%	85%	90%	95%
Irrigation Equipment Changes	MESA or LESA to LEPA or SDI 1.51	25%	30%	35%	40%	45%	50%	55%
Change in Crop Type	10.0	0%	5%	10%	15%	20%	25%	30%
Change in Crop Variety	3.7 (corn) 6.2 (sorghum)	10%	12.5%	15%	17.5%	20%	22.5%	25%
Conversion to Dryland	15.8	0%	0%	1.5%	3%	5%	5%	5%
Soil Management	1.75	84%	86.5%	89.0%	91.5%	94.0%	95.0%	95.0%
Advances in Plant Breeding	Corn, cotton, and soybean 15% (2020-2030) 30% starting in 2040	0%	50%	75%	85%	95%	95%	95%
	Wheat and sorghum 12% starting in 2030	0%	0%	50%	75%	85%	95%	95%

Description of Agricultural Conservation Strategies Including Baseline Values, Projected Adoption Rates and Implementation Costs

In this plan, the PWPG-AC identified seven potential agricultural water conservation strategies to be evaluated. These strategies include irrigation scheduling, irrigation equipment changes, change in crop type, change in crop variety, conversion to dryland, soil management and advances in plant breeding for drought tolerance. Two alternative strategies to resolve long-term or short-term strategies are discussed. These alternative strategies are precipitation enhancement and drilling additional wells. Precipitation enhancement is considered a limited-use strategy since it cannot be implemented by an individual producer and little interest has been shown in implementing this strategy by groundwater districts in the region except for the Panhandle Groundwater Conservation District. Drilling additional wells, while not a conservation solution, can provide an option to relieve needs where water is available. A description of each of these strategies is presented in the following sections.

Irrigation Scheduling

Irrigation scheduling refers to the process of allocating irrigation water according to crop requirements based on meteorological demands and field conditions. Proper and accurate irrigation scheduling is critical to ensure profitable agricultural production and conservation of water resources. Soil water measurement-based methods, plant stress sensing-based methods, and weather-based methods are the common irrigation-scheduling tools. The prevalent soil-based irrigation scheduling method utilized in the region today employs soil moisture probes that estimate soil moisture at different depths to schedule irrigation. Irrigation scheduling based on crop evapotranspiration reported by ET networks in the region is also an important weather-based irrigation-scheduling method since this data references the climatic demand, which varies annually and can vary substantially within the season. Plant stress-based irrigation-scheduling techniques using thermal sensors are also a developing irrigation-scheduling strategy but are not yet widespread in use. The soil moisture probe and thermal sensor methods can allow for automation of irrigation scheduling by wireless connection of the sensors to the respective irrigation systems. Proper and accurate irrigation scheduling can save up to 2 to 3 ac-in of irrigation per year for corn. In this analysis, the water savings from this strategy was assumed to be 10% of the water applied for each crop seasonally.

The percentage of baseline irrigated acreage utilizing some form or degree of irrigation scheduling was set at 65% for the 2018 baseline given the results of the NPGCD Master Irrigator surveys. The PWPG-AC expects this rate to continue to increase 5% per decade, reaching an adoption level of 95% in 2070.

The cost of irrigation scheduling varies significantly depending on the level of service, equipment costs, and the area served. More money tends to be invested in irrigation scheduling of higher value crops. A range of $6.50 to $12 per acre for irrigation scheduling was identified based on discussions with industry representatives, depending on the level of service. An average cost of $9.25 per acre annually was assumed for irrigation scheduling.

Irrigation Equipment Changes

Current irrigation methods practiced in the Texas Panhandle include center pivot irrigation (MESA: Mid Elevation Spray Application, LESA: Low Elevation Spray Application, and LEPA: Low Elevation Precision Application) and subsurface drip irrigation (SDI). The average application efficiency of MESA, LESA, LEPA and SDI is 78, 88, 95 and 97%, respectively (Amosson et al., 2011). These application efficiencies are the percentage of irrigation water applied that is used by the crop with the remainder being lost to runoff, evaporation or deep percolation. Switching from low-efficiency irrigation systems such as MESA to more efficient irrigation systems such as LEPA and SDI improves the efficiency of irrigation system water use and can help conserve groundwater resources. Switching irrigation systems can be a costly strategy to conserve irrigation water, but that expense can be partially offset by the decrease in pumping cost. The water conservation strategy of changing irrigation equipment includes converting MESA and LESA to LEPA or SDI to improve application efficiency. Establishing MESA, LESA, LEPA or SDI systems requires a major investment, while changing MESA and LESA to LEPA using conversion kits are comparatively less expensive. The regional water savings estimate in 2020 from this strategy is 1.51 ac-in water savings per acre for conversion MESA/LESA to LEPA. It should be noted that water savings from this strategy vary by county and over time as the amount of water pumped changes.

Results of the NPGCD Master Irrigator surveys indicate that 25% of the irrigation systems currently are either LEPA or SDI and 75% are either LESA or MESA. The PWPG-AG anticipates with appropriate incentives the conversion of LESA or MESA center pivots to more efficient systems could increase incrementally 5% per decade reaching 55% by 2070. Conversion of furrow irrigation systems to LEPA or SDI was also a water conservation strategy utilized in previous water plans; however, survey results indicate that less than a half a percent of the irrigated cropland is furrow irrigated therefore it was dropped as a potential strategy in the 2021 plan.

Since 96% of the high-efficiency irrigation systems are LEPA, the cost for implementing this strategy was assumed to be the cost of converting MESA or LESA systems to LEPA. The implementation cost of this strategy is estimated using the costs associated with the change in irrigation equipment required for each of the systems and their respective adoption rate. Currently, the most popular spacing of drops is 30 inches for conversions. The cost of replacing an existing 125-acre system with 60-inch spacing was estimated at $18,900 or $151.20 per acre (Personal communication. T-L Irrigation). This included replumbing, new hoses, heads, weights and labor. The cost of converting an existing 125-acre system that had 30-inch spacing was estimated to be $44 per acre, which included replacing heads, adding weights and installation labor (Personal communication, Senninger Irrigation). It was assumed that 80% of the conversions would require total replacement, resulting in an average cost of conversion of $129.76 per acre.

Change in Crop Type

Incorporation of crops with lower water requirements can be an effective water conservation strategy. Corn, cotton, wheat and grain sorghum are the four major crops in the Panhandle region accounting for about 90% of the total irrigated acreage. Corn has one of the highest water requirements of any irrigated crop grown in the Texas High Plains because of a longer growing season than most other spring crops, which can adversely affect yield in limited-moisture situations (Howell et al., 1996). The seasonal evaporative demand for corn is 28 to 32 inches, wheat is 26 to 28 inches, cotton is 13 to 27 inches, and grain sorghum is 13 to 24 inches. To date, the majority of water used for irrigation has been applied to high water-use crops such as corn. On the other hand, cotton, wheat and grain sorghum can tolerate lower moisture availability and are more suited to deficit irrigation practices.

Change in crop type was also a conservation strategy used in the 2016 plan where corn acreage was replaced by either irrigated cotton, sorghum or wheat to conserve water. In the 2021 plan, this strategy has been modified to just consider potentially moving irrigated corn to irrigated cotton due to changing conditions within the region. Irrigated cotton acreage has increased more than 180,000 acres in the region since the last water plan largely at the expense of irrigated wheat and to a lesser extent irrigated sorghum acreage, suggesting that cotton is the preferred low water-use crop. This is also supported by the construction of the world’s largest cotton gin in the region.

A survey of 25 producers and crop consultants was conducted to determine/validate actual water use per acre of corn and cotton during the 2016 to 2018 time period. The survey indicated the application of 20.6 ac-in to corn and 9.9 ac-in to cotton per acre. A conservative average of 10 ac-in was utilized to estimate water savings for this strategy with implementation of cotton production reaching 30% by 2070.

The cost of implementing this water conservation strategy was evaluated in terms of reduced land values as a result of reduced water availability. The cost was estimated as the difference between the average land for irrigated cropland with good water availability that would be necessary for corn production at $3,400 per acre and that of irrigated cropland with average water availability, which meets the needs of cotton at $2,300 per acre (ASFMRA, 2018). Therefore, $1,100 per acre was assumed to be a one-time cost for implementation of this strategy.

Change in Crop Variety

Short-season varieties can have a lower evaporative demand when compared to long-season varieties. Short-season varieties of corn and grain sorghum are generally viewed to use less water than the conventional longer-season varieties due to their shorter maturity. Water savings may be enhanced by planting a short-season hybrid outside the normal production window, which can also help avoid high evaporative demand periods such as during the pollination period. Thus, converting from long-season to short-season varieties of corn and grain sorghum can be a useful water conservation strategy. However, typically short-season varieties result in lower yields that can decrease overall profitability.

In this planning cycle, a panel of industry and university experts was utilized to update this strategy given the rapidly changing seed industry. The panel delineated both corn and sorghum into three maturity classes; full, medium and short season, estimating yields and water use for each class, as well as the current percentage of each class being planted. Analysis of the estimates provided by the panel indicated that moving to short-season corn from full/mid-season varieties could save 3.7 ac-in per acre but would result in an estimated 18% yield loss. Changing to a short-season sorghum variety from full/mid-season varieties was estimated to save 6.2 ac-in but would result in a 32% yield reduction. It was estimated that 10% of both corn and sorghum acreage is currently planted to short-season varieties, which is expected to reach an adoption level of 25% by 2070.

The implementation cost was assumed to be the compensation needed to account for the loss in yield. A partial budget analysis was conducted using the 2018 Texas A&M AgriLife Crop and Livestock Budgets for the region. The loss in revenue from the reduced yield using a five-year average price for the area versus the savings in seed cost, pumping cost, fertilizer and harvest expense were evaluated. Results of the partial budgets indicate a net loss to producers of $40.05 per acre for corn and $44.76 per acre for sorghum for transition to short-season varieties. However, taking into consideration the different levels of water savings per acre, the cost per acre-foot saved is $131.06 and $86.32 for corn and sorghum, respectively.

Conversion to Dryland

Converting from an irrigated to dryland cropping system may be a viable economic alternative for some producers on marginally irrigated lands or as a regional strategy to conserve water reserves. The primary dryland crops grown in the area are winter wheat, grain sorghum and cotton. Conversion programs that provide incentives, identifying crops that perform well under rainfed conditions, and developing higher yielding heat- and drought-tolerant varieties will be critical for implementing this strategy. The water savings for this strategy was estimated to be 15.8 ac-in per acre, which is the average water use by irrigated crops in the region.

Since the conversion of irrigated acreage to dryland production is measured from the baseline acreage (2016-2018 average), the 2018 baseline adoption rate was assumed to be 0%. Conversion of irrigated land to dryland was viewed by the PWPG-AC as a limited-use strategy given the economic base and grain deficit nature of the region. It was assumed a maximum of 5% total of the regional acreage would be converted by the end of the time horizon.

The cost of implementing this water conservation strategy was evaluated in terms of reduced land values and was estimated as the difference between the average land value across all water availability categories for irrigated cropland at $2,450 per acre and that of dryland at $925 per acre (ASFMRA, 2018). The range in prices of irrigated cropland per acre is reported for three classes of water availability: good $2,800-$4,000; average $1,800-$2,800; and $900-$1,700. With fair water availability in the region ranging from $900 to $4,000 per acre. The simple average ($2,450) of the range ($900 - $4,000) was used as the average land value for irrigated cropland in the region. The average land value of dryland crop production ranged from $350 to $650 per acre in the western parts of the region and from $750 to $1,500 in the eastern parts of the region, resulting in an overall average of $925 per acre. Therefore, the implementation cost to retire an acre of irrigated land was $1,525 ($2,450-$925) assuming the land would be suitable for dryland production. It should be noted, the amount of compensation required for this strategy would need to vary considerably depending on the water availability on a specific piece of land and the value of the dryland acreage in that part of the region. Also, implementing this strategy would be detrimental to the regional economy because of the reduced production and decrease in inputs used.

Soil Management

Effective soil management can increase the efficiency of both irrigation and rainfall events by increasing soil infiltration, reducing runoff, reducing evaporative loss, and conserving available moisture within the soil profile. Thus, these practices promote efficient use of the available soil profile water and enhance crop production and sustainability of the region's natural resources. Conservation tillage practices, furrow diking, and introduction of fallow and low water-use crops in the crop rotation are the most important land management practices that can lead to water conservation within the region.

Conservation tillage is defined as tillage practices that minimize soil and water loss by maintaining a surface residue cover of more than 30% on the soil surface (CTIC, 2014). Conservation tillage can reduce evaporation, increase rainfall infiltration, enhance soil profile water storage, soil moisture conservation, and water-use efficiency. Conservation tillage systems are also reported to have economic advantages as it reduces machinery, fuel and labor costs. Conservation tillage is a term covering a wide range of tillage practices with the common characteristic of reduced soil and water loss. Different tillage practices such as minimum tillage, reduced tillage, no-till; ridge tillage, vertical tillage and strip tillage are often interchangeably used with the term conservation tillage. In this analysis, the water savings from adopting effective soil management strategies is assumed to be 1.75 ac-in per acre.

Results of the NPGCD Master Irrigator surveys indicate conservation tillage in some form (minimum till, strip till or no-till) is practiced on 84% of the irrigated land in the region. Even given the relatively high level of adoption, members of the PWPG-AG expect conservation tillage can increase in the future albeit at a slow rate. Initially, they project a decadal increase of 2.5% slowing in later years of the planning horizon until 95% of all irrigated acreage practices some sort of conservation tillage.

The implementation cost of soil management strategy was estimated as the difference between the cost of conventional tillage and conservation tillage. In the Region A 2016 planning effort, a detailed partial budget analyzing the cost of conventional versus conservation tillage practices was conducted resulting in an estimated cost savings of $2.59/acre in favor of conservation tillage. However, a cost study performed on North Central Farm Management Association records (1996–2004) indicates a cost savings of $2.05 per acre for conventional/reduced till compared to no-till operations. The difference between these two studies is negligible and probably due to variances in input prices. In this analysis the annualized cost difference between conventional and conservation tillage is assumed to be zero. A study by Epplin et al. appears to validate this assumption. Their analysis of Oklahoma wheat farms indicates a slight cost advantage to conventional tillage in small wheat farms (less than 700 acres) while there was a small cost advantage to no-till operations in large farms. While there is little to no difference in the annualized cost, it should be noted that the necessary chemical control costs and change in equipment such as the additional purchase of a strip tiller or no-till planter can impede the adoption process.

Advances in Plant Breeding

Biotechnology utilized in plant breeding increased crop productivity and enhances efficiency of production inputs such as irrigation. Previously, plant breeding efforts were mainly concentrated on hybridization and selection to produce improved planting materials like composite seeds and F1 hybrid seeds. The success stories in this era were hybrid corn and semi-dwarf varieties of wheat and rice that triggered the green revolution. The advances made in genetic engineering led to the plant biotechnology era, which began in the 1980s when transgenic plants were produced. Transgenic planting materials for several crops are commercially available now. The commercial varieties for several crops with genetically modified organisms (GMOs) are also widely in use. From a water conservation standpoint, varieties with higher water-use efficiency and enhanced drought tolerance can lead to substantial water savings. Thus, the adoption of drought tolerant varieties with high water-use efficiency can be a potential water conservation strategy. The first wave of drought-tolerant varieties for corn, cotton and soybeans are expected to be released by 2020 and reduce water by 15% followed by a second wave by 2040 that will reduce water use an additional 15% compared to current varieties. It is also assumed that drought-tolerant varieties of wheat and grain sorghum will be available by 2030 and will reduce the water use by 12%. A focus group of industry and university experts recently reviewed this strategy and validated that all assumptions are still appropriate for inclusion in the 2021 regional water plan.

The new drought tolerant varieties have yet to hit the market; therefore, the 2018 baseline adoption rate was assumed to be 0%. The adoption rate was projected to be 50% in the first decade of market deployment (2020 for corn, soybeans and cotton; 2030 for wheat and sorghum) and escalate to 95% by the end of the planning horizon, assuming new varieties are cost effective.

The implementation cost of this strategy was the additional cost of drought-tolerant seed estimated at $1 for every 1% reduction in water use. Therefore, it was assumed a 15% reduction in water use will cost $15 per acre and a 30% reduction will cost $30 per acre. Cost estimates were made after consultation with seed industry personnel and researchers working in the area. These costs were then multiplied with the annual total acreage for corn, cotton and soybeans, affected by incorporation of this strategy. It is also assumed that drought-tolerant varieties of wheat and grain sorghum will cost $12/acre for a 12% reduction in water use.

Combination Strategies

In addition, the PWPG-AC identified three combinations of the previously mentioned strategies that may be employed specifically in irrigation-deficit counties. The combinations of strategies were: 1) change in crop type, irrigation scheduling and irrigation equipment changes; 2) changes in crop variety, irrigation scheduling and irrigation equipment changes; and 3) change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes. When implementing multiple strategies, the impact on potential water savings are not additive in most instances. The cumulative water savings from use of multiple strategies was estimated using a stepwise procedure; by first revising water use after implementing one strategy and then using the revised water use as the base before introducing the second strategy and repeating the process for the third and fourth strategy (where applicable). The implementation costs for the strategy combinations were additive in nature.

Regional Results and Analysis

Cumulative water savings and implementation cost for each of the water conservation strategies and combinations of strategies are presented in Table 3. A detailed analysis of estimated water savings and total implementation costs by conservation strategy for each county for selected years is in Appendices A and B. Nearly 85 million ac-ft of water is projected to be utilized for irrigation within the region over the 50-year planning horizon without adoption of any new conservation strategies or increases in the implementation of current strategies. Since final implementation rates of conservation strategies do not occur until 2070, the water savings and total implementation cost of all strategies were evaluated over a 50-year planning horizon. Total implementation costs include both the capital and operational costs associated with each strategy. Capital costs include the cost of additional equipment required and operational costs include variable production costs as well as the opportunity cost of land, where applicable. The method for calculating water savings and implementation costs of each strategy and all combination strategies is given in previous sections. Each of the conservation strategies is discussed in order of projected magnitude of water savings followed by the combinations of strategies that were considered.

Table 3: Estimated Water Savings and Costs Associated with Proposed Water Conservation Strategies in Region A (2020-2070).

Water Management Strategy	Cumulative Water Savings (WS)	Capital Cost	Operational Cost	Total Implementation Cost (IC)	IC/WS
	ac-ft	($1000)	($1000)	($1000)	$/ac-ft
Irrigation Scheduling	1,439,303	-	$101,159	$101,159	$70.28
Irrigation Equipment Changes	1,376,201	$47,302	-	$47,302	$34.37
Change in Crop Type	3,550,271	-	$156,212	$156,212	$44.00
Change in Crop Variety	797,448	-	$97,965	$97,965	$122.85
Conversion to Dryland	2,782,652	-	$111,183	$111,183	$39.96
Soil Management	765,524	-	-	-	-
Advances in Plant Breeding	14,363,673	-	$1,048,090	$1,048,090	$72.97
Change in Crop Type, Irrigation Equipment Changes and Irrigation Scheduling	6,275,456	$47,302	$257,370	$304,673	$48.55
Change in Crop Variety, Irrigation Equipment Changes and Irrigation Scheduling	3,573,101	$47,302	$199,123	$246,425	$68.97
Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding and Irrigation Scheduling	20,380,949	$47,302	$1,305,461	$1,352,763	$66.37

Anticipated advances in plant breeding (drought-tolerant varieties) in corn, cotton, sorghum, soybeans and wheat were estimated to generate by far the most substantial amount of water savings as an individual strategy, 14.4 million ac-ft over the 50-year planning horizon. Implementing this strategy was expected to cost $1 billion resulting in an average cost of $72.97 per ac-ft of water saved.

Changing the crop type, from irrigated corn to irrigated cotton, yielded the second highest savings at 3.6 million ac-ft. The change results in an estimated implementation cost of $156.2 million, or $44 per ac-ft of water saved, ranking third among the cost of the seven strategies.

Converting irrigated land to dryland production, the third largest savings from an individual strategy standpoint yielding water savings of 2.8 million ac-ft. The estimated change in land values resulted in an implementation cost of $111.1 million and a resultant cost of $39.96 per ac-ft ranked second among strategies in acre feet of water saved. It should be noted that this strategy is extremely detrimental to the regional economy because of the reduction in yield output and associated expenditures resulting in the Ag subcommittee of PWPG assigning it a low adoption rate.

Proper irrigation scheduling is estimated to save 1.4 million ac-ft over the 50-year planning horizon. Implementation cost are projected to total $101.2 million, averaging $70.28 per ac-ft of water saved.

Additional conversion of less efficient irrigation delivery systems in the region, such as MESA and LESA to more efficient systems of LEPA or SDI resulted in a savings of 1.3 million ac-ft. Investment in these more efficient systems results in an implementation cost of $47.3 million which translates into a cost of $34.37 per ac-ft of water saved.

The change to shorter season corn and sorghum varieties yielded the sixth largest water savings of 797,000 ac-ft. The implementation cost for this strategy was $97.9 million, resulting in the highest cost per ac-ft of water saved at $122.86. The results of this strategy are very dependent on the yield reductions of short-season varieties and crop prices. Lower prices and yield reductions increase the feasibility of this strategy. At this time, the lack of economic feasibility has limited the adoption of this strategy.

The soil management conservation strategy encompasses the adoption of conservation tillage. Increasing the level of soil management yielded the lowest water savings of 765,000 ac-ft which can be traced to the high level of adoption that has already occurred in the region (84%). The implementation cost of increased soil management was assessed by evaluating the cost differential between conventional and reduced till. The change in the relative cost of fuel and chemicals and conservation tillage methods was similar to conventional tillage; therefore, no annualized costs were assumed for the adoption of conservation tillage practices. While there is little to no difference in the annualized cost, it should be noted that the initial cost of converting to conservation tillage such as the additional purchase of a strip tiller or no-till planter could impede the adoption process.

The Ag subcommittee of PWPG identified three combinations of strategies to be used in water-deficit irrigated counties. These strategies were also evaluated for the region. The combination of change in crop type, irrigation scheduling and irrigation equipment changes resulted in an estimated water savings of 6.2 million ac-ft; the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes was projected to save 3.5 million ac-ft of water; and the combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes had estimated water savings of 20.3 million ac-ft. The interaction between some strategies results in lower water savings from implementing multiple strategies. The combination of change in crop type, irrigation scheduling and irrigation equipment changes implementation costs totaled $304.6 million, with the lowest average amongst the combinations of $48.55 per ac-ft of water saved. Implementing changes in crop variety, irrigation scheduling and irrigation equipment changes would cost $246.4 million or $68.97 per acre foot. Change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes has the largest estimated total implementation cost at $1.3 billion, however the average is only $66.37 per acre foot of water saved.

Irrigation Deficit County Analysis

One-third of the counties in Region A are projected to have irrigation deficits over the 50-year planning horizon. These seven counties include: Collingsworth, Dallam, Gray, Hall, Hartley, Moore and Sherman. Since the effectiveness of conservation strategies can be affected by the crop composition as well as other factors within the county, each of the projected deficit counties is evaluated in the following sections. The water savings by conservation strategy is estimated for selected years in the planning horizon as well as the projected irrigation demand and irrigation deficits. Estimates of water savings by conservation strategies were calculated based on baseline values for water use by crop and irrigated acreage in determining their effectiveness. The three combinations of strategies identified by the Ag subcommittee of PWPG were evaluated. However, it is important to understand that the implementation of certain strategies can diminish the effectiveness of others if they are also implemented.

Collingsworth County:
Irrigation Needs and Water Savings from Conservation Strategies

It is projected that Collingsworth County will have an irrigation need of 6,858 ac-ft in 2020 (Table 4). This annual shortfall will increase to 10,125 ac-ft in 2030 before falling to 9,064 ac-ft by 2070. Advances in plant breeding was the most effective individual water-saving strategy evaluated when fully implemented in Collingsworth County, reducing annual use by 8,169 ac-ft. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (1,424 ac-ft), irrigation scheduling (629 ac-ft), irrigation equipment changes (2,580 ac-ft), conversion to dryland (7 ac-ft), change in crop variety (1,480 ac-ft) and soil management (21 ac-ft). Therefore, implementing any individual strategy will not generate sufficient water savings to compensate for projected needs.

Implementing the combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was the only strategy estimated to be effective in covering needs. It covered the projected need by 2050 and generated a marginal surplus of 1,741 ac-ft (10,805-9,064) in 2070. The combination of change in crop type, irrigation scheduling and irrigation equipment changes, and the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were less effective and unable to generate enough water savings to offset needs in the time periods.

Table 4: Collingsworth County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	47,471	42,542	39,713	38,215	33,451	33,451
	Projected Need	-6,858	-10,125	-9,275	-9,588	-9,735	-9,064
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	237	475	712	949	1,187	1,424
	Irrigation Equipment Changes	247	493	740	987	1,233	1,480
	Change in Crop Type	4	7	11	14	18	21
	Change in Crop Variety	1	2	4	5	6	7
	Conversion to Dryland	0	774	1,548	2,580	2,580	2,580
	Soil Management	143	286	429	572	629	629
	Advances in Plant Breeding	2,135	3,232	7,303	8,163	8,169	8,169
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	486	970	1,451	1,930	2,407	2,880
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	484	965	1,444	1,921	2,395	2,867
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	2,610	4,170	8,645	9,930	10,372	10,805

Dallam County:
Irrigation Needs and Water Savings from Conservation Strategies

Dallam County is projected to have an irrigation need of 29,586 ac-ft in 2020 (Table 5). This annual shortfall peaks in 2040 at 107,956 ac-ft before falling to 74,251 ac-ft by 2070. Advances in plant breeding was the most effective individual water-saving strategy evaluated when fully implemented in reducing annual use by 68,594 ac-ft. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (10,315 ac-ft), irrigation scheduling (3,998 ac-ft), irrigation equipment changes (16,399 ac-ft), conversion to dryland (5,684 ac-ft), change in crop variety (9,408 ac-ft) and soil management (27,777 ac-ft).

The combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was estimated to be the only effective strategy in meeting the projected need by 2050 and generating a surplus of 38,669 ac-ft (112,920-74,251) in 2070. The combination of change in crop type, irrigation scheduling and irrigation equipment changes and, the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were less effective and unable to generate enough water savings to offset needs in the time periods.

Table 5: Dallam County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	343,830	343,830	286,928	228,243	174,217	174,217
	Projected Need	-29,586	-116,358	-107,956	-91,644	-74,251	-74,251
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	1,719	3,438	5,157	6,877	8,596	10,315
	Irrigation Equipment Changes	1,568	3,136	4,704	6,272	7,840	9,408
	Change in Crop Type	4,629	9,259	13,888	18,518	23,147	27,777
	Change in Crop Variety	947	1,895	2,842	3,789	4,737	5,684
	Conversion to Dryland	0	4,920	9,839	16,399	16,399	16,399
	Soil Management	909	1,817	2,726	3,634	3,998	3,998
	Advances in Plant Breeding	16,526	27,839	60,763	67,984	68,594	68,594
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	7,886	15,709	23,471	31,170	38,808	46,384
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	4,222	8,419	12,590	16,737	20,858	24,954
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	24,329	43,270	83,323	97,795	105,687	112,920

Gray County:
Irrigation Needs and Water Savings from Conservation Strategies

It is projected that Gray County will have a marginal surplus of water available for irrigation from 2020 to 2050 (Table 6). However, an annual shortfall is projected of 2,687 ac-ft for 2060 and 2070. Advances in plant breeding was the most effective individual water-saving strategy evaluated and able to meet the projected shortfalls when fully implemented in Gray County, reducing annual use by 5,857 ac-ft. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (2,284 ac-ft), conversion to dryland (2,003 ac-ft), irrigation equipment changes (1,149 ac-ft), irrigation scheduling (969 ac-ft), change in crop variety (499 ac-ft) and soil management (488 ac-ft).

The combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was estimated to be the most effective, generating an estimated annual water savings relative to the baseline of 9,981 ac-ft in 2070. The strategy of crop type, irrigation scheduling and irrigation equipment changes also met the projected need, resulting in a surplus of 1,612 ac-ft (4,299-2,687) in 2070. The combination of change in the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were less effective but implementing any of the three combination strategies generated enough water savings to offset needs in the time periods.

Table 6: Gray County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	32,289	32,289	32,289	32,289	32,289	32,289
	Projected Need	221	221	221	221	-2,687	-2,687
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	161	323	484	646	807	969
	Irrigation Equipment Changes	192	383	575	766	958	1,149
	Change in Crop Type	381	761	1,142	1,523	1,903	2,284
	Change in Crop Variety	83	166	249	333	416	499
	Conversion to Dryland	0	601	1,202	2,003	2,003	2,003
	Soil Management	111	222	333	444	488	488
	Advances in Plant Breeding	1,498	2,334	5,224	5,840	5,857	5,857
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	731	1,456	2,175	2,889	3,597	4,299
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	435	867	1,296	1,723	2,146	2,567
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	2,222	3,766	7,320	8,612	9,308	9,981

Hall County:
Irrigation Needs and Water Savings from Conservation Strategies

The irrigation need in Hall County is projected to be 15,695 ac-ft in 2020 (Table 7). This annual shortfall will decrease to 6,565 ac-ft by 2070. Advances in plant breeding was the most effective individual water-saving strategy evaluated when fully implemented in Hall County, reducing annual use by 6,104 ac-ft, which would exceed projected needs in 2060 and almost meet the need in 2070. None of the remaining individual strategies meet any of the projected needs for any of the selected years. The effectiveness of the remaining strategies once fully implemented ranked as follows: conversion to dryland (1,656 ac-ft), irrigation scheduling (954 ac-ft), irrigation equipment changes (950 ac-ft), soil management (404 ac-ft), change in crop variety (11 ac-ft) and change in crop type (0 ac-ft),

The combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was estimated to be the most effective meeting the projected need by 2060 and generating a surplus of 1,231 ac-ft (7,796-6,565) in 2070. The combination of change in crop type, irrigation scheduling and irrigation equipment changes and, the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were basically ineffective in generating water savings, due to the existing crop composition within Hall County (i.e., very little feed grain production), which made the strategies of changing crop type and changing crop variety irrelevant.

Table 7: Hall County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	31,792	31,792	31,792	31,792	31,792	31,792
	Projected Need	-15,695	-14,391	-11,474	-8,282	-5,283	-6,565
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	159	318	477	636	795	954
	Irrigation Equipment Changes	158	317	475	633	792	950
	Change in Crop Type	0	0	0	0	0	0
	Change in Crop Variety	2	4	5	7	9	11
	Conversion to Dryland	0	497	993	1,656	1,656	1,656
	Soil Management	92	183	275	367	404	404
	Advances in Plant Breeding	1,589	2,418	5,455	6,097	6,104	6,104
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	316	631	945	1,256	1,567	1,875
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	318	635	950	1,263	1,575	1,886
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	1,898	3,025	6,317	7,232	7,518	7,796

Hartley County:
Irrigation Needs and Water Savings from Conservation Strategies

It is projected that Hartley County will have an irrigation need of 84,766 ac-ft in 2020 (Table 8). Th annual shortage will increase to 192,765 ac-ft in 2030 before falling to 141,411 ac-ft by 2070. Advances in plant breeding was the most effective water-saving strategy evaluated when fully implemented in Hartley County, reducing annual use by 74,413 ac-ft. It was projected that this strategy by itself would not meet the projected need during the modeling time horizon; thus, implementing a combination of strategies will be required to meet irrigation needs. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (12,210 ac-ft), irrigation scheduling (4,460 ac-ft), irrigation equipment changes (18,294 ac-ft), conversion to dryland (7,023 ac-ft), change in crop variety (10,495 ac-ft) and soil management (32,433 ac-ft).

The combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes produced the most savings however was unable to generate enough water savings to offset needs in the time periods. The combination of change in crop type, irrigation scheduling and irrigation equipment changes and, the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were less effective and unable to generate sufficient water savings.

Table 8: Hartley County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	406,990	406,990	345,197	283,865	226,681	226,681
	Projected Need	-84,766	-192,765	-177,587	-159,542	-141,411	-141,411
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	2,035	4,070	6,105	8,140	10,175	12,210
	Irrigation Equipment Changes	1,749	3,498	5,248	6,997	8,746	10,495
	Change in Crop Type	5,406	10,811	16,217	21,622	27,028	32,433
	Change in Crop Variety	1,170	2,341	3,511	4,682	5,852	7,023
	Conversion to Dryland	0	5,488	10,976	18,294	18,294	18,294
	Soil Management	1,014	2,027	3,041	4,054	4,460	4,460
	Advances in Plant Breeding	18,097	30,116	65,986	73,819	74,413	74,413
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	9,154	18,236	27,247	36,186	45,054	53,850
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	4,940	9,851	14,732	19,585	24,408	29,202
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	27,160	48,052	92,243	108,529	117,607	126,031

Moore County:
Irrigation Needs and Water Savings from Conservation Strategies

It is projected that Moore County will have an irrigation need of 9,208 ac-ft in 2020 (Table 9). This annual shortfall will increase to 49,251 ac-ft by 2040 before falling to 38,281 ac-ft by 2070. As a standalone strategy, implementing advances in plant breeding was sufficient to meet projected deficits in all time periods, except 2030 and 2040, with estimated annual savings of 49,935 ac-ft by 2070. The effectiveness of the remaining strategies once fully implemented ranked as follows: soil management (15,995 ac-ft), irrigation equipment changes (9,484 ac-ft), change in crop type (6,017 ac-ft), change in crop variety (5,441 ac-ft), conversion to dryland (4,408 ac-ft), and irrigation scheduling (2,312 ac-ft).

Implementing any of the three combinations of strategies was enough to meet projected needs. The combination of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was estimated to be the most effective, generating a surplus of 36,965 ac-ft (75,246-38,281) in 2070. While less effective, the combination of change in crop type, irrigation scheduling and irrigation equipment changes and the strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes were less effective and unable to generate sufficient water savings to offset needs in the time periods.

Table 9: Moore County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	200,550	200,550	171,892	136,086	102,919	102,919
	Projected Need	-9,208	-47,976	-49,251	-43,861	-38,281	-38,281
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	1,003	2,006	3,008	4,011	5,014	6,017
	Irrigation Equipment Changes	907	1,814	2,720	3,627	4,534	5,441
	Change in Crop Type	2,666	5,332	7,997	10,663	13,329	15,995
	Change in Crop Variety	735	1,469	2,204	2,939	3,674	4,408
	Conversion to Dryland	0	2,845	5,690	9,484	9,484	9,484
	Soil Management	525	1,051	1,576	2,102	2,312	2,312
	Advances in Plant Breeding	12,133	20,215	44,275	49,532	49,935	49,935
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	4,558	9,079	13,565	18,016	22,430	26,809
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	2,636	5,256	7,859	10,446	13,016	15,570
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	16,630	29,092	57,177	66,557	71,116	75,246

Sherman County:
Irrigation Needs and Water Savings from Conservation Strategies

Sherman County is projected to have a marginal surplus of water available for irrigation for 2020 and 2030 (Table 10) before deficits start occurring by 2040. Advances in plant breeding was the most effective water saving strategy evaluated when fully implemented in Hartley County, reducing annual use by 74,871 ac-ft and generating a surplus of 36,448 ac-ft. The effectiveness of the remaining individual strategies by 2070 ranked as follows: change in crop type (9,131 ac-ft), irrigation scheduling (3,657 ac-ft), irrigation equipment changes (15,000 ac-ft), conversion to dryland (6,707 ac-ft), change in crop variety (8,605 ac-ft) and soil management (28,857 ac-ft). Precipitation enhancement was not considered a viable option for the county.

The strategy that includes change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes was estimated to be the most effective, generating an estimated annual water savings relative to the baseline of 118,095 ac-ft in 2070. In addition, implementing the combination of change in crop type, irrigation scheduling and irrigation equipment changes, while less effective, generated enough water savings to cover irrigation shortfalls in most years. The strategy of implementing changes in crop variety, irrigation scheduling and irrigation equipment changes also resulted in savings, but it wasn't enough to offset projected irrigation needs.

Table 10: Sherman County Projected Annual Irrigation Need and Water Savings by Strategy (ac-ft/year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	304,360	304,360	304,360	246,760	182,536	182,536
	Projected Need	159	159	-29,567	-38,831	-38,207	-38,423
	Projected Water Savings						
Water Saving Strategies	Irrigation Scheduling	1,522	3,044	4,565	6,087	7,609	9,131
	Irrigation Equipment Changes	1,434	2,868	4,303	5,737	7,171	8,605
	Change in Crop Type	4,810	9,619	14,429	19,238	24,048	28,857
	Change in Crop Variety	1,118	2,236	3,354	4,472	5,590	6,707
	Conversion to Dryland	0	4,500	9,000	15,000	15,000	15,000
	Soil Management	831	1,662	2,493	3,324	3,657	3,657
	Advances in Plant Breeding	18,252	30,280	66,410	74,291	74,871	74,871
	Change in Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling	7,734	15,406	23,016	30,563	38,047	45,469
	Change in Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling	4,061	8,097	12,107	16,092	20,051	23,984
	Change in Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling	25,895	45,383	88,429	103,368	111,047	118,095

Alternative Agricultural Conservation/Water Enhancement Strategies

Participation enhancement and drilling additional wells were selected as potential alternative strategies by the PWPG Ag subcommittee for the 2021 plan. Participation enhancement is already practiced by the Panhandle Groundwater Conservation District, which encompasses 35% of the total acreage within Region A. The remaining groundwater districts within the region have expressed no interest in implementing this strategy, therefore, it was not included in the primary water conservation strategies considered for implementation. While drilling a new well is not a water conservation strategy, it is a method that producers can implement to enhance irrigation water availability to meet needs if untapped supplies are available on their property. Relevant information concerning these two alternatives are presented in the following sections.

Precipitation Enhancement

Precipitation enhancement, commonly known as cloud seeding or weather modification, is a process in which clouds are inoculated with condensation agents (such as silver iodide) to enhance rainfall formation. Cloud seeding is also used as a technique for hail suppression or reducing hailstone size (Encyclopedia Britannica, 2014). The strategy of precipitation enhancement is adopted only by the counties in the Panhandle Groundwater Conservation District (PGCD). In 2018, a total of 28 seeding flights and 12 reconnaissance flights were made in the district. Based on the literature, it is assumed to have a water savings of 1 acre-inch per acre for all irrigated acreage in the region by precipitation enhancement. In consultation with PGCD personnel, the cost of this strategy was reported to be 4.6 cents per acre in 2016 and 4.1 cents per acre in both 2017 and 2018. While there is a benefit to all land within the district, the estimated cost of water savings on irrigated land within the district was $14.62/ac-ft.

Additional Irrigation Supply from Groundwater Wells

While the PWPG does not advocate new groundwater wells as a strategy to meet future irrigation needs during the planning period, drilling of new wells is an option for irrigation water users who require additional supplies. Approximate cost estimates were developed to determine the expense associated with installing irrigation wells. Calculations assumed a well with a depth of 375 feet, pumping at less than 500 gpm costs $95 per foot; and pumping equipment is estimated at $75 per foot. At the 500-foot well-depth level, drilling cost was estimated at $110 per foot and pumping equipment cost estimates varied as to whether a submersible or electric turbine was employed (personal communications with Curry Drilling, Danny Kreinke and Brent Auvermann). Table 11 summarizes two scenarios: a well pumping rate of less than and greater than 500 gallons per minute.

Table 11: Estimated Costs of Irrigation Wells in Region A

Pumping Rate (gpm)	Approximate Well Depth (ft.)	Approximate Well Casing Diameter (in.)	Approximate Pumping Unit Diameter (in.)	Well Cost	Pumping Equipment Cost	Total Cost
Less than 500	375	12¾	4 - 6	$33,750	$25,500	$59,250
Greater than 500	500	16	8	$55,000 $55,000	$54,500[1] $61,000[2]	$109,500 $116,000

[1] Assumes submersible pump and associated equipment
[2] Assumes electric turbine and associated equipment

Potential Impact of Declining Water Availability on Projected Water Savings of Conservation Strategies

Five (Collingsworth, Dallam, Hartley, Moore and Sherman) of the seven deficit counties are projected to have declining irrigation demands as the result of reduced water availability in the future. Inherently, the lower water availability will reduce the water-saving effectiveness of conservation strategies. An analysis of the combination strategy of change in crop type, irrigation equipment changes, advances in plant breeding and irrigation scheduling that was identified by the Ag subcommittee of PWPG as the preferred conservation method was conducted to determine potential impacts of falling water availability on the effectiveness of implementing this strategy.

Two factors were considered in developing the methodology for estimating the reduced water savings of the combined strategy. The first was reduction in water availability, which was measured from the baseline water use. The second was the offset in that loss due to water availability from the savings that had been achieved by implementing the conservation strategy in the prior period, which would be able to be used in the current period. For example, Dallam County is projected to have an irrigation demand in 2040 of 286,928 ac-ft, which is a 16.5% ((343,830-286,928) / 343,830)) reduction from the baseline availability (Table 12). However, this assumes the water savings generated by the conservation strategy in the previous period is available for use the adjusted reduction is 4% ((343,830 – 286,928 - 43,270) / 343,830)). Therefore, the estimated projected water savings from the conservation strategy is reduced from 83,323 ac-ft to 80,019 ac-ft in 2040 to account for the reduced water availability and the savings accrued from the water conservation strategy in the previous period. By 2060, when water availability for irrigation is anticipated to be the smallest (174,217 ac-ft), the resulting water savings is projected to fall to 25,185 ac-ft or a decline of 23.8% in the effectiveness of the irrigation strategy following the outlined methodology.

The impact of the reduced water availability and the offset from the previous time periods conservation savings are presented for each of the five counties in Table 12. The projected percentage decline in irrigation demand by the end of the planning horizon (2070) was 29.5% for Collingsworth, 49.3% for Dallam, 44.3% for Hartley, 48.7% for Moore and 40% for Sherman. However, considering the water savings achieved in the previous period by the conservation strategy, the impact is largely offset. For example, in 2070 the estimated reduction in water savings considering both water availability and past period water savings was 9.7%, 25.9%, 21.1%, 19.1% and 5.8% for Collingsworth, Dallam, Hartley, Moore and Sherman counties, respectively. The variation in the impact between counties can be traced to the size of the projected deficit, the crop composition within the specific counties and other factors.

Table 12: Original and Adjusted Water Savings for Selected Water Combination Strategy: Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling and Irrigation Equipment Changes (ac-ft/year), 2020-2070.

	2020	2030	2040	2050	2060	2070
	Collingsworth County					
Projected Irrigation Demand	47,471	42,542	39,713	38,215	33,451	33,451
Original Water Savings	2,610	4,170	8,645	9,930	10,372	10,805
Adjusted Water Savings	2,610	3,966	7,955	9,658	9,419	9,757
	Dallam County					
Projected Irrigation Demand	343,830	343,830	286,928	228,243	174,217	174,217
Original Water Savings	24,329	43,270	83,323	97,795	105,687	112,920
Adjusted Water Savings	24,329	43,270	80,019	87,678	80,502	83,654
	Hartley County					
Projected Irrigation Demand	406,990	406,990	345,197	283,865	226,681	226,681
Original Water Savings	27,160	48,052	92,243	108,529	117,607	126,031
Adjusted Water Savings	27,160	48,052	89,129	99,463	94,245	99,380
	Moore County					
Projected Irrigation Demand	200,550	200,550	171,892	136,086	102,919	102,919
Original Water Savings	16,630	29,092	57,177	66,557	71,116	75,246
Adjusted Water Savings	16,630	29,092	57,177	64,138	59,240	60,841
	Sherman County					
Projected Irrigation Demand	304,360	304,360	304,360	246,760	182,536	182,536
Original Water Savings	25,895	45,383	88,429	103,368	111,047	118,095
Adjusted Water Savings	25,895	45,383	88,429	103,368	104,313	111,300

Summary and Conclusions

Prioritizing and implementing the seven irrigation conservation strategies will depend on the individual irrigator and regional support for the strategy. The one strategy that has the largest water savings is the adoption of drought-tolerant varieties of corn, cotton, sorghum, soybeans and wheat, which are being developed with the aid of advances in plant breeding. It is estimated to have the potential to save 14.4 million ac-ft over the 50-year planning horizon and is significantly more than the other strategies evaluated. The cumulative water savings of the remaining strategies in millions of ac-ft are as follows: irrigation scheduling (1.4), irrigation equipment changes (1.3), change in crop type (3.5), change in crop variety (0.7), conversion to dryland (2.7), and soil management (0.7). The combination strategy of change in crop type, irrigation equipment changes, advances in plant breeding and irrigation scheduling resulted in the largest cumulative projected water savings of 20,380,949 ac-ft over the planning horizon. The other combinations considered included: changes in crop type, irrigation scheduling and irrigation equipment changes, and crop variety, irrigation scheduling and irrigation equipment changes resulted in a projected savings of 6,275,456 ac-ft and 3,573,101 ac-ft, respectively.

Implementation cost can be a critical barrier to the adoption or rate of adoption of water conservation strategies. The estimated cost of implementing the various strategies expressed in

$/ac-ft of water savings varied considerably. No annualized costs for soil management suggests there are no implementation costs, which is erroneous. The initial cost of converting to conservation tillage such as the additional purchase of a strip tiller or no-till planter can impede the adoption process. However, the savings in conventional tillage methods offset the investment costs once the implements are prorated over their useful life. Irrigation equipment changes, conversion to dryland and changes in crop type were the next three most cost-effective strategies at $34.37, $39.96 and $44 per ac-ft, respectively. The remaining strategies where implementation costs were identified included irrigation scheduling, advances in plant breeding and change in crop variety at $70.28, $72.97 and $122.85 per ac-ft. The three combination strategies: change in crop type and irrigation equipment changes; advances in plant breeding and irrigation scheduling; changes in crop type, irrigation scheduling and irrigation equipment changes; and implementing changes in crop variety, irrigation scheduling and irrigation equipment changes resulted in a projected cost per acre foot of water saved of $66.37, $48.55 and $68.97, respectively.

Water conservation strategies can have significantly different impacts on the regional economy, which is often measured by the change in gross receipts or costs. The impact on the regional economy should be a major consideration in prioritizing strategies to be implemented. In this planning effort, no attempt was made to quantify the impacts of individual strategies on the regional economy. However, it is apparent that at least two of the strategies will have a negative impact. Implementing the conversion to dryland strategy would be detrimental to the regional economy because of the reduced production and decrease in inputs used. For the same reasons, albeit to a lesser degree, change in crop variety will have a negative impact on the regional economy.

Projected irrigation needs were severe enough in five of the seven counties identified to have shortfalls of water availability for irrigation purposes in the later years of the planning horizon. The counties of Collingsworth, Dallam, Hartley and Moore are projected to have reduced irrigation availability, while Sherman is expected to have a marginal surplus for 2020 and 2030 before experiencing irrigation reductions. None of the individual or combinations of strategies evaluated were able to generate enough water savings to cover projected deficits in the near term (prior to 2050) in Collingsworth, Dallam and Hartley counties. Once fully in place, one of the combinations of strategies yielded enough water savings to overcome the projected deficits in later years for Collingsworth and Dallam counties. The combination included change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes. In Moore County, implementing advances in plant breeding or the combination strategy of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes were enough to meet projected deficits by 2070. While employing advances in plant breeding, the combinations of change in crop type, advances in plant breeding, irrigation scheduling and irrigation equipment changes or, change in crop type, irrigation scheduling and irrigation equipment changes will generate water savings to meet need projections for Sherman County, with surplus in 2070.

The PWPG-AC selected the combination strategy of change in crop type, irrigation equipment changes, advances in plant breeding, and irrigation scheduling based on water savings, cost and feasibility of implementation as the recommended strategy to be implemented in the deficit counites. This strategy is projected to meet irrigation needs in all but one of the counties by 2070, if not earlier. No individual or combination strategy evaluated met the projected irrigation needs in Hartley County.

An analysis was performed to estimate the impact on the effectiveness of recommended conservation strategies due to the projected declining water availability for irrigation in Collingsworth, Dallam, Hartley and Sherman counties. Two factors were included in the analysis: the decline in water availability and the water savings generated by the strategy in the previous period. The projected decline in water availability by 2070 ranged from 29.5% to 49.3%. Considering both factors, projected water savings in 2070 from the combination strategy were estimated to decrease at a minimum from 9.7% to 25.9% depending of the crop composition within the county. Realistically, depending on how producers choose to use conservation savings, the percentage reduction in strategy effectiveness probably lies somewhere between estimates of reduced water availability and reduced water availability considering water savings offset from implemented conservation strategies.

A couple of caveats to this analysis need to be mentioned. First, the associated water savings with these strategies are “potential” water savings. Advances in plant breeding is projected to be the most effective individual strategy and is a part of the suite of strategies that make up the recommended combination. However, these advances have yet to occur and if they fall short of industry projections, several of the deficit counties may not be able to meet irrigation needs with the current conservation strategies as evaluated. Second, depending on the economics, the improved water-use efficiencies generated from some of these strategies may increase the depletion rate of the Ogallala Aquifer.

Finally, it needs to be stated that accurately evaluating the effectiveness of agricultural conservation strategies is difficult. Changes in irrigation demand, supply, needs, strategy implementation rates, conservation strategies, future crop composition which is primarily determined by relative profitability, as well as, accounting for the potential interaction between all these factors need to be considered in projecting the potential effectiveness of conservation strategies.

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Appendix A
Estimated Water Savings for Water Conservation Strategies by County for Selected Years

Table A-1: Estimated Water Savings from Irrigation Scheduling by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	31	62	94	125	156	187	**4,683**
Carson	436	873	1,309	1,746	2,182	2,619	**65,467**
Childress	71	141	212	283	354	424	**10,607**
Collingsworth	237	475	712	949	1,187	1,424	**35,603**
Dallam	1,719	3,438	5,157	6,877	8,596	10,315	**257,873**
Donley	155	309	464	618	773	927	**23,183**
Gray	161	323	484	646	807	969	**24,217**
Hall	159	318	477	636	795	954	**23,844**
Hansford	859	1,719	2,579	3,438	4,298	5,157	**128,925**
Hartley	2,035	4,070	6,105	8,140	10,175	12,210	**305,243**
Hemphill	28	57	85	114	142	170	**4,259**
Hutchinson	300	599	899	1,198	1,498	1,797	**44,933**
Lipscomb	204	409	613	817	1,022	1,226	**30,653**
Moore	1,003	2,006	3,008	4,011	5,014	6,017	**150,413**
Ochiltree	422	845	1,267	1,689	2,112	2,534	**63,345**
Oldham	24	47	71	94	118	142	**3,541**
Potter	16	32	48	64	79	95	**2,382**
Randall	89	177	266	354	443	532	**13,290**
Roberts	43	85	128	171	214	256	**6,407**
Sherman	1,522	3,044	4,565	6,087	7,609	9,131	**228,270**
Wheeler	81	162	243	324	406	487	**12,168**
Total	**9,595**	**19,191**	**28,786**	**38,381**	**47,977**	**57,572**	**1,439,303**

Table A-2: Estimated Water Savings from Irrigation Equipment Changes by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	40	80	120	161	201	241	**6,020**
Carson	485	970	1,456	1,941	2,426	2,911	**72,778**
Childress	88	176	264	352	440	527	**13,185**
Collingsworth	247	493	740	987	1,233	1,480	**37,000**
Dallam	1,568	3,136	4,704	6,272	7,840	9,408	**235,194**
Donley	169	337	506	675	844	1,012	**25,312**
Gray	192	383	575	766	958	1,149	**28,730**
Hall	158	317	475	633	792	950	**23,748**
Hansford	920	1,840	2,760	3,680	4,600	5,520	**137,988**
Hartley	1,749	3,498	5,248	6,997	8,746	10,495	**262,381**
Hemphill	65	130	195	260	326	391	**9,766**
Hutchinson	223	447	670	894	1,117	1,341	**33,524**
Lipscomb	217	435	652	870	1,087	1,305	**32,619**
Moore	907	1,814	2,720	3,627	4,534	5,441	**136,024**
Ochiltree	454	908	1,362	1,816	2,270	2,724	**68,110**
Oldham	28	55	83	110	138	165	**4,130**
Potter	9	17	26	34	43	51	**1,285**
Randall	97	194	291	388	485	582	**14,557**
Roberts	43	86	129	173	216	259	**6,470**
Sherman	1,434	2,868	4,303	5,737	7,171	8,605	**215,134**
Wheeler	82	163	245	326	408	490	**12,243**
Total	**9,175**	**18,349**	**27,524**	**36,699**	**45,873**	**55,048**	**1,376,201**

Table A-3: Estimated Water Savings from Change in Crop Type by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	39	78	116	155	194	233	**5,815**
Carson	1,052	2,104	3,156	4,208	5,259	6,311	**157,783**
Childress	6	12	18	25	31	37	**919**
Collingsworth	4	7	11	14	18	21	**531**
Dallam	4,629	9,259	13,888	18,518	23,147	27,777	**694,419**
Donley	77	153	230	307	383	460	**11,498**
Gray	381	761	1,142	1,523	1,903	2,284	**57,098**
Hall	0	0	0	0	0	0	**0**
Hansford	2,217	4,435	6,652	8,869	11,087	13,304	**332,601**
Hartley	5,406	10,811	16,217	21,622	27,028	32,433	**810,833**
Hemphill	0	1	1	2	2	3	**75**
Hutchinson	486	971	1,457	1,942	2,428	2,913	**72,828**
Lipscomb	423	847	1,270	1,694	2,117	2,541	**63,515**
Moore	2,666	5,332	7,997	10,663	13,329	15,995	**399,868**
Ochiltree	1,116	2,232	3,348	4,464	5,580	6,696	**167,401**
Oldham	49	99	148	198	247	297	**7,415**
Potter	10	19	29	38	48	57	**1,433**
Randall	122	245	367	489	612	734	**18,347**
Roberts	112	223	335	446	558	669	**16,730**
Sherman	4,810	9,619	14,429	19,238	24,048	28,857	**721,425**
Wheeler	65	130	195	260	325	390	**9,738**
Total	**23,668**	**47,337**	**71,005**	**94,674**	**118,342**	**142,011**	**3,550,271**

Table A-4: Estimated Water Savings from Change in Crop Variety by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	12	24	35	47	59	71	**1,766**
Carson	253	506	760	1,013	1,266	1,519	**37,977**
Childress	3	6	9	11	14	17	**429**
Collingsworth	1	2	4	5	6	7	**176**
Dallam	947	1,895	2,842	3,789	4,737	5,684	**142,100**
Donley	16	32	49	65	81	97	**2,428**
Gray	83	166	249	333	416	499	**12,473**
Hall	2	4	5	7	9	11	**267**
Hansford	440	880	1,319	1,759	2,199	2,639	**65,973**
Hartley	1,170	2,341	3,511	4,682	5,852	7,023	**175,569**
Hemphill	0	0	0	0	0	1	**14**
Hutchinson	107	214	321	428	534	641	**16,031**
Lipscomb	87	174	261	348	435	522	**13,051**
Moore	735	1,469	2,204	2,939	3,674	4,408	**110,211**
Ochiltree	246	492	739	985	1,231	1,477	**36,934**
Oldham	11	22	33	44	55	66	**1,659**
Potter	2	4	5	7	9	11	**263**
Randall	43	85	128	171	214	256	**6,412**
Roberts	27	53	80	107	134	160	**4,006**
Sherman	1,118	2,236	3,354	4,472	5,590	6,707	**167,686**
Wheeler	13	27	40	54	67	81	**2,022**
Total	**5,316**	**10,633**	**15,949**	**21,265**	**26,582**	**31,898**	**797,448**

Table A-5: Estimated Water Savings from Conversion to Dryland by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	0	126	252	420	420	420	**12,173**
Carson	0	1,522	3,045	5,074	5,074	5,074	**147,156**
Childress	0	276	552	919	919	919	**26,661**
Collingsworth	0	774	1,548	2,580	2,580	2,580	**74,814**
Dallam	0	4,920	9,839	16,399	16,399	16,399	**475,558**
Donley	0	529	1,059	1,765	1,765	1,765	**51,181**
Gray	0	601	1,202	2,003	2,003	2,003	**58,091**
Hall	0	497	993	1,656	1,656	1,656	**48,018**
Hansford	0	2,886	5,773	9,621	9,621	9,621	**279,010**
Hartley	0	5,488	10,976	18,294	18,294	18,294	**530,530**
Hemphill	0	204	409	681	681	681	**19,747**
Hutchinson	0	701	1,402	2,337	2,337	2,337	**67,785**
Lipscomb	0	682	1,365	2,274	2,274	2,274	**65,955**
Moore	0	2,845	5,690	9,484	9,484	9,484	**275,039**
Ochiltree	0	1,425	2,849	4,749	4,749	4,749	**137,717**
Oldham	0	86	173	288	288	288	**8,352**
Potter	0	27	54	90	90	90	**2,598**
Randall	0	304	609	1,015	1,015	1,015	**29,434**
Roberts	0	135	271	451	451	451	**13,083**
Sherman	0	4,500	9,000	15,000	15,000	15,000	**434,996**
Wheeler	0	256	512	854	854	854	**24,756**
Total	**0**	**28,786**	**57,572**	**95,954**	**95,954**	**95,954**	**2,782,652**

Table A-6: Estimated Water Savings from Soil Management by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	23	47	70	93	102	102	**3,349**
Carson	281	562	843	1,125	1,237	1,237	**40,483**
Childress	51	102	153	204	224	224	**7,335**
Collingsworth	143	286	429	572	629	629	**20,582**
Dallam	909	1,817	2,726	3,634	3,998	3,998	**130,829**
Donley	98	196	293	391	430	430	**14,080**
Gray	111	222	333	444	488	488	**15,981**
Hall	92	183	275	367	404	404	**13,210**
Hansford	533	1,066	1,599	2,132	2,345	2,345	**76,757**
Hartley	1,014	2,027	3,041	4,054	4,460	4,460	**145,952**
Hemphill	38	75	113	151	166	166	**5,433**
Hutchinson	130	259	389	518	570	570	**18,648**
Lipscomb	126	252	378	504	554	554	**18,145**
Moore	525	1,051	1,576	2,102	2,312	2,312	**75,665**
Ochiltree	263	526	789	1,052	1,158	1,158	**37,887**
Oldham	16	32	48	64	70	70	**2,298**
Potter	5	10	15	20	22	22	**715**
Randall	56	112	169	225	247	247	**8,098**
Roberts	25	50	75	100	110	110	**3,599**
Sherman	831	1,662	2,493	3,324	3,657	3,657	**119,670**
Wheeler	47	95	142	189	208	208	**6,810**
Total	**5,316**	**10,632**	**15,948**	**21,265**	**23,391**	**23,391**	**765,524**

Table A-7: Estimated Water Savings from Advances in Plant Breeding by County for Selected Years.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	181	327	698	781	793	793	**27,796**
Carson	5,351	8,585	19,031	21,283	21,395	21,395	**756,444**
Childress	494	775	1,730	1,934	1,941	1,941	**68,734**
Collingsworth	2,135	3,232	7,303	8,163	8,169	8,169	**290,030**
Dallam	16,526	27,839	60,763	67,984	68,594	68,594	**2,417,063**
Donley	720	1,104	2,484	2,777	2,782	2,782	**98,663**
Gray	1,498	2,334	5,224	5,840	5,857	5,857	**207,534**
Hall	1,589	2,418	5,455	6,097	6,104	6,104	**216,627**
Hansford	10,644	17,344	38,256	42,790	43,065	43,065	**1,520,991**
Hartley	18,097	30,116	65,986	73,819	74,413	74,413	**2,624,311**
Hemphill	4	7	15	17	17	17	**596**
Hutchinson	3,444	5,678	12,478	13,958	14,060	14,060	**496,184**
Lipscomb	1,331	2,112	4,698	5,254	5,277	5,277	**186,714**
Moore	12,133	20,215	44,275	49,532	49,935	49,935	**1,760,896**
Ochiltree	5,121	8,290	18,323	20,493	20,615	20,615	**728,416**
Oldham	156	299	627	703	716	716	**25,004**
Potter	87	207	410	459	475	475	**16,370**
Randall	700	1,430	2,950	3,306	3,382	3,382	**117,674**
Roberts	489	774	1,724	1,927	1,936	1,936	**68,498**
Sherman	18,252	30,280	66,410	74,291	74,871	74,871	**2,641,045**
Wheeler	672	1,063	2,367	2,647	2,658	2,658	**94,083**
Total	**99,622**	**164,428**	**361,207**	**404,055**	**407,054**	**407,054**	**14,363,673**

Table A-8: Estimated Water Savings from Crop Type, Irrigation Equipment Changes, and Irrigation, Scheduling Combination.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	110	219	327	434	541	647	**16,301**
Carson	1,966	3,916	5,851	7,771	9,675	11,564	**291,801**
Childress	164	328	490	651	812	972	**24,452**
Collingsworth	486	970	1,451	1,930	2,407	2,880	**72,446**
Dallam	7,886	15,709	23,471	31,170	38,808	46,384	**1,170,443**
Donley	399	795	1,189	1,580	1,969	2,356	**59,317**
Gray	731	1,456	2,175	2,889	3,597	4,299	**108,471**
Hall	316	631	945	1,256	1,567	1,875	**47,157**
Hansford	3,981	7,931	11,849	15,736	19,592	23,416	**590,887**
Hartley	9,154	18,236	27,247	36,186	45,054	53,850	**1,358,782**
Hemphill	94	187	279	371	462	552	**13,920**
Hutchinson	1,005	2,003	2,994	3,978	4,954	5,924	**149,335**
Lipscomb	842	1,678	2,507	3,330	4,146	4,956	**125,024**
Moore	4,558	9,079	13,565	18,016	22,430	26,809	**676,480**
Ochiltree	1,985	3,953	5,906	7,844	9,766	11,672	**294,539**
Oldham	100	200	298	396	493	590	**14,874**
Potter	34	68	101	135	168	201	**5,050**
Randall	307	612	914	1,214	1,512	1,808	**45,591**
Roberts	197	392	585	777	968	1,156	**29,183**
Sherman	7,734	15,406	23,016	30,563	38,047	45,469	**1,147,659**
Wheeler	227	452	676	899	1,120	1,340	**33,746**
TOTAL	**42,274**	**84,220**	**125,838**	**167,127**	**208,087**	**248,719**	**6,275,456**

Table A-9: Estimated Water Savings from Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling Combination.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	83	165	247	328	409	489	**12,327**
Carson	1,171	2,335	3,491	4,640	5,782	6,916	**174,192**
Childress	161	321	480	639	796	952	**23,971**
Collingsworth	484	965	1,444	1,921	2,395	2,867	**72,098**
Dallam	4,222	8,419	12,590	16,737	20,858	24,954	**628,249**
Donley	339	675	1,010	1,343	1,674	2,004	**50,414**
Gray	435	867	1,296	1,723	2,146	2,567	**64,664**
Hall	318	635	950	1,263	1,575	1,886	**47,419**
Hansford	2,212	4,411	6,597	8,768	10,926	13,071	**329,147**
Hartley	4,940	9,851	14,732	19,585	24,408	29,202	**735,164**
Hemphill	93	186	278	369	460	550	**13,860**
Hutchinson	628	1,253	1,875	2,493	3,108	3,720	**93,579**
Lipscomb	507	1,012	1,513	2,011	2,506	2,998	**75,486**
Moore	2,636	5,256	7,859	10,446	13,016	15,570	**392,134**
Ochiltree	1,119	2,231	3,336	4,434	5,525	6,610	**166,463**
Oldham	62	124	185	246	306	366	**9,224**
Potter	26	52	78	104	130	155	**3,901**
Randall	228	454	679	902	1,124	1,345	**33,874**
Roberts	112	224	335	445	554	663	**16,692**
Sherman	4,061	8,097	12,107	16,092	20,051	23,984	**604,071**
Wheeler	176	351	524	697	869	1,040	**26,172**
Total	**24,014**	**47,883**	**71,607**	**95,186**	**118,620**	**141,910**	**3,573,101**

Table A-10: Estimated Water Savings from Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling Combination.

County	Water Savings (ac-ft/yr.)						Cumulative ac-ft over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	290	542	1,014	1,200	1,314	1,415	**43,596**
Carson	7,290	12,416	24,597	28,628	30,535	32,317	**1,034,659**
Childress	655	1,095	2,194	2,547	2,704	2,854	**91,953**
Collingsworth	2,610	4,170	8,645	9,930	10,372	10,805	**357,275**
Dallam	24,329	43,270	83,323	97,795	105,687	112,920	**3,544,036**
Donley	1,115	1,888	3,636	4,301	4,681	5,054	**156,211**
Gray	2,222	3,766	7,320	8,612	9,308	9,981	**312,281**
Hall	1,898	3,025	6,317	7,232	7,518	7,796	**259,899**
Hansford	14,572	25,101	49,532	57,670	61,580	65,189	**2,084,549**
Hartley	27,160	48,052	92,243	108,529	117,607	126,031	**3,935,911**
Hemphill	97	194	294	387	478	569	**14,505**
Hutchinson	4,432	7,624	15,285	17,656	18,663	19,562	**636,600**
Lipscomb	2,167	3,768	7,135	8,478	9,291	10,074	**308,387**
Moore	16,630	29,092	57,177	66,557	71,116	75,246	**2,405,717**
Ochiltree	7,080	12,160	23,955	27,927	29,865	31,668	**1,009,868**
Oldham	255	495	916	1,085	1,191	1,284	**39,427**
Potter	120	272	505	585	631	661	**21,123**
Randall	1,003	2,027	3,820	4,454	4,810	5,089	**161,138**
Roberts	683	1,158	2,283	2,666	2,855	3,034	**96,451**
Sherman	25,895	45,383	88,429	103,368	111,047	118,095	**3,741,225**
Wheeler	895	1,505	3,008	3,493	3,712	3,918	**126,140**
Total	**141,398**	**247,004**	**481,627**	**563,101**	**604,965**	**643,562**	**20,380,949**

Appendix B

Estimated Implementation Cost for Water Conservation Strategies by County for Selected Years

Table B-1: Estimated Implementation Cost of Irrigation Scheduling by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$2,950	$5,900	$8,850	$11,801	$14,751	$17,701	**$442,521**
Carson	$35,664	$71,328	$106,992	$142,656	$178,320	$35,664	**$5,349,594**
Childress	$6,461	$12,923	$19,384	$25,845	$32,307	$6,461	**$969,204**
Collingsworth	$18,131	$36,263	$54,394	$72,526	$90,657	$18,131	**$2,719,721**
Dallam	$115,254	$230,508	$345,762	$461,015	$576,269	$115,254	**$17,288,081**
Donley	$12,404	$24,808	$37,212	$49,616	$62,020	$12,404	**$1,860,589**
Gray	$14,079	$28,157	$42,236	$56,314	$70,393	$14,079	**$2,111,785**
Hall	$11,637	$23,275	$34,912	$46,550	$58,187	$11,637	**$1,745,616**
Hansford	$67,619	$135,239	$202,858	$270,478	$338,097	$67,619	**$10,142,923**
Hartley	$128,577	$257,153	$385,730	$514,307	$642,883	$128,577	**$19,286,504**
Hemphill	$4,786	$9,572	$14,358	$19,143	$23,929	$4,786	**$717,878**
Hutchinson	$16,428	$32,856	$49,284	$65,712	$82,140	$16,428	**$2,464,200**
Lipscomb	$15,985	$31,969	$47,954	$63,938	$79,923	$15,985	**$2,397,682**
Moore	$66,657	$133,314	$199,971	$266,628	$333,285	$66,657	**$9,998,563**
Ochiltree	$33,376	$66,753	$100,129	$133,506	$166,882	$33,376	**$5,006,471**
Oldham	$2,024	$4,048	$6,072	$8,096	$10,120	$2,024	**$303,605**
Potter	$630	$1,259	$1,889	$2,518	$3,148	$630	**$94,434**
Randall	$7,134	$14,267	$21,401	$28,534	$35,668	$7,134	**$1,070,038**
Roberts	$3,171	$6,342	$9,512	$12,683	$15,854	$3,171	**$475,614**
Sherman	$105,424	$210,847	$316,271	$421,694	$527,118	$105,424	**$15,813,532**
Wheeler	$6,000	$11,999	$17,999	$23,999	$29,999	$6,000	**$899,959**
Total	**$674,390**	**$1,348,780**	**$2,023,170**	**$2,697,560**	**$3,371,950**	**$689,141**	**$101,158,515**

[1]An average operational cost of $9.25 per acre annually was assumed for services including any required equipment.

Table B-2: Estimated Implementation Cost of Irrigation Equipment Changes by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$4,138	$4,138	$4,138	$4,138	$4,138	$4,138	**$206,924**
Carson	$50,030	$50,030	$50,030	$50,030	$50,030	$50,030	**$2,501,489**
Childress	$9,064	$9,064	$9,064	$9,064	$9,064	$9,064	**$453,203**
Collingsworth	$25,435	$25,435	$25,435	$25,435	$25,435	$25,435	**$1,271,751**
Dallam	$161,679	$161,679	$161,679	$161,679	$161,679	$161,679	**$8,083,969**
Donley	$17,400	$17,400	$17,400	$17,400	$17,400	$17,400	**$870,018**
Gray	$19,750	$19,750	$19,750	$19,750	$19,750	$19,750	**$987,478**
Hall	$16,325	$16,325	$16,325	$16,325	$16,325	$16,325	**$816,256**
Hansford	$94,857	$94,857	$94,857	$94,857	$94,857	$94,857	**$4,742,867**
Hartley	$180,369	$180,369	$180,369	$180,369	$180,369	$180,369	**$9,018,439**
Hemphill	$6,714	$6,714	$6,714	$6,714	$6,714	$6,714	**$335,683**
Hutchinson	$23,045	$23,045	$23,045	$23,045	$23,045	$23,045	**$1,152,269**
Lipscomb	$22,423	$22,423	$22,423	$22,423	$22,423	$22,423	**$1,121,165**
Moore	$93,507	$93,507	$93,507	$93,507	$93,507	$93,507	**$4,675,364**
Ochiltree	$46,821	$46,821	$46,821	$46,821	$46,821	$46,821	**$2,341,044**
Oldham	$2,839	$2,839	$2,839	$2,839	$2,839	$2,839	**$141,967**
Potter	$883	$883	$883	$883	$883	$883	**$44,158**
Randall	$10,007	$10,007	$10,007	$10,007	$10,007	$10,007	**$500,354**
Roberts	$4,448	$4,448	$4,448	$4,448	$4,448	$4,448	**$222,399**
Sherman	$147,889	$147,889	$147,889	$147,889	$147,889	$147,889	**$7,394,465**
Wheeler	$8,416	$8,416	$8,416	$8,416	$8,416	$8,416	**$420,824**
Total	**$946,042**	**$946,042**	**$946,042**	**$946,042**	**$946,042**	**$946,042**	**$47,302,086**

[1]The average capital cost of conversion was $129.76 per acre with no change in operational costs.

Table B-3: Estimated Implementation Cost of Change in Crop Type by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$5,117	$5,117	$5,117	$5,117	$5,117	$5,117	**$255,841**
Carson	$138,849	$138,849	$138,849	$138,849	$138,849	$138,849	**$6,942,470**
Childress	$809	$809	$809	$809	$809	$809	**$40,426**
Collingsworth	$467	$467	$467	$467	$467	$467	**$23,342**
Dallam	$611,089	$611,089	$611,089	$611,089	$611,089	$611,089	**$30,554,447**
Donley	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118	**$505,892**
Gray	$50,246	$50,246	$50,246	$50,246	$50,246	$50,246	**$2,512,301**
Hall	$0	$0	$0	$0	$0	$0	**$0**
Hansford	$292,689	$292,689	$292,689	$292,689	$292,689	$292,689	**$14,634,432**
Hartley	$713,533	$713,533	$713,533	$713,533	$713,533	$713,533	**$35,676,669**
Hemphill	$66	$66	$66	$66	$66	$66	**$3,284**
Hutchinson	$64,089	$64,089	$64,089	$64,089	$64,089	$64,089	**$3,204,437**
Lipscomb	$55,894	$55,894	$55,894	$55,894	$55,894	$55,894	**$2,794,678**
Moore	$351,884	$351,884	$351,884	$351,884	$351,884	$351,884	**$17,594,178**
Ochiltree	$147,313	$147,313	$147,313	$147,313	$147,313	$147,313	**$7,365,665**
Oldham	$6,525	$6,525	$6,525	$6,525	$6,525	$6,525	**$326,257**
Potter	$1,261	$1,261	$1,261	$1,261	$1,261	$1,261	**$63,059**
Randall	$16,145	$16,145	$16,145	$16,145	$16,145	$16,145	**$807,248**
Roberts	$14,723	$14,723	$14,723	$14,723	$14,723	$14,723	**$736,132**
Sherman	$634,854	$634,854	$634,854	$634,854	$634,854	$634,854	**$31,742,705**
Wheeler	$8,569	$8,569	$8,569	$8,569	$8,569	$8,569	**$428,456**
Total	**$3,124,238**	**$3,124,238**	**$3,124,238**	**$3,124,238**	**$3,124,238**	**$3,124,238**	**$156,211,918**

[1]The average cost of $1,100 per acre was assumed to be a one-time cost for implementation which reflects the change in land values from land with good water to land with average water availability.

Table B-4: Estimated Implementation Cost of Change in Crop Variety by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$1,334	$2,669	$4,003	$5,337	$6,672	$8,006	**$200,154**
Carson	$30,485	$60,971	$91,456	$121,941	$152,426	$182,912	**$4,572,793**
Childress	$297	$594	$891	$1,188	$1,485	$1,782	**$44,541**
Collingsworth	$130	$260	$390	$520	$651	$781	**$19,518**
Dallam	$119,757	$239,515	$359,272	$479,029	$598,786	$718,544	**$17,963,589**
Donley	$2,026	$4,052	$6,078	$8,104	$10,130	$12,156	**$303,897**
Gray	$10,301	$20,602	$30,903	$41,204	$51,505	$61,807	**$1,545,163**
Hall	$154	$308	$462	$616	$769	$923	**$23,085**
Hansford	$56,158	$112,316	$168,474	$224,631	$280,789	$336,947	**$8,423,675**
Hartley	$145,386	$290,771	$436,157	$581,542	$726,928	$872,313	**$21,807,835**
Hemphill	$12	$24	$36	$48	$60	$72	**$1,794**
Hutchinson	$13,209	$26,418	$39,627	$52,836	$66,045	$79,254	**$1,981,358**
Lipscomb	$10,985	$21,970	$32,955	$43,939	$54,924	$65,909	**$1,647,728**
Moore	$85,295	$170,591	$255,886	$341,181	$426,477	$511,772	**$12,794,301**
Ochiltree	$30,411	$60,822	$91,233	$121,644	$152,055	$182,466	**$4,561,642**
Oldham	$1,360	$2,721	$4,081	$5,441	$6,802	$8,162	**$204,048**
Potter	$230	$459	$689	$918	$1,148	$1,378	**$34,439**
Randall	$4,693	$9,386	$14,080	$18,773	$23,466	$28,159	**$703,982**
Roberts	$3,220	$6,441	$9,661	$12,882	$16,102	$19,323	**$483,072**
Sherman	$135,959	$271,917	$407,876	$543,835	$679,793	$815,752	**$20,393,805**
Wheeler	$1,696	$3,393	$5,089	$6,786	$8,482	$10,179	**$254,464**
Total	**$653,099**	**$1,306,198**	**$1,959,298**	**$2,612,397**	**$3,265,496**	**$3,918,595**	**$97,964,884**

[1]The cost per acre-foot saved is $131.06 and $86.32 for corn and sorghum, respectively, which reflects the net change in seed cost, pumping cost, fertilizer, and harvest expenses as well as changes in crop yield.

Table B-5: Estimated Implementation Cost of Conversion to Dryland by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$0	$14,591	$14,591	$19,455	$0	$0	**$486,374**
Carson	$0	$176,392	$176,392	$235,189	$0	$0	**$5,879,734**
Childress	$0	$31,958	$31,958	$42,610	$0	$0	**$1,065,251**
Collingsworth	$0	$89,677	$89,677	$119,570	$0	$0	**$2,989,243**
Dallam	$0	$570,039	$570,039	$760,053	$0	$0	**$19,001,314**
Donley	$0	$61,349	$61,349	$81,799	$0	$0	**$2,044,971**
Gray	$0	$69,632	$69,632	$92,842	$0	$0	**$2,321,061**
Hall	$0	$57,558	$57,558	$76,744	$0	$0	**$1,918,605**
Hansford	$0	$334,442	$334,442	$445,923	$0	$0	**$11,148,078**
Hartley	$0	$635,933	$635,933	$847,911	$0	$0	**$21,197,779**
Hemphill	$0	$23,671	$23,671	$31,561	$0	$0	**$789,019**
Hutchinson	$0	$81,252	$81,252	$108,336	$0	$0	**$2,708,400**
Lipscomb	$0	$79,059	$79,059	$105,412	$0	$0	**$2,635,290**
Moore	$0	$329,682	$329,682	$439,576	$0	$0	**$10,989,412**
Ochiltree	$0	$165,078	$165,078	$220,104	$0	$0	**$5,502,608**
Oldham	$0	$10,011	$10,011	$13,348	$0	$0	**$333,692**
Potter	$0	$3,114	$3,114	$4,152	$0	$0	**$103,792**
Randall	$0	$35,282	$35,282	$47,043	$0	$0	**$1,176,078**
Roberts	$0	$15,682	$15,682	$20,910	$0	$0	**$522,747**
Sherman	$0	$521,419	$521,419	$695,226	$0	$0	**$17,380,639**
Wheeler	$0	$29,674	$29,674	$39,566	$0	$0	**$989,144**
Total	**$0**	**$3,335,497**	**$3,335,497**	**$4,447,329**	**$0**	**$0**	**$111,183,232**

[1]The implementation cost to retire an acre of average irrigated land was $1,525 assuming the land would be suitable for dryland production.

Table B-6: Estimated Implementation Cost of Advances in Plant Breeding by County for Selected Years.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$20,723	$43,299	$88,780	$99,513	$101,955	$101,955	**$3,542,709**
Carson	$435,656	$749,727	$1,625,595	$1,819,106	$1,838,355	$1,838,355	**$64,684,395**
Childress	$66,586	$111,012	$243,091	$271,952	$274,179	$274,179	**$9,668,198**
Collingsworth	$193,045	$319,679	$701,520	$784,760	$790,783	$790,783	**$27,897,870**
Dallam	$1,027,362	$2,036,230	$4,235,811	$4,745,793	$4,844,830	$4,844,830	**$168,900,261**
Donley	$90,351	$153,701	$334,455	$374,231	$377,866	$377,866	**$13,306,042**
Gray	$136,280	$242,816	$520,946	$583,137	$590,817	$590,817	**$20,739,961**
Hall	$142,371	$228,266	$506,126	$566,017	$568,959	$568,959	**$20,117,389**
Hansford	$762,108	$1,392,140	$2,964,634	$3,319,272	$3,369,068	$3,369,068	**$118,072,217**
Hartley	$1,136,459	$2,185,685	$4,585,455	$5,136,237	$5,232,437	$5,232,437	**$182,762,724**
Hemphill	$1,554	$12,619	$20,716	$23,395	$25,453	$25,453	**$837,366**
Hutchinson	$170,584	$320,925	$677,559	$758,803	$771,813	$771,813	**$26,996,836**
Lipscomb	$107,673	$205,495	$432,067	$483,933	$492,730	$492,730	**$17,218,974**
Moore	$702,539	$1,336,901	$2,813,271	$3,150,905	$3,207,524	$3,207,524	**$112,111,401**
Ochiltree	$365,914	$675,283	$1,432,241	$1,603,691	$1,628,775	$1,628,775	**$57,059,041**
Oldham	$11,746	$29,338	$57,516	$64,558	$66,902	$66,902	**$2,300,594**
Potter	$1,720	$7,700	$13,527	$15,239	$16,263	$16,263	**$544,489**
Randall	$41,693	$115,656	$221,431	$248,731	$259,354	$259,354	**$8,868,645**
Roberts	$32,036	$58,737	$124,947	$139,898	$142,035	$142,035	**$4,976,529**
Sherman	$1,136,590	$2,124,247	$4,493,449	$5,031,958	$5,115,830	$5,115,830	**$179,020,740**
Wheeler	$53,012	$100,950	$212,389	$237,880	$242,167	$242,167	**$8,463,984**
Total	**$6,636,001**	**$12,450,406**	**$26,305,526**	**$29,459,010**	**$29,958,093**	**$29,958,093**	**$1,048,090,366**

[1]The implementation cost of this strategy was the additional operational cost of drought-tolerant seed estimated at $1 for every 1% reduction in water use.

Table B-7: Estimated Implementation Cost of the Crop Type, Irrigation Equipment Changes, and Irrigation Scheduling Combination.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$12,205	$15,156	$18,106	$21,056	$24,006	$26,956	**$905,286**
Carson	$224,543	$260,207	$295,871	$331,535	$367,199	$224,543	**$14,793,554**
Childress	$16,334	$22,795	$29,257	$35,718	$42,179	$16,334	**$1,462,833**
Collingsworth	$44,033	$62,165	$80,296	$98,428	$116,559	$44,033	**$4,014,814**
Dallam	$888,022	$1,003,276	$1,118,530	$1,233,784	$1,349,038	$888,022	**$55,926,497**
Donley	$39,922	$52,326	$64,730	$77,134	$89,538	$39,922	**$3,236,499**
Gray	$84,074	$98,153	$112,231	$126,310	$140,388	$84,074	**$5,611,565**
Hall	$27,963	$39,600	$51,237	$62,875	$74,512	$27,963	**$2,561,872**
Hansford	$455,165	$522,785	$590,404	$658,024	$725,643	$455,165	**$29,520,223**
Hartley	$1,022,479	$1,151,056	$1,279,632	$1,408,209	$1,536,786	$1,022,479	**$63,981,611**
Hemphill	$11,565	$16,351	$21,137	$25,923	$30,709	$11,565	**$1,056,845**
Hutchinson	$103,562	$119,990	$136,418	$152,846	$169,274	$103,562	**$6,820,906**
Lipscomb	$94,301	$110,286	$126,271	$142,255	$158,240	$94,301	**$6,313,526**
Moore	$512,048	$578,705	$645,362	$712,019	$778,676	$512,048	**$32,268,105**
Ochiltree	$227,511	$260,887	$294,264	$327,640	$361,017	$227,511	**$14,713,180**
Oldham	$11,389	$13,413	$15,437	$17,461	$19,485	$11,389	**$771,830**
Potter	$2,774	$3,403	$4,033	$4,663	$5,292	$2,774	**$201,651**
Randall	$33,286	$40,419	$47,553	$54,686	$61,820	$33,286	**$2,377,640**
Roberts	$22,341	$25,512	$28,683	$31,854	$35,024	$22,341	**$1,434,145**
Sherman	$888,167	$993,590	$1,099,014	$1,204,438	$1,309,861	$888,167	**$54,950,702**
Wheeler	$22,985	$28,985	$34,985	$40,984	$46,984	$22,985	**$1,749,238**
Total	**$4,744,670**	**$5,419,060**	**$6,093,450**	**$6,767,840**	**$7,442,231**	**$4,759,421**	**$304,672,519**

[1]The implementation costs were calculated as the sum of the implementation costs for crop type, irrigation equipment changes, and irrigation scheduling.

Table B-8: Estimated Implementation Cost of the Crop Variety, Irrigation Equipment Changes, and Irrigation Scheduling Combination.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$8,423	$12,707	$16,992	$21,276	$25,561	$29,845	**$849,599**
Carson	$116,179	$182,328	$248,478	$314,627	$380,776	$268,605	**$12,423,877**
Childress	$15,822	$22,581	$29,339	$36,097	$42,856	$17,307	**$1,466,948**
Collingsworth	$43,697	$61,958	$80,220	$98,481	$116,743	$44,347	**$4,010,990**
Dallam	$396,691	$631,702	$866,713	$1,101,724	$1,336,735	$995,477	**$43,335,639**
Donley	$31,830	$46,260	$60,690	$75,120	$89,550	$41,960	**$3,034,504**
Gray	$44,129	$68,509	$92,889	$117,268	$141,648	$95,635	**$4,644,427**
Hall	$28,116	$39,908	$51,699	$63,490	$75,282	$28,886	**$2,584,957**
Hansford	$218,635	$342,412	$466,189	$589,967	$713,744	$499,424	**$23,309,466**
Hartley	$454,331	$728,293	$1,002,256	$1,276,218	$1,550,180	$1,181,259	**$50,112,778**
Hemphill	$11,511	$16,309	$21,107	$25,905	$30,703	$11,571	**$1,055,355**
Hutchinson	$52,682	$82,319	$111,957	$141,594	$171,231	$118,728	**$5,597,827**
Lipscomb	$49,393	$76,362	$103,332	$130,301	$157,270	$104,317	**$5,166,575**
Moore	$245,460	$397,412	$549,365	$701,317	$853,269	$671,936	**$27,468,228**
Ochiltree	$110,608	$174,396	$238,183	$301,971	$365,758	$262,663	**$11,909,157**
Oldham	$6,224	$9,608	$12,992	$16,377	$19,761	$13,025	**$649,620**
Potter	$1,742	$2,601	$3,461	$4,320	$5,179	$2,890	**$173,031**
Randall	$21,834	$33,661	$45,487	$57,314	$69,141	$45,300	**$2,274,374**
Roberts	$10,839	$17,230	$23,622	$30,013	$36,404	$26,942	**$1,181,085**
Sherman	$389,272	$630,654	$872,036	$1,113,418	$1,354,801	$1,069,065	**$43,601,802**
Wheeler	$16,113	$23,809	$31,505	$39,201	$46,897	$24,595	**$1,575,247**
Total	**$2,273,531**	**$3,601,020**	**$4,928,510**	**$6,255,999**	**$7,583,488**	**$5,553,778**	**$246,425,484**

[1]The implementation costs were calculated as the sum of the implementation costs for crop variety, irrigation equipment changes, and irrigation scheduling.

Table B-9: Estimated Implementation Cost of the Crop Type, Irrigation Equipment Changes, Advances in Plant Breeding, and Irrigation Scheduling Combination.[1]

County	Implementation Cost ($/yr.)						Cumulative cost over 50 years
	2020	2030	2040	2050	2060	2070	
Armstrong	$32,929	$58,455	$106,886	$120,568	$125,961	$128,912	**$4,447,995**
Carson	$660,199	$1,009,934	$1,921,466	$2,150,641	$2,205,554	$2,062,898	**$79,477,949**
Childress	$82,920	$133,807	$272,348	$307,670	$316,358	$290,513	**$11,131,031**
Collingsworth	$237,078	$381,844	$781,816	$883,188	$907,342	$834,816	**$31,912,684**
Dallam	$1,915,384	$3,039,506	$5,354,341	$5,979,577	$6,193,868	$5,732,853	**$224,826,758**
Donley	$130,273	$206,027	$399,185	$451,365	$467,404	$417,788	**$16,542,541**
Gray	$220,354	$340,969	$633,177	$709,447	$731,205	$674,891	**$26,351,525**
Hall	$170,334	$267,866	$557,364	$628,892	$643,471	$596,921	**$22,679,261**
Hansford	$1,217,273	$1,914,925	$3,555,038	$3,977,296	$4,094,711	$3,824,233	**$147,592,440**
Hartley	$2,158,937	$3,336,740	$5,865,087	$6,544,446	$6,769,222	$6,254,916	**$246,744,335**
Hemphill	$13,119	$28,970	$41,853	$49,318	$56,161	$37,018	**$1,894,212**
Hutchinson	$274,146	$440,916	$813,977	$911,649	$941,087	$875,375	**$33,817,742**
Lipscomb	$201,975	$315,781	$558,337	$626,188	$650,970	$587,031	**$23,532,500**
Moore	$1,214,587	$1,915,606	$3,458,633	$3,862,924	$3,986,200	$3,719,572	**$144,379,505**
Ochiltree	$593,425	$936,170	$1,726,505	$1,931,331	$1,989,792	$1,856,286	**$71,772,221**
Oldham	$23,135	$42,751	$72,952	$82,018	$86,386	$78,290	**$3,072,424**
Potter	$4,494	$11,103	$17,560	$19,902	$21,555	$19,037	**$746,140**
Randall	$74,978	$156,075	$268,983	$303,417	$321,174	$292,640	**$11,246,285**
Roberts	$54,377	$84,249	$153,630	$171,752	$177,059	$164,376	**$6,410,674**
Sherman	$2,024,757	$3,117,838	$5,592,463	$6,236,395	$6,425,691	$6,003,997	**$233,971,442**
Wheeler	$75,997	$129,935	$247,374	$278,865	$289,151	$265,152	**$10,213,222**
Total	**$11,380,671**	**$17,869,467**	**$32,398,977**	**$36,226,850**	**$37,400,323**	**$34,717,514**	**$1,352,762,885**

[1]The implementation costs were calculated as the sum of the implementation costs for crop type, irrigation equipment changes, advances in plant breeding, and irrigation scheduling.

APPENDIX D

COST ESTIMATES

Panhandle Regional Water Planning Area Cost Estimates

As part of the 2021 Panhandle Regional Water Plan, cost estimates were developed for each of the recommended and alternate water management strategies for the PWPA. In accordance with the Texas Water Development Board guidance the costs for water management strategies are reported in September 2018 dollars. The methodology used to develop the 2021 costs is described in the following sections. When detailed costs were provided by the sponsor, these costs were used, and where necessary, the costs were adjusted to September 2018 dollars using the Engineering News Record (ENR) Index for construction. An increase of 16.9% from September 2013 to September 2018 was determined using the ENR Index method.

D.1 Introduction

1. The evaluation of water management strategies requires developing cost estimates. Guidance for cost estimates may be found in the TWDB's "Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development (Exhibit C)", Section 5.5. Costs are to be reported in September 2018 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 "Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development (Exhibit C)".
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 (3% annual interest rate less a 0.5% 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.

D.2 Assumptions for Capital Costs

The unit cost and factors show in the Tables D-1 through D-7 were developed directly from the TWDB Costing Tool. These costs are the basis of the capital costs developed for this plan. If applicable, other capital costs should include:

- Engineering, contingencies, financial, and legal services
- Permitting and mitigation activities, including, but not limited to archeological/historic resources, environmental and biological analyses, mitigation activities (evaluation, land acquisition, implementation, monitoring), and other activities.
- Land purchase costs not associated with mitigation.
- Easement costs. For pipelines, this includes a permanent easement plus a temporary construction easement as well as rights to enter easements for maintenance
- Purchases of water rights.

Conveyance Systems

Standard pipeline costs used for these cost estimates are shown in Table D-1. Pump station costs are based on required Horsepower capacity of capacity (MGD) and are listed in Table D-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)
- Peaking factor of 1.2 to 1.5 can be used if there are additional water sources and/or the water is transported to a terminal storage facility.
- The target flow velocity in pipes is 5 fps and the Hazen-Williams Factor is assumed to be 120.
- 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 D-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 D-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 Potable Reuse

Direct potable reuse (DRP) is the use of reclaimed water that is transported directly from a wastewater treatment plant to a drinking water system. In the most recent version of the TWDB costing tool, cost estimation tables for advanced water treatment facilities (AWTF) were added for direct potable reuse strategies. These costs were adapted from TWDB DPR Resource Document Table 5-1 and are summarized in Table D-5. There are two AWTF schemes listed for direct potable reuse. The primary difference between the two is the use of RO, which is included in Scheme 1, but not in Scheme 2. In order to utilize Scheme 2, nitrogen must be removed at the WWTP.

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.

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 D-6. The costing tool differentiated the wells based upon purpose. The categories were Public Supply, Irrigation, and Aquifer Storage and Recovery (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 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 (https://www.recenter.tamu.edu/data/rural-land/) 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 3 percent annual interest rate on total borrowed funds, less a 0.5 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.

D.3 Assumptions for Annual Costs

Annual costs are to be estimated using the following assumptions:

- Debt service for all non-reservoir infrastructure (transmission and treatment facilities) is to be annualized over 20 years unless otherwise justified. For reservoirs, this period is 40 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 3.5 percent for both reservoir and non-reservoir projects.
- 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. Per the "Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development (Exhibit C)", 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 and AWTF improvements were developed by the TWDB and are shown in Table D-7 and Table D-8.
- Pumping costs are to be estimated using an electricity rate of $0.08 per Kilowatt Hour. If local data is available, this can be used.
- Power connection costs for pump stations are estimated to be $150 per HP.

Table D-1
Pipeline Costs

Diameter	Soil		Rock	
	Rural	Urban	Rural	Urban
(Inches)	($/Foot)	($/Foot)	($/Foot)	(Feet)
6	25	31	35	49
8	40	50	56	77
10	54	69	77	106
12	68	87	97	134
14	83	106	118	163
16	97	125	138	191
18	111	144	159	220
20	125	163	180	248
24	154	200	221	305
30	197	257	283	390
36	240	313	345	476
42	283	370	407	561
48	325	426	469	647
54	368	482	531	732
60	411	539	592	817
66	454	595	654	903
72	497	652	716	988
78	606	778	867	1159
84	715	904	1018	1330
90	824	1031	1169	1500
96	933	1157	1321	1671
102	1043	1284	1472	1841
108	1152	1410	1623	2012
114	1261	1536	1774	2183
120	1370	1663	1925	2353
132	1588	1915	2227	2694
144	1806	2168	2529	3036

Table D-2
Pump Station Costs

Horsepower	Booster PS Cost ($ million)	Intake PS cost ($ millions)
0	$0.00	$0.00
5	$2.75	$0.73
10	$2.84	$0.80
20	$3.00	$0.84
25	$3.08	$0.88
50	$3.49	$0.92
100	$4.31	$0.97
200	$5.96	$1.28
300	$7.60	$1.90
400	$9.25	$2.51
500	$10.89	$3.12
600	$12.53	$3.72
700	$14.18	$4.32
800	$15.82	$4.92
900	$17.46	$5.51
1,000	$19.11	$6.10
2,000	$35.55	$11.75
3,000	$37.09	$16.99
4,000	$38.31	$23.78
5,000	$39.53	$30.56
6,000	$41.09	$31.92
7,000	$42.31	$32.94
8,000	$43.52	$34.13
9,000	$44.73	$35.32
10,000	$45.94	$36.51
20,000	$58.06	$48.40
30,000	$70.18	$60.30
40,000	$82.30	$72.19
50,000	$94.42	$84.08
60,000	$106.54	$95.98
70,000	$118.66	$107.87

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 D-3
Ground Storage Tanks

Tank Volume (MG)	With Roof ($)	Without Roof ($)
0.05	833,996	413,402
0.1	901,492	432,305
0.5	1,077,270	583,324
1	1,296,813	772,047
1.5	1,516,458	960,769
2	1,736,104	1,149,595
2.5	1,955,647	1,338,317
3	2,175,292	1,527,143
3.5	2,394,938	1,715,865
4	2,614,480	1,904,588
5	3,053,771	2,282,136
6	3,492,960	2,659,683
7	3,932,251	3,037,231
8	4,371,439	3,414,779
10	5,376,487	4,444,586
12	6,603,646	5,474,393
14	7,815,600	6,504,302

Note: Costs assume steel tanks smaller than 1 MG, concrete tanks 1 MG and larger.

Table D-4
Conventional Water Treatment Plant Costs

	Level 0 Chlorine Disinfection (GW)	Level 1 Iron & Manganese Removal	Level 2 Simple Filtration	Level 3 (new) Conventional Treatment	Level 3 (exp) Conventional Treatment	Level 4 Brackish Desalination	Level 5 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	23,087	288,588	1,325,778	1,767,123	1,767,123	1,178,589	2,833,393
1	88,885	1,158,201	4,640,222	6,231,155	6,231,155	4,714,357	18,958,622
10	566,903	4,820,001	24,526,888	42,424,887	23,863,999	31,872,968	126,854,757
50	2,834,513	13,998,840	92,804,441	174,438,444	86,175,552	121,218,137	478,967,996
75	4,251,769	20,197,138	135,671,254	256,406,422	137,000,217	169,716,220	669,375,527
100	5,669,026	24,745,097	178,538,068	336,992,859	166,063,345	215,487,708	848,802,709
150	8,503,538	37,868,167	264,271,694	495,344,555	249,090,998	301,702,040	1,186,233,245
200	11,338,051	43,605,494	350,005,321	651,027,289	307,211,963	383,069,344	1,504,204,967

Note: Plant is sized for finished peak day capacity.

Table D-5
Advanced Water Treatment Facility Costs

Capacity (MGD)	Scheme 1 (includes RO)	Scheme 2
0	$0	$0
1	$9,918,242	$9,444,692
5	$35,384,711	$26,571,419
10	$61,298,421	$42,224,878
25	$152,259,491	$95,038,861

Table D-6
Cost Elements for Water Wells

Well Depth (ft)	Public Supply Well Costs Well Capacity (MGD)					
	100	175	350	700	1000	1800
150	$88,218	$112,093	$144,629			
300	$145,169	$220,377	$376,039	$425,012	$529,953	$774,816
500	$195,890	$279,843	$447,749	$512,463	$633,146	$897,247
700	$253,608	$349,804	$531,702	$612,157	$753,828	$1,044,164
1000	$306,079	$412,769	$606,910	$703,106	$862,267	$1,173,592
1500	$402,275	$528,204	$746,831	$869,263	$1,063,404	$1,414,957
2000	$563,184	$722,345	$977,702	$1,147,357	$1,395,717	$1,813,734
Irrigation Well Costs						
150	$80,455	$124,181	$211,631	$243,114	$307,828	$444,251
300	$106,690	$159,161	$258,854	$306,079	$388,283	$542,196
500	$132,926	$199,389	$309,576	$374,290	$475,734	$655,883
700	$153,913	$229,122	$353,302	$432,008	$552,690	$753,828
1000	$201,137	$295,585	$444,251	$550,941	$704,855	$946,220
1500	$281,593	$409,271	$594,667	$748,580	$956,714	$1,264,541
2000	$360,298	$519,459	$745,082	$944,471	$1,210,322	$1,584,612
ASR Well Costs						
150	$160,910	$248,360	$432,008	$487,977	$608,659	$897,247
300	$211,631	$307,828	$503,717	$575,427	$711,851	$1,021,427
500	$269,349	$379,538	$587,670	$675,122	$834,283	$1,166,596
700	$323,568	$442,502	$664,628	$766,071	$940,973	$1,297,772
1000	$418,015	$557,938	$802,801	$932,228	$1,142,111	$1,537,389
1500	$580,675	$750,330	$1,033,670	$1,210,322	$1,474,424	$1,936,165
2000	$739,836	$942,722	$1,264,541	$1,488,416	$1,808,486	$2,336,690

Table D-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

Table D-8
Advanced Water Treatment Facility O&M Costs

Capacity (MGD)	Scheme 1 (includes RO)	Scheme 2
0	$0	$0
1	$1,186,267	$642,163
5	$4,609,938	$2,379,709
10	$8,287,126	$4,185,417
25	$18,027,189	$8,879,063

Table D-9

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Amarillo - ASR (Randall Co.)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$8,199,000
TOTAL COST OF FACILITIES	**$8,199,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,870,000
Environmental & Archaeology Studies and Mitigation	$85,000
Land Acquisition and Surveying (8 acres)	$10,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$308,000
TOTAL COST OF PROJECT	**$11,472,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$807,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$82,000
Pumping Energy Costs (10000000 kW-hr @ 0.08 $/kW-hr)	$800,000
TOTAL ANNUAL COST	**$1,689,000**
Available Project Yield (acft/yr)	6,500
Annual Cost of Water ($ per acft), based on PF=1	$260
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$136
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.80
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.42
HK	*10/21/2019*

Table D-10

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Amarillo - Amarillo Direct Potable Reuse*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (12 in dia., 7 miles)	$4,950,000
Primary Pump Stations (1.6 MGD)	$1,064,000
Two Water Treatment Plants (5 MGD and 5 MGD)	$30,955,000
TOTAL COST OF FACILITIES	**$36,969,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,692,000
Environmental & Archaeology Studies and Mitigation	$185,000
Land Acquisition and Surveying (44 acres)	$51,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,373,000
TOTAL COST OF PROJECT	**$51,270,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,607,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$50,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$27,000
Water Treatment Plant	$4,191,000
Pumping Energy Costs (374007 kW-hr @ 0.08 $/kW-hr)	$30,000
TOTAL ANNUAL COST	**$7,905,000**
Available Project Yield (acft/yr)	3,500
Annual Cost of Water ($ per acft), based on PF=1.5	$2,259
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$1,228
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$6.93
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$3.77
Jeremy Rice	*11/7/2019*

Table D-11

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Amarillo - Develop Phase II of the Potter/Carson County Well Field

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (36 in dia., 5 miles)	$6,314,000
Primary Pump Stations (17.9 MGD)	$2,689,000
Well Fields (Wells, Pumps, and Piping)	$11,643,000
TOTAL COST OF FACILITIES	**$20,646,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,910,000
Environmental & Archaeology Studies and Mitigation	$843,000
Land Acquisition and Surveying (314 acres)	$414,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$793,000
TOTAL COST OF PROJECT	**$29,606,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,083,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$180,000
Pumping Energy Costs (10720161 kW-hr @ 0.08 $/kW-hr)	$858,000
TOTAL ANNUAL COST	**$3,188,000**
Available Project Yield (acft/yr)	10,000
Annual Cost of Water ($ per acft), based on PF=1	$319
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$111
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.98
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.34

JJR *11/7/2019*

Table D-12

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Amarillo - Roberts County Pipeline*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (36 in dia., 25.6 miles)	$37,500,000
Primary Pump Stations (20 MGD)	$12,474,000
Transmission Pump Station(s) & Storage Tank(s)	$15,183,000
TOTAL COST OF FACILITIES	$65,157,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$20,930,000
Environmental & Archaeology Studies and Mitigation	$651,000
Land Acquisition and Surveying (196 acres)	$238,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$5,980,000
TOTAL COST OF PROJECT	$92,956,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$6,540,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$375,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$691,000
Pumping Energy Costs (11817434 kW-hr @ 0.08 $/kW-hr)	$945,000
TOTAL ANNUAL COST	$8,551,000
Note: One or more cost element has been calculated externally	
Spencer Schnier, Freese and Nichols	*11/7/2019*

Table D-13

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Amarillo - Roberts County Wellfield*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$14,419,000
TOTAL COST OF FACILITIES	$14,419,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$5,047,000
Environmental & Archaeology Studies and Mitigation	$91,000
Land Acquisition and Surveying (24 acres)	$30,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$539,000
TOTAL COST OF PROJECT	$20,126,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,416,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$144,000
Pumping Energy Costs (16214600 kW-hr @ 0.08 $/kW-hr)	$1,297,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	$2,857,000
Note: One or more cost element has been calculated externally	
Spencer Schnier, Freese and Nichols	*11/7/2019*

Table D-14

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Booker - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,279,000
TOTAL COST OF FACILITIES	**$1,279,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$448,000
Environmental & Archaeology Studies and Mitigation	$16,000
Land Acquisition and Surveying (4 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$49,000
TOTAL COST OF PROJECT	**$1,796,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$126,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Pumping Energy Costs (225628 kW-hr @ 0.08 $/kW-hr)	$18,000
Purchase of Water (700 acft/yr @ 500 $/acft)	$350,000
TOTAL ANNUAL COST	**$507,000**
Available Project Yield (acft/yr)	400
Annual Cost of Water ($ per acft), based on PF=1	$1,268
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$953
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$3.89
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.92
HK	*1/7/2020*

Table D-15

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Cactus - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018	
Item	***Estimated Costs for Facilities***
Transmission Pump Station(s) & Storage Tank(s)	$901,000
Well Fields (Wells, Pumps, and Piping)	$10,995,000
TOTAL COST OF FACILITIES	**$11,896,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,164,000
Environmental & Archaeology Studies and Mitigation	$84,000
Land Acquisition and Surveying (5 acres)	$9,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$445,000
TOTAL COST OF PROJECT	**$16,598,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,168,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$119,000
Pumping Energy Costs (6576345 kW-hr @ 0.08 $/kW-hr)	$526,000
TOTAL ANNUAL COST	**$1,813,000**
Available Project Yield (acft/yr)	5,000
Annual Cost of Water ($ per acft), based on PF=1	$363
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$129
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.11
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.40
Note: One or more cost element has been calculated externally	
David Hawkins	*6/17/2019*

Table D-16

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Canyon - Develop Additional Groundwater Well(s) - Dockum*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,912,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,297,000
TOTAL COST OF FACILITIES	**$3,209,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,123,000
Environmental & Archaeology Studies and Mitigation	$16,000
Land Acquisition and Surveying (4 acres)	$4,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$120,000
TOTAL COST OF PROJECT	**$4,472,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$315,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$32,000
Pumping Energy Costs (731241 kW-hr @ 0.08 $/kW-hr)	$58,000
TOTAL ANNUAL COST	**$405,000**
Available Project Yield (acft/yr)	1,500
Annual Cost of Water ($ per acft), based on PF=1	$270
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$60
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.83
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.18
HK	*1/7/2020*

Table D-17

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Canyon - Develop Additional Groundwater Well(s) - Ogallala

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,918,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,736,000
TOTAL COST OF FACILITIES	**$3,654,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,279,000
Environmental & Archaeology Studies and Mitigation	$18,000
Land Acquisition and Surveying (4 acres)	$5,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$137,000
TOTAL COST OF PROJECT	**$5,093,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$358,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$37,000
Pumping Energy Costs (577849 kW-hr @ 0.08 $/kW-hr)	$46,000
TOTAL ANNUAL COST	**$441,000**
Available Project Yield (acft/yr)	1,500
Annual Cost of Water ($ per acft), based on PF=1	$294
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$55
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.17

HK *1/7/2020*

Table D-18

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *CRMWA - ASR - Region O*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Primary Pump Stations (13.4 MGD)	$4,998,000
Well Fields (Wells, Pumps, and Piping)	$14,883,000
TOTAL COST OF FACILITIES	**$19,881,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,958,000
Environmental & Archaeology Studies and Mitigation	$225,000
Land Acquisition and Surveying (19 acres)	$6,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$745,000
TOTAL COST OF PROJECT	**$27,815,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,957,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$149,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$125,000
Pumping Energy Costs (16498253 kW-hr @ 0.08 $/kW-hr)	$1,320,000
TOTAL ANNUAL COST	**$3,551,000**
Available Project Yield (acft/yr)	10,000
Annual Cost of Water ($ per acft), based on PF=1.5	$355
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$159
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.49
HK	*11/7/2019*

Table D-19

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *CRMWA - Roberts County Wellfield*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$40,073,000
Storage Tanks (Other Than at Booster Pump Stations)	$4,874,000
Integration, Relocations, & Other	$2,940,000
TOTAL COST OF FACILITIES	$47,887,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$16,761,000
Environmental & Archaeology Studies and Mitigation	$189,000
Land Acquisition and Surveying (47 acres)	$57,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,785,000
TOTAL COST OF PROJECT	$66,679,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,692,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$479,000
Pumping Energy Costs (86569467 kW-hr @ 0.08 $/kW-hr)	$6,926,000
TOTAL ANNUAL COST	$12,097,000
Note: One or more cost element has been calculated externally	
Spencer Schnier, Freese and Nichols	*11/7/2019*

Table D-20

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *CRMWA Roberts County CRMWA-Only Pipeline*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (66 in dia., 9.5 miles)	$26,357,000
Primary Pump Stations (65 MGD)	$44,020,000
TOTAL COST OF FACILITIES	$70,377,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$23,314,000
Environmental & Archaeology Studies and Mitigation	$243,000
Land Acquisition and Surveying (74 acres)	$90,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$6,465,000
TOTAL COST OF PROJECT	$100,489,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$7,071,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$264,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$1,101,000
Pumping Energy Costs (27748675 kW-hr @ 0.08 $/kW-hr)	$2,220,000
TOTAL ANNUAL COST	$10,656,000
Note: One or more cost element has been calculated externally	
Spencer Schnier, Freese and Nichols	*11/7/2019*

Table D-21

Canadian River Municipal Water Authority Replace Capacity of Roberts County Well Field (Ogallala Aquifer)				
Owner:	Canadian River Municipal Water Authority			
Quantity:	15,000 AF/Y			
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
Collection Pipeline(s)	8	EA	$100,000	$800,000
Well Field(s) and Wells	8	EA	$1,271,000	$10,168,000
Total Capital Cost				**$10,968,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% for pipelines)				$240,000
Engineering, Legal Costs and Contingencies (35% for wellfield)				$3,558,800
Interest During Construction (1 year)				$708,000
Total Project Cost				**$15,474,800**
Annual Costs				
Debt Service (3.5 percent for 20 years)				$1,089,000
Pipeline and Well Operation and Maintenance				$110,000
Pumping Energy Costs ($0.08/kWh)				$1,192,000
Total Annual Cost				**$2,391,000**
Unit Cost				
Annual Cost of Water ($ per acft)				$159
Annual Cost of Water ($ per 1,000 gallons)				$0.49

Table D-22

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
CRMWA Shared Pipeline

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (72 in dia., 57.3 miles)	$173,981,000
Transmission Pump Station(s) & Storage Tank(s)	$39,876,000
TOTAL COST OF FACILITIES	$213,857,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$66,151,000
Environmental & Archaeology Studies and Mitigation	$1,444,000
Land Acquisition and Surveying (427 acres)	$518,000
Interest During Construction (3% for 2.5 years with a 0.5% ROI)	$19,385,000
TOTAL COST OF PROJECT	$301,355,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$21,204,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,739,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$997,000
Pumping Energy Costs (89199385 kW-hr @ 0.08 $/kW-hr)	$7,136,000
TOTAL ANNUAL COST	$31,076,000

Note: One or more cost element has been calculated externally

Spencer Schnier, Freese and Nichols *11/7/2019*

Table D-23

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Dalhart - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (16 in dia., 2 miles)	$1,020,000
Primary Pump Stations (3 MGD)	$984,000
Well Fields (Wells, Pumps, and Piping)	$2,107,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,077,000
TOTAL COST OF FACILITIES	**$5,188,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,765,000
Environmental & Archaeology Studies and Mitigation	$96,000
Land Acquisition and Surveying (28 acres)	$35,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$195,000
TOTAL COST OF PROJECT	**$7,279,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$512,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$42,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Pumping Energy Costs (996156 kW-hr @ 0.08 $/kW-hr)	$80,000
TOTAL ANNUAL COST	**$659,000**
Available Project Yield (acft/yr)	1,300
Annual Cost of Water ($ per acft), based on PF=1	$507
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$113
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.56
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.35
HK	*1/7/2020*

Table D-24

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Dumas - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$3,977,000
TOTAL COST OF FACILITIES	**$3,977,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,392,000
Environmental & Archaeology Studies and Mitigation	$32,000
Land Acquisition and Surveying (9 acres)	$10,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$149,000
TOTAL COST OF PROJECT	**$5,560,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$391,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$40,000
Pumping Energy Costs (3013967 kW-hr @ 0.08 $/kW-hr)	$241,000
TOTAL ANNUAL COST	**$672,000**
Available Project Yield (acft/yr)	5,000
Annual Cost of Water ($ per acft), based on PF=1	$134
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$56
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.17

HK *1/7/2020*

Table D-25

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Greenbelt Municipal and Industrial Water Authority - Develop Additional Supplies from the Ogallala Aquifer in Donley County*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (16 in dia., 16 miles)	$8,163,000
Primary Pump Stations (2.7 MGD)	$946,000
Transmission Pump Station(s) & Storage Tank(s)	$975,000
Well Fields (Wells, Pumps, and Piping)	$2,723,000
TOTAL COST OF FACILITIES	**$12,807,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,074,000
Environmental & Archaeology Studies and Mitigation	$425,000
Land Acquisition and Surveying (57 acres)	$94,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$479,000
TOTAL COST OF PROJECT	**$17,879,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$1,258,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$119,000
Pumping Energy Costs (1056710 kW-hr @ 0.08 $/kW-hr)	$85,000
TOTAL ANNUAL COST	**$1,486,000**
Available Project Yield (acft/yr)	2,000
Annual Cost of Water ($ per acft), based on PF=1.5	$743
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$114
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$2.28
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.35
JSA	*9/25/2019*

Table D-26

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Gruver - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$640,000
TOTAL COST OF FACILITIES	**$640,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$224,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$24,000
TOTAL COST OF PROJECT	**$891,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$63,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
Pumping Energy Costs (139061 kW-hr @ 0.08 $/kW-hr)	$11,000
TOTAL ANNUAL COST	**$80,000**
Available Project Yield (acft/yr)	280
Annual Cost of Water ($ per acft), based on PF=1	$286
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$61
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.88
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.19
HK	*8/1/2019*

Table D-27

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Hall County-Other - Brice-Lesley - Develop Additional Groundwater Well(s) - Seymour*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$282,000
TOTAL COST OF FACILITIES	**$282,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$99,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$398,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$28,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
TOTAL ANNUAL COST	**$31,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=1	$620
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$60
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.18
HK	*1/7/2020*

Table D-28

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Hall County-Other - Estelline - Develop Additional Groundwater Well(s) - Seymour*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$146,000
TOTAL COST OF FACILITIES	**$146,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$51,000
Environmental & Archaeology Studies and Mitigation	$5,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,000
TOTAL COST OF PROJECT	**$209,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$15,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$1,000
TOTAL ANNUAL COST	**$16,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=1	$320
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$20
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.98
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.06
HK	*1/7/2020*

Table D-29

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Hall County-Other - Lakeview - Lakeview Nitrate Removal*	
Cost based on ENR CCI 11170.28 for September 2018 and ***a PPI of 201.9 for September 2018***	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Storage Tanks (Other Than at Booster Pump Stations)	$901,000
Advanced Water Treatment Facility (0.1 MGD)	$992,000
TOTAL COST OF FACILITIES	**$1,893,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$663,000
Interest During Construction (3% for 0.5 years with a 0.5% ROI)	$36,000
TOTAL COST OF PROJECT	**$2,592,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$182,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$9,000
Advanced Water Treamtent Facility	$119,000
TOTAL ANNUAL COST	**$310,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=1	$6,200
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$2,560
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$19.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$7.86
Spencer Schnier, Freese and Nichols	*1/23/2020*

Table D-30

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of McLean - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$292,000
TOTAL COST OF FACILITIES	**$292,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$102,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$12,000
TOTAL COST OF PROJECT	**$414,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
TOTAL ANNUAL COST	**$32,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=1	$213
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$20
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.65
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.06
HK	*8/1/2019*

Table D-31

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Memphis - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$507,000
Connection to Pump Station	$280,000
TOTAL COST OF FACILITIES	**$787,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$275,000
Environmental & Archaeology Studies and Mitigation	$28,000
Land Acquisition and Surveying (6 acres)	$7,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$31,000
TOTAL COST OF PROJECT	**$1,128,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$79,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$8,000
Pumping Energy Costs (50230 kW-hr @ 0.08 $/kW-hr)	$4,000
Purchase of Water (150 acft/yr @ 500 $/acft)	$75,000
TOTAL ANNUAL COST	**$166,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=1.5	$1,107
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$580
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$3.40
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$1.78

HK *9/12/2019*

Table D-32

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Moore County Manufacturing - Develop Additional Groundwater Well(s) - Dockum Aquifer

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,873,000
TOTAL COST OF FACILITIES	**$1,873,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$656,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (3 acres)	$3,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$70,000
TOTAL COST OF PROJECT	**$2,608,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$183,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000
Pumping Energy Costs (1233844 kW-hr @ 0.08 $/kW-hr)	$99,000
TOTAL ANNUAL COST	**$301,000**
Available Project Yield (acft/yr)	2,000
Annual Cost of Water ($ per acft), based on PF=1	$151
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$59
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.46
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.18

HK *1/7/2020*

Table D-33

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Moore County Manufacturing - Develop Additional Groundwater Well(s) - Ogallala Aquifer

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$725,000
TOTAL COST OF FACILITIES	**$725,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$254,000
Environmental & Archaeology Studies and Mitigation	$3,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$28,000
TOTAL COST OF PROJECT	**$1,012,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$71,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$7,000
Pumping Energy Costs (689379 kW-hr @ 0.08 $/kW-hr)	$55,000
TOTAL ANNUAL COST	**$133,000**
Available Project Yield (acft/yr)	1,000
Annual Cost of Water ($ per acft), based on PF=1	$133
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$62
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.19

HK *1/7/2020*

Table D-34

Connecting to Palo Duro Reservoir

Owner:	Palo Duro River Authority		Percentage	
Quantity:	Cactus	1,744	45.0%	
	Dumas	1,356	35.0%	
	Sunray	271	7.0%	
	Gruver	116	3.0%	
	Spearman	271	7.0%	
	Stinnet	116	3.0%	
	Total	3,875	100.0%	

		Quantity	Units	Unit Price	Cost
Water Treatment Plant					
9 MGD Conventional Treatment Plant		1	LS	$38,403,000	$38,403,000
Engineering and Contingencies (35%)					$13,441,000
Subtotal for Water Treatment Plant					**$51,844,000**

	Construction	Capital	O&M
Cactus	$17,281,000	$23,330,000	$1,219,000
Dumas	$13,441,000	$18,145,000	$948,000
Sunray	$2,688,000	$3,629,000	$190,000
Gruver	$1,152,000	$1,555,000	$81,000
Spearman	$2,688,000	$3,629,000	$190,000
Stinnet	$1,152,000	$1,555,000	$81,000

		Quantity	Units	Unit Price	Cost
Pipeline System Components					
24" line from Res. to WTP		9,000	LF	$187	$1,681,000
24" line from WTP to Spearman		51,000	LF	$187	$9,528,000
Crossings		230	LF	$719	$165,000
Connection to Spearman		2	LS	$79,000	$158,000
ROW	20	23	AC	$1,350	$31,000
Engineering and Contingencies (30%)					$3,460,000
Pipeline Subtotal at Spearman					**$15,023,000**

	Construction	Capital	Electricity ($)
Cactus	$5,044,000	$6,760,000	$101,000
Dumas	$3,923,000	$5,258,000	$78,000
Sunray	$785,000	$1,052,000	$16,000
Gruver	$336,000	$451,000	$7,000
Spearman	$785,000	$1,052,000	$16,000
Stinnet	$336,000	$451,000	$7,000

		Quantity	Units	Unit Price	Cost
8" line from Spearman to Gruver		71,300	LF	$48	$3,408,000
Crossings		460	LF	$240	$110,000
Connection to Gruver		1	LS		$50,000
ROW	15	25	AC	$1,350	$34,000
Engineering and Contingencies (30%)					$1,070,000
Pipeline Subtotal at Gruver					**$4,672,000**

Table D-34

Connecting to Palo Duro Reservoir

		Quantity	**Units**	**Unit Price**	**Cost**
24" line from Spearman to Stinnet Spur		133,500	LF	$187	$24,940,400
Crossings		460	LF	$719	$331,000
ROW	20	61	AC	$1,350	$82,000
Engineering and Contingencies (30%)					$7,581,000
Pipeline Subtotal at Stinnet Spur					**$32,934,400**
	Construction	Capital	Electricity ($)		
Cactus	$12,470,000	$16,467,000	$78,000		
Dumas	$9,699,000	$12,808,000	$61,000		
Sunray	$1,940,000	$2,562,000	$12,000		
Gruver	$0	$0	$0		
Spearman	$0	$0	$0		
Stinnet	$831,000	$1,098,000	$5,000		
		Quantity	**Units**	**Unit Price**	**Cost**
8" line from Stinnet Spur to Stinnet		83,350	LF	$48	$3,984,000
Crossings		1,680	LF	$240	$403,000
Connection to Stinnet		1	LS		$50,000
ROW	20	38	AC	$1,350	$51,000
Engineering and Contingencies (30%)					$1,331,000
Pipeline Subtotal at Stinnet					**$5,819,000**
		Quantity	**Units**	**Unit Price**	**Cost**
24" line from Stinnet Spur to Dumas		122,800	LF	$187	$22,941,000
Crossings		460	LF	$719	$331,000
Connection to Dumas		1	LS		$50,000
ROW	20	56	AC	$1,350	$76,000
Engineering and Contingencies (30%)					$6,997,000
Pipeline Subtotal at Dumas					**$30,395,000**
	Construction	Capital	Electricity ($)		
Cactus	$11,866,000	$15,722,000	$101,000		
Dumas	$9,229,000	$12,228,000	$78,000		
Sunray	$1,846,000	$2,446,000	$16,000		
Gruver	$0	$0	$0		
Spearman	$0	$0	$0		
Stinnet	$0	$0	$0		
		Quantity	**Units**	**Unit Price**	**Cost**
8" line from Sunray Spur to Sunray		28,000	LF	$48	$1,338,000
Crossings		460	LF	$240	$110,000
Pressure Reducing Valve		1	EA		$35,000
Connection to Sunray		1	LS		$50,000
ROW	15	10	AC	$1,350	$14,000
Engineering and Contingencies (30%)					$460,000
Pipeline Subtotal at Sunray					**$669,000**

Table D-34

Connecting to Palo Duro Reservoir					
		Quantity	**Units**	**Unit Price**	**Cost**
18" line from Dumas to Cactus		67,150	LF	$135	$9,061,000
Crossings		460	LF	$539	$248,000
Connection to Cactus		1	LS		$50,000
ROW	20	31	AC	$1,350	$42,000
Engineering and Contingencies (30%)					$2,808,000
Pipeline Subtotal at Cactus					**$12,209,000**
Pump Station Components		**Quantity**	**Units**	**Unit Price**	**Cost**
6.92 MGD PS at intake		500	HP		$10,890,000
6.92 MGD PS at WTP		500	HP		$10,890,000
9 MGD PS at Spearman		800	HP		$15,821,000
8.12 MGD at Stinnet Spur		800	HP		$15,821,000
4.04 MGD at Dumas		100	HP		$4,315,000
Engineering and Contingencies (35%)					$20,208,000
Pump Station Subtotal					**$77,945,000**
Construction Costs	6.92 MGD PS at intake	6.92 MGD PS at WTP	9 MGD PS at Spearman	8.12 MGD at Stinnet Spur	4.04 MGD at Dumas
Cactus	$4,901,000	$4,901,000	$7,119,000	$7,911,000	$2,427,000
Dumas	$3,812,000	$3,812,000	$5,537,000	$6,153,000	$1,888,000
Sunray	$762,000	$762,000	$1,107,000	$1,231,000	$0
Gruver	$327,000	$327,000	$475,000	$0	$0
Spearman	$762,000	$762,000	$1,107,000	$0	$0
Stinnet	$327,000	$327,000	$475,000	$527,000	$0
check total	$10,891,000	$10,891,000	$15,820,000	$15,822,000	$4,315,000
Capital Costs	9 MGD PS at intake	9 MGD PS at WTP	9 MGD PS at Spearman	8.12 MGD at Stinnet Spur	4.04 MGD at Dumas
Cactus	$6,616,000	$6,616,000	$9,611,000	$10,679,000	$3,277,000
Dumas	$5,146,000	$5,146,000	$7,475,000	$8,306,000	$2,549,000
Sunray	$1,029,000	$1,029,000	$1,495,000	$1,661,000	$0
Gruver	$441,000	$441,000	$641,000	$0	$0
Spearman	$1,029,000	$1,029,000	$1,495,000	$0	$0
Stinnet	$441,000	$441,000	$641,000	$712,000	$0
check total	$14,702,000	$14,702,000	$21,358,000	$21,358,000	$5,826,000
Ground Storage Tanks		**Quantity**	**Units**	**Unit Price**	**Cost**
3 MG at WTP		1	LS	$1,527,000	$1,527,000
3 MG at Spearman		1	LS	$1,527,000	$1,527,000
2.5 MG at Stinnet Spur		1	LS	$1,338,000	$1,338,000
1.5 MG at Dumas		1	LS	$961,000	$961,000
Engineering and Contingencies (35%)					$1,874,000
Pump Station Subtotal					**$7,227,000**

Table D-34

Connecting to Palo Duro Reservoir

Construction Costs	3 MG at WTP	3 MG at Spearman	2.5 MG at Stinnet Spur	1.5 MG at Dumas
Cactus	$687,000	$687,000	$669,000	$541,000
Dumas	$534,000	$534,000	$520,000	$420,000
Sunray	$107,000	$107,000	$104,000	$0
Gruver	$46,000	$46,000	$0	$0
Spearman	$107,000	$107,000	$0	$0
Stinnet	$46,000	$46,000	$45,000	$0

Capital Costs	3 MG at WTP	3 MG at Spearman	2.5 MG at Stinnet Spur	1.5 MG at Dumas
Cactus	$928,000	$928,000	$903,000	$730,000
Dumas	$722,000	$722,000	$702,000	$568,000
Sunray	$144,000	$144,000	$140,000	$0
Gruver	$62,000	$62,000	$0	$0
Spearman	$144,000	$144,000	$0	$0
Stinnet	$62,000	$62,000	$60,000	$0

TOTAL COST OF FACILITIES	
Cactus	$114,776,000
Dumas	$79,775,000
Sunray	$16,000,000
Gruver	$8,325,000
Spearman	$8,522,000
Stinnet	$11,342,000

Interest During Construction (24 month)	
Cactus	$7,049,000
Dumas	$4,876,000
Sunray	$994,000
Gruver	$521,000
Spearman	$521,000
Stinnet	$704,000

Environmental & Archaeology Studies and Mitigation	
Cactus	$736,000
Dumas	$488,000
Sunray	$114,000
Gruver	$63,000
Spearman	$52,000
Stinnet	$80,000

Table D-34

Connecting to Palo Duro Reservoir

TOTAL CAPITAL COST	
Cactus	$122,561,000
Dumas	$85,139,000
Sunray	$17,108,000
Gruver	$8,909,000
Spearman	$9,095,000
Stinnet	$12,126,000
check total	$254,938,000

Annual Costs - Cactus	**Cost**
Debt Service (3.5 percent for 20 years)	$8,624,000
Electricity ($0.08 per kwh)	$298,000
Price to Purchase Water ($0.15 per 1,000 gal)	$85,000
Operation and Maintenance	$2,286,000
Total Annual Cost	$11,293,000
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$6,476
Water Cost ($ per 1,000 gallons)	$19.87
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$1,531
Water Cost ($ per 1,000 gallons)	$4.70

Annual Costs - Dumas	**Cost**
Debt Service (3.5 percent for 20 years)	$5,990,000
Electricity ($0.08 per kwh)	$217,000
Price to Purchase Water ($0.15 per 1,000 gal)	$66,000
Operation and Maintenance	$1,707,000
Total Annual Cost	$7,980,000
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$5,884
Water Cost ($ per 1,000 gallons)	$18.06
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$1,467
Water Cost ($ per 1,000 gallons)	$4.50

Annual Costs - Sunray	**Cost**
Debt Service (3.5 percent for 20 years)	$1,204,000
Electricity ($0.08 per kwh)	$44,000
Price to Purchase Water ($0.15 per 1,000 gal)	$13,000
Operation and Maintenance	$346,000
Total Annual Cost	$1,607,000
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$5,924
Water Cost ($ per 1,000 gallons)	$18.18

Table D-34

Connecting to Palo Duro Reservoir	
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$1,486
Water Cost ($ per 1,000 gallons)	$4.56
Annual Costs - Gruver	**Cost**
Debt Service (3.5 percent for 20 years)	$627,000
Electricity ($0.08 per kwh)	$9,500
Price to Purchase Water ($0.15 per 1,000 gal)	$6,000
Operation and Maintenance	$147,000
Total Annual Cost	$789,500
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$6,791
Water Cost ($ per 1,000 gallons)	$20.84
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$1,398
Water Cost ($ per 1,000 gallons)	$4.29
Annual Costs - Spearman	**Cost**
Debt Service (3.5 percent for 20 years)	$640,000
Electricity ($0.08 per kwh)	$16,000
Price to Purchase Water ($0.15 per 1,000 gal)	$13,300
Operation and Maintenance	$90,000
Total Annual Cost	$759,300
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$2,799
Water Cost ($ per 1,000 gallons)	$8.59
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$440
Water Cost ($ per 1,000 gallons)	$1.35
Annual Costs - Stinnet	**Cost**
Debt Service (3.5 percent for 20 years)	$853,200
Electricity ($0.08 per kwh)	$14,100
Price to Purchase Water ($0.15 per 1,000 gal)	$5,700
Operation and Maintenance	$173,900
Total Annual Cost	$1,046,900
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$9,006
Water Cost ($ per 1,000 gallons)	$27.64
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$1,666
Water Cost ($ per 1,000 gallons)	$5.11

Table D-35

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Pampa - City of Pampa ASR*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,572,000
TOTAL COST OF FACILITIES	**$1,572,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$550,000
Environmental & Archaeology Studies and Mitigation	$1,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$59,000
TOTAL COST OF PROJECT	**$2,183,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$154,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$16,000
TOTAL ANNUAL COST	**$170,000**
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft), based on PF=1.5	$340
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.5	$32
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.5	$1.04
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.5	$0.10
HK	*10/22/2019*

Table D-36

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Pampa - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Primary Pump Stations (1.2 MGD)	$1,008,000
Well Fields (Wells, Pumps, and Piping)	$1,317,000
Storage Tanks (Other Than at Booster Pump Stations)	$539,000
TOTAL COST OF FACILITIES	**$2,864,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,002,000
Environmental & Archaeology Studies and Mitigation	$85,000
Land Acquisition and Surveying (26 acres)	$30,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$110,000
TOTAL COST OF PROJECT	**$4,091,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$288,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Pumping Energy Costs (707818 kW-hr @ 0.08 $/kW-hr)	$57,000
TOTAL ANNUAL COST	**$389,000**
Available Project Yield (acft/yr)	1,100
Annual Cost of Water ($ per acft), based on PF=1.2	$354
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.2	$92
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$1.09
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.28

HK *1/7/2020*

Table D-37

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Panhandle - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$1,305,000
TOTAL COST OF FACILITIES	**$1,305,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$457,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$49,000
TOTAL COST OF PROJECT	**$1,814,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$128,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$13,000
Pumping Energy Costs (1164666 kW-hr @ 0.08 $/kW-hr)	$93,000
TOTAL ANNUAL COST	**$234,000**
Available Project Yield (acft/yr)	600
Annual Cost of Water ($ per acft), based on PF=1	$390
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$177
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.54

HK *1/7/2020*

Table D-38

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Perryton - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (12 in dia., 9.9 miles)	$3,576,000
Primary Pump Stations (1.5 MGD)	$1,084,000
Well Fields (Wells, Pumps, and Piping)	$1,783,000
TOTAL COST OF FACILITIES	**$6,443,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,076,000
Environmental & Archaeology Studies and Mitigation	$257,000
Land Acquisition and Surveying (67 acres)	$77,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$244,000
TOTAL COST OF PROJECT	**$9,097,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$640,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$54,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$27,000
Pumping Energy Costs (780672 kW-hr @ 0.08 $/kW-hr)	$62,000
TOTAL ANNUAL COST	**$783,000**
Available Project Yield (acft/yr)	820
Annual Cost of Water ($ per acft), based on PF=2	$955
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$174
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$2.93
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.54

AMC *7/1/2020*

Table D-39

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Potter County Manufacturing - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$231,000
TOTAL COST OF FACILITIES	**$231,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$81,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$9,000
TOTAL COST OF PROJECT	**$324,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$23,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$2,000
Pumping Energy Costs (160808 kW-hr @ 0.08 $/kW-hr)	$13,000
TOTAL ANNUAL COST	**$38,000**
Available Project Yield (acft/yr)	150
Annual Cost of Water ($ per acft), based on PF=1	$253
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$100
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.78
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.31

AMC *8/1/2019*

Table D-40

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Randall County Manufacturing - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$276,000
TOTAL COST OF FACILITIES	**$276,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$96,000
Environmental & Archaeology Studies and Mitigation	$2,000
Land Acquisition and Surveying (1 acres)	$1,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$386,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$27,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$3,000
Pumping Energy Costs (119990 kW-hr @ 0.08 $/kW-hr)	$10,000
TOTAL ANNUAL COST	**$40,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=1	$400
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$130
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.23
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.40

HK *8/1/2019*

Table D-41

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Spearman - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (8 in dia., 1 miles)	$209,000
Primary Pump Stations (0.6 MGD)	$754,000
Well Fields (Wells, Pumps, and Piping)	$888,000
TOTAL COST OF FACILITIES	**$1,851,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$637,000
Environmental & Archaeology Studies and Mitigation	$32,000
Land Acquisition and Surveying (12 acres)	$14,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$70,000
TOTAL COST OF PROJECT	**$2,604,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$183,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Pumping Energy Costs (379930 kW-hr @ 0.08 $/kW-hr)	$30,000
TOTAL ANNUAL COST	**$243,000**
Available Project Yield (acft/yr)	520
Annual Cost of Water ($ per acft), based on PF=1.2	$467
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.2	$115
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$1.43
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.35
HK	*8/9/2019*

Table D-42

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Stinnett - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$605,000
TOTAL COST OF FACILITIES	**$605,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$212,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$23,000
TOTAL COST OF PROJECT	**$848,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$60,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$6,000
TOTAL ANNUAL COST	**$66,000**
Available Project Yield (acft/yr)	50
Annual Cost of Water ($ per acft), based on PF=1	$1,320
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$120
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.05
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.37

HK *8/9/2019*

Table D-43

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Sunray - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Primary Pump Stations (0.6 MGD)	$776,000
Well Fields (Wells, Pumps, and Piping)	$1,427,000
Storage Tanks (Other Than at Booster Pump Stations)	$945,000
TOTAL COST OF FACILITIES	**$3,148,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,102,000
Environmental & Archaeology Studies and Mitigation	$72,000
Land Acquisition and Surveying (20 acres)	$23,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$120,000
TOTAL COST OF PROJECT	**$4,465,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$314,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$24,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Pumping Energy Costs (260079 kW-hr @ 0.08 $/kW-hr)	$21,000
TOTAL ANNUAL COST	**$378,000**
Available Project Yield (acft/yr)	500
Annual Cost of Water ($ per acft), based on PF=1.3	$756
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.3	$128
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.3	$2.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.3	$0.39

HK *8/9/2019*

Table D-44

Cost Estimate Summary ***Water Supply Project Option*** ***September 2018 Prices*** ***TCW Supply Inc - Develop Additional Groundwater Well(s)***	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (6 in dia., 2 miles)	$268,000
Primary Pump Stations (0.4 MGD)	$935,000
Well Fields (Wells, Pumps, and Piping)	$687,000
Storage Tanks (Other Than at Booster Pump Stations)	$901,000
TOTAL COST OF FACILITIES	**$2,791,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$964,000
Environmental & Archaeology Studies and Mitigation	$60,000
Land Acquisition and Surveying (20 acres)	$24,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$106,000
TOTAL COST OF PROJECT	**$3,945,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$278,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$19,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$23,000
Pumping Energy Costs (335962 kW-hr @ 0.08 $/kW-hr)	$27,000
TOTAL ANNUAL COST	**$347,000**
Available Project Yield (acft/yr)	400
Annual Cost of Water ($ per acft), based on PF=1.2	$868
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.2	$173
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$2.66
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.53
HK	*8/9/2019*

Table D-45

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Texline - Develop Additional Groundwater Well(s)*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Well Fields (Wells, Pumps, and Piping)	$350,000
TOTAL COST OF FACILITIES	**$350,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$123,000
Environmental & Archaeology Studies and Mitigation	$6,000
Land Acquisition and Surveying (2 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$14,000
TOTAL COST OF PROJECT	**$495,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$35,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$4,000
TOTAL ANNUAL COST	**$39,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=1	$390
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$40
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.12
HK	*8/9/2019*

Table D-46

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *Turkey - Develop Additional Groundwater Well(s) - Ogallala Briscoe*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (6 in dia., 3.5 miles)	$468,000
Well Fields (Wells, Pumps, and Piping)	$632,000
TOTAL COST OF FACILITIES	**$1,100,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$362,000
Environmental & Archaeology Studies and Mitigation	$90,000
Land Acquisition and Surveying (1 acres)	$2,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$43,000
TOTAL COST OF PROJECT	**$1,597,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$112,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Pumping Energy Costs (67947 kW-hr @ 0.08 $/kW-hr)	$5,000
TOTAL ANNUAL COST	**$128,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=2	$1,280
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$160
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$3.93
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.49
HK	*1/7/2020*

Table D-47

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Wellington - Develop Additional Groundwater Well(s) - Seymour

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 201.9 for September 2018

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Transmission Pipeline (8 in dia., 3 miles)	$627,000
Well Fields (Wells, Pumps, and Piping)	$435,000
TOTAL COST OF FACILITIES	**$1,062,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$340,000
Environmental & Archaeology Studies and Mitigation	$109,000
Land Acquisition and Surveying (6 acres)	$10,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$42,000
TOTAL COST OF PROJECT	**$1,563,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$110,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Pumping Energy Costs (53312 kW-hr @ 0.08 $/kW-hr)	$4,000
TOTAL ANNUAL COST	**$125,000**
Available Project Yield (acft/yr)	100
Annual Cost of Water ($ per acft), based on PF=1.3	$1,250
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.3	$150
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.3	$3.84
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.3	$0.46

HK *1/7/2020*

Table D-48

Cost Estimate Summary *Water Supply Project Option* *September 2018 Prices* *City of Wellington - Wellington Nitrate Removal*	
Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Storage Tanks (Other Than at Booster Pump Stations)	$1,077,000
Advanced Water Treatment Facility (0.5 MGD)	$4,959,000
TOTAL COST OF FACILITIES	**$6,036,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,113,000
Interest During Construction (3% for 0.5 years with a 0.5% ROI)	$113,000
TOTAL COST OF PROJECT	**$8,262,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$581,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Advanced Water Treatment Facility	$593,000
TOTAL ANNUAL COST	**$1,185,000**
Available Project Yield (acft/yr)	560
Annual Cost of Water ($ per acft), based on PF=1	$2,116
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$1,079
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$6.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$3.31
Spencer Schnier, Freese and Nichols	*1/23/2020*

Table D-49

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
City of Wheeler - Develop Additional Groundwater Well(s)

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 201.9 for September 2018

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Transmission Pipeline (6 in dia., 2 miles)	$268,000
Primary Pump Stations (0.2 MGD)	$819,000
Well Fields (Wells, Pumps, and Piping)	$855,000
TOTAL COST OF FACILITIES	**$1,942,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$666,000
Environmental & Archaeology Studies and Mitigation	$69,000
Land Acquisition and Surveying (21 acres)	$24,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$75,000
TOTAL COST OF PROJECT	**$2,776,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$195,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$11,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$20,000
Pumping Energy Costs (96931 kW-hr @ 0.08 $/kW-hr)	$8,000
TOTAL ANNUAL COST	**$234,000**
Available Project Yield (acft/yr)	160
Annual Cost of Water ($ per acft), based on PF=1.2	$1,463
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.2	$244
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.2	$4.49
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.2	$0.75

HK *8/9/2019*

APPENDIX E

CONSISTENCY MATRIX

CHECKLIST FOR COMPARISON OF THE REGIONAL WATER PLAN TO APPLICABLE WATER PLANNING REGULATIONS

The purpose of this attachment is to facilitate the determination of how the Regional Water Plan is consistent with the long-term protection of the water, agricultural, and natural resources of the State of Texas, particularly within this region. The following checklist includes a regulatory citation (Column 1) for all subsections and paragraphs contained in the following applicable portions of the water planning regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.3
- 31 TAC Chapter 357.4
- 31 TAC Chapter 357.2
- 31 TAC Chapter 357.5

According to 31 TAC Chapter 357.41, the Regional Water Plan is considered to be consistent with the long-term protection of the State's resources if it complies with the above listed requirements. Therefore, the Regional Water Plan has been compared to each applicable section of the regulations as a means of determining consistency.

The checklist also includes a summary description of each cited regulation (Column 2). It should be understood that this summary is intended only to provide a general description of the particular section of the regulation and should not be assumed to contain all specifics of the actual regulation. The evaluation of the Regional Water Plan should be performed against the complete regulation, as contained in the actual 31 TAC 358 and 31 TAC 357 regulations.

The evidence of where, in the Regional Water Plan, the stated regulation is addressed is provided in Column 3. Where the regulation is addressed in multiple locations within the Regional Water Plan, this column may cite only the primary locations. In addition to identifying where the regulation is addressed, this column may include commentary about the application of the regulation in the Regional Water Plan.

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(Col 1)	(Col 2)	(Col 4)
Guidance Principles		
31 TAC §358.3		
358.3 (1)	The state water plan shall provide for the preparation for and response to drought conditions.	Chapters 1, 2, 3, 5, 7
(2)	The RWP and SWP shall serve as water supply plans under drought of record conditions.	See above
(3)	Consideration shall be given to the construction and improvement of surface water resources and the application of principles that result in voluntary redistribution of water resources.	Chapter 5
(4)	RWP 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 affected regional water planning areas and the state.	Chapters 5, 6 and 7
(5)	RWP 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.	Chapters 5 and 7
(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.	Chapter 10
(7)	The RWPG shall establish terms of participation in water planning efforts that shall be equitable and shall not unduly hinder participation.	Chapter 10
(8)	Consideration of the effect of policies or water management strategies on the public interest of the state, water supply, and those entities involved in providing this supply throughout the entire state.	Chapters 5 and 8
(9)	Consideration of all water management strategies the regional water plan determines to be potentially feasible when developing plans to meet future water needs and to respond to drought so that cost effective water management strategies which are consistent with long-term protection of the state's water resources, agricultural resources, and natural resources are considered and approved.	Chapters 5 and 6
(10)	Consideration of opportunities that encourage and result in voluntary transfers of water resources, including but not limited to regional water banks, sales, leases, options, subordination agreements, and financing agreements.	Chapter 5
(11)	Consideration of a balance of economic, social, aesthetic, and ecological viability.	Chapter 5, Attachment 5-2
(12)	For regional water planning areas without approved regional water plans or water providers for which revised plans are not developed through the regional water planning process, the use of information from the adopted state water plan and other completed studies that are sufficient for water planning shall represent the water supply plan for that area or water provider.	N/A
(13)	All surface waters are held in trust by the state, their use is subject to rights granted and administered by the Commission, and the use of surface water is governed by the prior appropriation doctrine, unless adjudicated otherwise.	Chapter 3, Appendix B
(14)	Existing water rights, water contracts, and option agreements shall be protected. However, potential amendments of water rights, contracts and agreements may be considered and evaluated. Any amendments will require the eventual consent of the owner.	Chapters 3 and 5
(15)	The production and use of groundwater in Texas is governed by the rule of capture doctrine unless and to the extent that such production and use is regulated by a groundwater conservation district as codified by the legislature at Texas Water Code §36.002 (relating to Ownership of Groundwater).	Chapters 3 and 5

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(16)	Consideration of recommendations of river and stream segments of unique ecological value to the legislature for potential protection.	Chapter 8
(17)	Consideration of recommendation of sites of unique value for the construction of reservoirs to the legislature for potential protection.	Chapter 8
(18)	Consideration of water planning and management activities of local, regional, state, and federal agencies, along with existing local, regional, and state water plans and information and existing state and federal programs and goals.	Chapters 1 and 5
(19)	Designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained.	Chapter 6
(20)	Coordination of water planning and management activities of RWPGs to identify common needs and issues and achieve efficient use of water supplies, including the Board and other relevant RWPGs, working together to identify common needs, issues, and challenges while working together to resolve conflicts in a fair, equitable, and efficient manner.	Entire RWP
(21)	The water management strategies identified in approved RWPs to meet needs shall be described in sufficient detail to allow a state agency making a financial or regulatory decision to determine if a proposed action before the state agency is consistent with an approved RWP.	Chapter 5, Appendices C and D
(22)	The evaluation of water management strategies shall use environmental information in accordance with the Commission's adopted environmental flow standards under 30 TAC Chapter 298 (relating to Environmental Flow Standards for Surface Water) where applicable or, in basins where standards are not available or have not been adopted, information from existing site-specific studies or state consensus environmental planning criteria.	Chapter 5; No new appropriations are recommended.
(23)	Consideration of environmental water needs including instream flows and bay and estuary inflows, including adjustments by the RWPGs to water management strategies to provide for environmental water needs including instream flows and bay and estuary needs. Consideration shall be consistent with the Commission's adopted environmental flow standards under 30 TAC Chapter 298 in basins where standards have been adopted.	Chapter 5; No new appropriations are recommended. Existing instream regulations considered.
(24)	Planning shall be consistent with all laws applicable to water use for the state and regional water planning area.	Entire RWP
(25)	The inclusion of ongoing water development projects that have been permitted by the Commission or a predecessor agency.	Chapter 5; None in PWPA
(26)	Specific recommendations of water management strategies shall be based upon identification, analysis, and comparison of all water management strategies the RWPG determines to be potentially feasible so that the cost effective water management strategies which are environmentally sensitive are considered and adopted unless the RWPG demonstrates that adoption of such strategies is not appropriate. To determine cost-effectiveness, the RWPGs will use the process describedin §357.34(d)(3)(A) of this title (relating to Identificationand Evaluation of Potentially Feasible Water Management Strategies)and, to determine environmental sensitivity, the RWPGs shall use theprocess described in §357.34(d)(3)(B) of this title.	Chapter 5, Attachment 5-2, Appendix D
(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.	Chapters 5 and 10
(28)	RWPGs must consider existing regional water planning efforts when developing their plans.	Chapters 1, 5 and 10

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
Chapter One Description of the Regional Water Planning Area		
31 TAC §357.30		
	RWPGs shall describe their regional water planning area including the following:	
357.3 (1)	Social and economic aspects of a region such as information on current population, economic activity and economic sectors heavily dependent on water resources	Section 1.3
(2)	Current water use and major water demand centers	Section 1.6
(3)	Current groundwater, surface water, and reuse supplies including major springs that are important for water supply or protection of natural resources	Section 1.5
(4)	Major water providers	Section 1.4
(5)	Agricultural and natural resources	Section 1.7
(6)	Identified water quality problems	Sections 1.5, 1.7 and 1.8
(7)	Identified threats to agricultural and natural resources due to water quantity problems or water quality problems related to water supply	Section 1.8
(8)	Summary of existing local and regional water plans	Section 1.11
(9)	The identified historic drought(s) of record within the planning area	Section 1.8 and Chapter 7
(10)	Current preparations for drought within the RWPA	Section 1.8, Chapter 7, and http://www.panhandlewater.org/
(11)	Information compiled by the Board from water loss audits (see also Texas Administrative Code §358.6)	Section 1.9
(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.	Section 1.8 and Chapter 6
Chapter Two Projected Non Municipal, Municipal and Population Water Demands		
31 TAC §357.31		
357.31 (a)	RWPs shall present projected population and Water Demands by WUG as defined in §357.10 of this title (relating to Definitions and Acronyms). If a WUG lies in one or more counties or RWPA or river basins, data shall be reported for each river basin, RWPA, and county split.	Chapter 2, Attachment 2-1, Appendix J
(b)	RWPs shall present projected Water Demands associated with MWPs by category of water use, including municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock for the RWPA.	Section 2.6, Attachment 2-1
(c)	RWPs shall evaluate the current contractual obligations of WUGs and WWPs to supply water in addition to any demands projected for the WUG or WWP. Information regarding obligations to supply water to other users must also be incorporated into the water supply analysis in §357.32 of this title (relating to Water Supply Analysis) in order to determine net existing water supplies available for each WUG's own use. The evaluation of contractual obligations under this subsection is limited to determining the amount of water secured by the contract and the duration of the contract.	Chapters 2 and 3
(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. RWPGs shall report how changes in plumbing fixtures would affect projected municipal Water Demands using projections with plumbing code savings provided by the Board or by methods approved by the EA.	Section 2.3 and Attachment 2-1
(e)	Source of population and Water Demands. In developing RWPs, RWPGs shall use:	
(e) (1)	Population and water demand projections developed by the EA that will be contained in the next state water plan and adopted by the Board after consultation with the RWPGs, Commission, Texas Department of Agriculture, and the Texas Parks and Wildlife Department.	Chapter 2

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(e) (2)	RWPGs may request revisions of Board adopted population or Water Demand projections if the request demonstrates that population or Water Demand projections no longer represents a reasonable estimate of anticipated conditions based on changed conditions and or new information. Before requesting a revision to population and Water Demand projections, the RWPG shall discuss the proposed revisions at a public meeting for which notice has been posted in accordance with §357.21(c) of this title (relating to Notice and Public Participation). The RWPG shall summarize public comments received on the proposed request for projection revisions. The EA shall consult with the requesting RWPG and respond to their request within 45 days after receipt of a request from an RWPG for revision of population or Water Demand projections.	Chapter 2 - Adjustments to population projections were made to eight municipal water user groups. Water demand adjustments were made to municipal water user group based on baseline GPCD errors and alternative dry year. Agricultural demand users were changed based on the Texas A&M AgriLife Memorandum included as Appendix A
(f)	Population and Water Demand projections shall be presented for each Planning Decade for WUGs and MWPs.	Chapter 2, Attachment 2-1
Chapter Three Water Supply Analysis		
31 TAC §357.32		
357.32 (a)	RWPGs shall evaluate:	
(a) (1)	Source water availability during drought of record conditions.	Chapter 3 and Appendix B
(a) (2)	Existing water supplies that are legally and physically available to WUGs and wholesale water suppliers within the RWPA for use during the drought of record.	Sections 3.1, 3.2
(b)	Consider surface water and groundwater 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	Sections 3.1, 3.2
(c)	Evaluation of the existing surface water available during drought of record shall be based on firm yield. The analysis may be based on justified operational procedures other than firm yield.	Section 3.1, Appendix B
(d)	Use modeled available groundwater volumes for groundwater availability, as issued by the Board, and incorporate such information in its RWP unless no modeled available groundwater volumes are provided.	Section 3.1
(e)	Evaluate the existing water supplies for each WUG and WWP	Section 3.2
(f)	Water supplies based on contracted agreements will be based on the terms of the contract, which may be assumed to renew upon contract termination if the contract contemplates renewal or extensions.	Sections 3.1, 3.2
(g)	Evaluation results shall be reported by WUG in accordance with §357.31(a) of this title (relating to Projected Population and Water Demands) and MWPs in accordance with §357.31(b) of this title	Chapters 2 and 3, Attachment 3-1
Chapter Four Identification of Water Needs		
31 TAC §357.33		
357.33 (a)	RWPs shall include comparisons of existing water supplies and projected Water Demands to identify Water Needs.	Chapter 4
(b)	RWPGs shall compare projected Water Demands, developed in accordance with §357.31 of this title (relating to Projected Population and Water Demands), with existing water supplies available to WUGs and WWPs in a planning area, as developed in accordance with §357.32 of this title (relating to Water Supply Analysis), to determine whether WUGs will experience water surpluses or needs for additional supplies. Results shall be reported for WUGs by categories of use including municipal, manufacturing, irrigation, steam electric, mining, and livestock watering for each county or portion of a county in an RWPA. Results shall be reported for MWPs by categories of use including municipal, manufacturing, irrigation, steam electric, mining, and livestock watering for the RWPA.	Section 4.2, Attachment 4-1
(c)	The social and economic impacts of not meeting water needs will be evaluated by RWPGs and reported for each RWPA.	Chapter 6, Appendix G

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(d)	Results of evaluations will be reported by WUG in accordance with §357.31(a) of this title and MWPs in accordance with §357.31(b) of this title.	Chapter 4, Attachment 4-1
(e)	RWPGs shall perform a secondary water needs analysis for all WUGs and WWPs for which conservation WMSs or direct Reuse WMSs are recommended. This secondary water needs analysis shall calculate the Water Needs that would remain after assuming all recommended conservation and direct Reuse WMSs are fully implemented. The resulting secondarywater needs volumes shall be presented in the RWP by WUG and MWP and decade.	Section 4.3 and Appendix J
Chapter Five Identification and Evaluation of Potentially Feasible Water Management Strategies		
31 TAC §357.34		
357.34 (a)	RWPGs shall identify and evaluate potentially feasible WMSs and the WMSPs required to implement those strategies for all WUGs and WWPs with identified Water Needs.	Chapter 5
(b)	RWPGs shall identify potentially feasible WMSs to meet water supply needs identified in §357.33 of this title (relating to Needs Analysis: Comparison of Water Supplies and Demands)in accordance with the process in §357.12(b) of this title (relating to General Regional Water Planning Group Responsibilities and Procedures). Strategies shall be developed for WUGs and WWPs. The strategies shall meet new water supply obligations necessary to implement recommended WMSs 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.	Subchapter 5A and Attachment 5-1
(c)	Potential Feasible Water Management Strategies should include, but are not limited to:	
(c) (1)	Expanded use of existing supplies including system optimization and conjunctive use of water resources, reallocation of reservoir storage to new uses, voluntary redistribution of water resources including contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements, subordination of existing water rights through voluntary agreements, enhancements of yields of existing sources, and improvement of water quality including control of naturally occurring chlorides.	Subchapters 5A.1.3, Reallocation of reservoir storage is extremely limited in PWPA. Due to limited supply, this strategy was not considered for PWPA.
(c) (2)	New supply development including construction and improvement of surface water and groundwater resources, brush control, precipitation enhancement, seawater desalination, brackish groundwater desalination, water supply that could be made available by cancellation of water rights based on data provided by the Commission, rainwater harvesting, and aquifer storage and recovery.	Subchapters 5A.1.4 (Groundwater), 5A.1.9 (Brush Control), 5A.1.10 (Precipitation Enhancement) - PWPG did not consider water right cancellation, seawater desalination, or rain water harvesting to be a feasible strategy for PWPA. ASR is considered to fall within the "Expanded Use of Existing Supplies" category, found in 5A.1.3.
(c) (3)	Conservation and drought management measures including demand management.	Subchapters 5A.1.1, 5B and Chapter 7
(c) (4)	Reuse of wastewater.	Subchapter 5A.1.2
(c) (5)	Interbasin transfers of surface water.	Subchapter 5A; There are no new interbasin transfer of surface water strategies for PWPA
(c) (6)	Emergency transfers of surface water including a determination of the part of each water right for non-municipal use in the RWPA that may be transferred without causing unreasonable damage to the property of the non-municipal water rights holder in accordance with Texas Water Code §11.139 (relating to Emergency Authorizations).	Subchapter 5A, Chapter 7

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(d)	All recommended WMSs and WMSPs that are entered into the State Water Planning Database and prioritized by RWPGs shall be designed to reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or develop, deliver or treat additional water supply volumes to WUGs or WWPs in at least one planning decade such that additional water is available during Drought of Record conditions. Any other RWPG recommendations regarding permit modifications, operational changes, and/or other infrastructure that are not designed to reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or develop, deliver or treat additional water supply volumes to WUGs or WWPs in at least one Planning Decade such that additional water is available during Drought of Record conditions shall be indicated as such and presented separately in the RWP and shall not be eligible for funding from the State Water Implementation Fund for Texas.	Chapter 5
(e)	Evaluations of potentially feasible WMSs and associated WMSPs shall include the following analyses:	
(e) (1)	For the purpose of evaluating potentially feasible WMSs, the Commission's most current Water Availability Model with assumptions of no return flows and full utilization of senior water rights, is to be used. Alternative assumptions may be used with written approval from the EA who shall consider a written request from an RWPG to use assumptions other than no return flows and full utilization of senior water rights.	Appendix B; There are no proposed new appropriations of surface water for PWPA.
(e) (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.	Subchapter 5C, 5D and Attachment 5-2
(e) (3) (A)	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, taking into account and reporting anticipated strategy water losses, incorporating factors used calculating infrastructure debt payments and may include present costs and discounted present value costs. Costs do not include distribution of water within a WUG after treatment.	Subchapters 5B, 5C, 5D, Attachments 5-2
(e) (3) (B)	A quantitative reporting of the environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico. Evaluations of effects on environmental flows shall include consideration of the Commission's adopted environmental flow standards under 30 Texas Administrative Code Chapter 298 (relating to Environmental Flow Standards for Surface Water). If environmental flow standards have not been established, then environmental information from existing site-specific studies, or in the absence of such information, state environmental planning criteria adopted by the Board for inclusion in the State Water Plan after coordinating with staff of the Commission and the Texas Parks and Wildlife Department to ensure that WMSs are adjusted to provide for environmental water needs including instream flows and bays and estuaries inflows.	Chapter 6, Subchapter 5C, 5D, and Attachment 5-2
(e) (3) (C)	A quantitative reporting of the impacts to agricultural resources.	Subchapters 5C, 5D, Attachment 5-2, Chapter 6
(e) (4)	Discussion of the plan's impact on other water resources of the state including other water management strategies and groundwater and surface water interrelationships.	Subchapters 5C, 5D, Attachment 5-2, Chapter 6
(e) (5)	Discussion of each threat to agricultural or natural resources identified pursuant to §357.30(7) of this title (relating to Description of the Regional Water Planning Area) including how that threat will be addressed or affected by the water management strategies evaluated	Subchapters 5C, 5D, Attachment 5-2, Chapter 6

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(e) (6)	If applicable, consideration and discussion of the provisions in Texas Water Code §11.085(k)(1) for interbasin transfers of surface water. At minimum, this consideration will include a summation of water needs in the basin of origin and in the receiving basin.	Subchapter 5A; There are no new interbasin strategies for PWPA.
(e) (7)	Consideration of third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas.	Subchapters 5C, 5D, Attachment 5-2, Chapter 6
(e) (8)	A description of the major impacts of recommended water management strategies on key parameters of water quality identified by RWPGs as important to the use of a water resource and comparing conditions with the recommended water management strategies to current conditions using best available data.	Subchapters 5C, 5D, Attachment 5-2, Chapter 6
(e) (9)	Consideration of water pipelines and other facilities that are currently used for water conveyance as described in §357.22(a)(3) of this title (relating to General Considerations for Development of Regional Water Plans).	Chapter 1 and Subchapter 5C and 5D
(e) (10)	Other factors as deemed relevant by the RWPG including recreational impacts.	Subchapters 5C, 5D, Attachment 5-2, Chapter 6
(f)	RWPGs shall evaluate and present potentially feasible WMSs and WMSPs with sufficient specificity to allow state agencies to make financial or regulatory decisions to determine consistency of the proposed action before the state agency with an approved RWP.	Chapter 5, Attachment 5-1, 5-2 and Appendix D
(g)	If an RWPG does not recommend aquifer storage and recovery strategies, seawater desalination strategies, or brackish groundwater desalination strategies it must document the reason(s) in the RWP.	Chapter 5
(h)	In instances where an RWPG has determined there are significant identified Water Needs in the RWPA, the RWP shall include an assessment of the potential for aquifer storage and recovery to meet those Water Needs. Each RWPG shall define the threshold to determine whether it has significant identified Water Needs. Each RWP shall include, at a minimum, a description of the methodology used to determine the threshold of significant needs. If a specific assessment is conducted, the assessment may be based on information from existing studies and shall include minimum parameters as defined in contract guidance.	Subchapter 5A
(i)	Conservation, Drought Management Measures, and Drought Contingency Plans shall be considered by RWPGs when developing the regional plans, particularly during the process of identifying, evaluating, and recommending WMSs. RWPs shall incorporate water conservation planning and drought contingency planning in the RWPA.	Chapter 5 and 7
(i) (1)	Drought Management Measures including water demand management. RWPGs shall consider Drought Management Measures for each need identified in §357.33 of this title and shall include such measures for each user group to which Texas Water Code §11.1272 (relating to Drought Contingency Plans for Certain Applicants and Water Right Holders) applies. Impacts of the Drought Management Measures on Water Needs must be consistent with guidance provided by the Commission in its administrative rules implementing Texas Water Code §11.1272. If an RWPG does not adopt a drought management strategy for a need it must document the reason in the RWP. Nothing in this paragraph shall be construed as limiting the use of voluntary arrangements by water users to forgo water usage during drought periods.	Chapter 7 and Subchapter 5A
(i) (2)	Water conservation practices. RWPGs must consider water conservation practices, including potentially applicable best management practices, for each identified Water Need.	Subchapter 5B, 5C and 5D
(i) (2) (A)	RWPGs shall include water conservation practices for each user group to which Texas Water Code §11.1271 and §13.146 (relating to Water Conservation Plans) apply. The impact of these water conservation practices on Water Needs must be consistent with requirements in appropriate Commission administrative rules related to Texas Water Code §11.1271 and §13.146.	Subchapter 5B and Attachment 5-2

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(i) (2) (B)	RWPGs shall consider water conservation practices for each WUG beyond the minimum requirements of subparagraph (A) of this paragraph, whether or not the WUG is subject to Texas Water Code §11.1271 and §13.146. If RWPGs do not adopt a Water Conservation Strategy to meet an identified need, they shall document the reason in the RWP.	Subchapters 5B, 5C, 5D and Attachment 5-2
(i) (2) (C)	For each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 (relating to Interbasin Transfers) applies, RWPGs shall include a Water Conservation Strategy, pursuant to Texas Water Code §11.085(l), that will result in the highest practicable level of water conservation and efficiency achievable. For these strategies, RWPGs shall determine and report projected water use savings in gallons per capita per day based on its determination of the highest practicable level of water conservation and efficiency achievable. RWPGs shall develop conservation strategies based on this determination. In preparing this evaluation, RWPGs shall seek the input of WUGs and WWPs as to what is the highest practicable level of conservation and efficiency achievable, in their opinion, and take that input into consideration. RWPGs shall develop water conservation strategies consistent with guidance provided by the Commission in its administrative rules that implement Texas Water Code §11.085. When developing water conservation strategies, the RWPGs must consider potentially applicable best management practices. Strategy evaluation in accordance with this section shall include a quantitative description of the quantity, cost, and reliability of the water estimated to be conserved under the highest practicable level of water conservation and efficiency achievable.	N/A There are no new interbasin strategies for PWPA.
(i) (2) (D)	RWPGs shall consider strategies to address any issues identified in the information compiled by the Board from the water loss audits performed by Retail Public Utilities pursuant to §358.6 of this title (relating to Water Loss Audits).	Chapter 1 and Subchapter 5B
(i) (3)	RWPGs shall recommend Gallons Per Capita Per Day goal(s) for each municipal WUG or specified groupings of municipal WUGs. Goals must be recommended for each planning decade and may be a specific goal or a range of values. At a minimum, the RWPs shall include Gallons Per Capita Per Day goals based on drought conditions to align with guidance principles in §358.3 of this title (relating to Guidance Principles).	Subchapter 5B, Attachment 5-3
(j)	RWPs shall include a subchapter consolidating the RWPG's recommendations regarding water conservation. RWPGs shall include in the RWPs model Water Conservation Plans pursuant to Texas Water Code §11.1271.	Subchapter 5B, http://www.panhandlewater.org/
31 TAC §357.35		
357.35 (a)	RWPGs shall recommend WMSs and the WMSPs required to implement those WMSs to be used during a Drought of Record based on the potentially feasible WMSs evaluated under §357.34 of this title (relating to Identification and Evaluation of Potentially Feasible Water Management Strategies and Water Management Strategy Projects).	Chapter 5, Attachments 5-1 and 5-2
(b)	RWPGs shall recommend specific WMSs and WMSPs based upon the identification, analysis, and comparison of WMSs by the RWPG that the RWPG determines are potentially feasible so that the cost effective WMSs that are environmentally sensitive are considered and adopted unless an RWPG demonstrates that adoption of such WMSs is inappropriate. To determine cost-effectiveness and environmental sensitivity,RWPGs shall follow processes described in §357.34 of this title. The RWP may include Alternative WMSs evaluated by the processes described in §357.34 of this title.	Chapter 5, Attachments 5-1 and 5-2
(c)	Strategies will be selected by the RWPGs so that cost effective water management strategies, which are consistent with long-term protection of the state's water resources, agricultural resources, and natural resources are adopted.	Chapter 5, Attachments 5-1 and 5-2

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(d)	RWPGs shall identify and recommend WMSs for all WUGs and WWPs with identified Water Needs and that meet all Water Needs during the Drought of Record except in cases where:	
(d) (1)	no WMS is feasible. In such cases, RWPGs must explain why no WMSs are feasible; or	Chapter 5, Attachments 5-1 and 5-2
(d) (2)	a Political Subdivision that provides water supply other than water supply corporations, counties, or river authorities explicitly does not participate in the regional water planning process for needs located within its boundaries or extraterritorial jurisdiction.	Chapter 5, Attachments 5-1 and 5-2
(e)	Specific recommendations of water management strategies to meet an identified need will not be shown as meeting a need for a political subdivision if the political subdivision in question objects to inclusion of the strategy for the political subdivision and specifies its reasons for such objection. This does not prevent the inclusion of the strategy to meet other needs.	Chapter 5, Attachments 5-1 and 5-2
(f)	Recommended strategies shall protect existing water rights, water contracts, and option agreements, but may consider potential amendments of water rights, contracts and agreements, which would require the eventual consent of the owner.	Chapter 5, Attachments 5-1 and 5-2
(g)	RWPGs shall report the following:	
(g) (1)	Recommended WMSs, recommended WMSPs, and the associated results of all the potentially feasible WMS evaluations by WUG and MWP. If a WUG lies in one or more counties or RWPAs or river basins, data shall be reported for each river basin, RWPA, and county.	Chapter 5, Data table reports in Appendix J
(g) (2)	Calculated planning management supply factors for each WUG and MWP included in the RWP assuming all recommended WMSs are implemented. This calculation shall be based on the sum of: the total existing water supplies, plus all water supplies from recommended WMSs for each entity; divided by that entity's total projected Water Demand, within the Planning Decade. The resulting calculated management supply factor shall be presented in the plan by entity and decade for every WUG and MWP. Calculating planning management supply factors is for reporting purposes only.	Data table reports in Appendix J
(g) (3)	Fully evaluated Alternative WMSs and associated WMSPs included in the adopted RWP shall be presented together in one place in the RWP.	Attachment 5-2
HB807, TWC 16.053 (e)(11)	Set one or more specific goals for gallons of water use per capita per day in each decade of the period covered by the plan for the municipal water user groups in the RWPA.	Subchapter 5B, Attachment 5-3
HB807, TWC 16.053 (e)(10)	Specific assessment of Aquifer Storage and Recovery (ASR) potential if significant identified needs.	Subchapter 5A, Attachment 5-1, and 5-2
Chapter Six Impacts of Regional Water Plan and Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources		
31 TAC §357.40		
357.40(a)	RWPs shall include a quantitative description of the socioeconomic impacts of not meeting the identified Water Needs pursuant to §357.33(c) of this title (relating to Needs Analysis: Comparison of Water Supplies and Demands).	Chapter 6, Appendix F
(b)	RWPs shall include a description of the impacts of the RWP regarding:	
(b) (1)	Agricultural resources pursuant to §357.34(e)(3)(C) of this title (relating to Identification and Evaluation of Potentially Feasible Water Management Strategies);	Chapter 6 and Attachment 5-2
(b) (2)	Other water resources of the state including other WMSs and groundwater and surface water interrelationships pursuant to §357.34(e)(4) of this title;	Chapter 6 and Attachment 5-2
(b) (3)	Threats to agricultural and natural resources identified pursuant to §357.34(e)(5) of this title;	Chapter 6 and Attachment 5-2

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(b) (4)	Third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas pursuant to §357.34(e)(7) of this title;	Chapter 6
(b) (5)	Major impacts of recommended WMSs on key parameters of water quality pursuant to §357.34(e)(8) of this title; and	Section 6.1
(b) (6)	Effects on navigation	Section 6.4; The PWPA Plan does not have an impact on navigation.
(c)	RWPs shall include a summary of the identified Water Needs that remain unmet by the RWP.	Subchapter 5D, Section 5D.23
31 TAC §357.41		
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 as embodied in the guidance principles in §358.3(4) and (8) of this title (relating to Guidance Principles).	Chapter 6
Chapter Seven Drought Response Information, Activities, and Recommendations		
31 TAC §357.42		
357.42 (a)	RWPs shall consolidate and present information on current and planned preparations for, and responses to, drought conditions in the region including, but not limited to, drought of record conditions based on the following subsections.	Chapter 7
(b)	RWPGs shall conduct an overall assessment of current preparations for drought within the RWPA including a description of how water suppliers in the RWPA identify and respond to the onset of drought. This may include information from local drought contingency plans.	Section 7.2
(b) (1)	A description of how water suppliers in the RWPA identify and respond to the onset of drought; and	Chapter 7, Attachments 7-1 and 7-2
(b) (2)	Identification of unnecessary or counterproductive variations in drought response strategies among water suppliers that may confuse the public or impede drought response efforts. At a minimum, RWPGs shall review and summarize drought response efforts for neighboring communities including the differences in the implementation of outdoor watering restrictions.	Section 7.2
(c)	RWPGs shall develop drought response recommendations regarding the management of existing groundwater and surface water sources in the RWPA designated in accordance with §357.32 of this title (relating to Water Supply Analysis), including:	
(c) (1)	Factors specific to each source of water supply to be considered in determining whether to initiate a drought response for each water source including specific recommended drought response triggers (See also §357.32 of Regional Planning Guidelines)	Section 7.5
(c) (2)	Actions to be taken as part of the drought response by the manager of each water source and the entities relying on each source, including the number of drought stages; and	Section 7.5 and Attachment 7-1
(c) (3)	Triggers and actions developed in paragraphs (1) and (2) of this subsection may consider existing triggers and actions associated with existing drought contingency plans.	Section 7.5 and Attachments 7-1, 7-2
(d)	RWPGs shall collect information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water. At a minimum, the RWP shall include a general description of the methodology used to collect the information, the number of existing and potential emergency interconnects in the RWPA, and a list of which entities are connected to each other. In accordance with Texas Water Code §16.053(r), certain information regarding water infrastructure facilities is excepted from the Public Information Act, Texas Government Code, Chapter 552. Any excepted information collected shall be submitted separately to the EA in accordance with guidance to be provided by EA.	No confidential information received.

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(e)	RWPGs shall provide general descriptions of local drought contingency plans that involve making emergency connections between water systems or WWP systems that do not include locations or descriptions of facilities that are disallowed under subsection (d) of this section.	Sections 7.3, 7.4
(f)	RWPGs may designate recommended and alternative drought management water management strategies and other recommended drought measures in the RWP including:	
(f) (1)	List and description of the recommended drought management water management strategies and associated WUGs and WWPs, if any, that are recommended by the RWPG. Information to include associated triggers to initiate each of the recommended drought management water management strategies	Section 7.6. No drought management strategies are recommended. The PWPG supports local control and implementation of drought management plans.
(f) (2)	List and description of alternative drought management water management strategies and associated WUGs and WWPs, if any, that are included in the plan. Information to include associated triggers to initiate each of the alternative drought management water management strategies	N/A
(f) (3)	List of all potentially feasible drought management water management strategies that were considered or evaluated by the RWPG but not recommended; and	N/A
(f) (4)	List and summary of any other recommended drought management measures, if any, that are included in the RWP, including associated triggers if applicable	N/A
(g)	The RWPGs shall evaluate potential emergency responsesto local drought conditions or loss of existing water supplies; the evaluation shall include identification of potential alternative water sources that may be considered for temporary emergency use by WUGs and WWPs in the event that the Existing Water Supply sources become temporarily unavailable to the WUGs and WWPs due to unforeseeable hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts. RWPGs shall evaluate, at a minimum, municipal WUGs that:	Section 7.4
(g) (1)	have existing populations less than 7,500;	See above
(g) (2)	rely on a sole source for its water supply regardless of whether the water is provided by a WWP; and	
(g) (3)	all County-Other WUGs.	
(h)	RWPGs shall consider any relevant recommendations from the Drought Preparedness Council.	Chapter 7
(i)	RWPGs shall make drought preparation and response recommendations regarding:	
(i) (1)	Development of, content contained within, and implementation of local drought contingency plans required by the Commission	Sections 7.2, 7.5 and Attachment 7-1
(i) (2)	Current drought management preparations in the RWPA including:	Sections 7.2, 7.5 and Attachment 7-1
(i) (2) (A)	drought response triggers; and	Sections 7.2, 7.5 and Attachment 7-1
(i) (2) (B)	responses to drought conditions;	Sections 7.2, 7.5 and Attachment 7-1
(i) (3)	The Drought Preparedness Council and the State Drought Preparedness Plan; and	Section 7.7
(i) (4)	Any other general recommendations regarding drought management in the region or state	Section 7.7
(j)	The RWPGs shall develop region-specific model Drought Contingency Plans.	Section 7.5, http://www.panhandlewater.org/
HB807, TWC 16.053 (e)(3)(E)	Identify unnecessary or counterproductive variations in specific drought response strategies, including outdoor watering restrictions, among user groups in the regional water planning area that may confuse the public or otherwise impede drought response efforts	Drought response strategies are discussed in Chapter 7. No unnecessary or counterproductive strategies were identified.

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
Chapter Eight Policy Recommendations and Unique Sites		
31 TAC §357.43		
357.43 (a)	The RWPs shall contain any regulatory, administrative, or legislative recommendations developed by the RWPGs	Chapter 8
(b)	Ecologically Unique River and Stream Segments. RWPGs may include in adopted RWP's recommendations for all or parts of river and stream segments of unique ecological value located within the RWPA by preparing a recommendation package consisting of a physical description giving the location of the stream segment, maps, and photographs of the stream segment and a site characterization of the stream segment documented by supporting literature and data. The recommendation package shall address each of the criteria for designation of river and stream segments of ecological value found in this subsection. The RWPG shall forward the recommendation package to the Texas Parks and Wildlife Department and allow the Texas Parks and Wildlife Department 30 days for its written evaluation of the recommendation. The adopted RWP shall include, if available, Texas Parks and Wildlife Department's written evaluation of each river and stream segment recommended as a river or stream segment of unique ecological value.	Section 8.1
(b) (1)	An RWPG may recommend a river or stream segment as being of unique ecological value based upon the criteria set forth in §358.2 of this title (relating to Definitions)	Section 8.1
(b) (2)	For every river and stream segment that has been designated as a unique river or stream segment by the legislature, during a session that ends not less than one year before the required date of submittal of an adopted RWP to the Board, or recommended as a unique river or stream segment in the RWP, the RWPG shall assess the impact of the RWP on these segments. The assessment shall be a quantitative analysis of the impact of the plan on the flows important to the river or stream segment, as determined by the RWPG, comparing current conditions to conditions with implementation of all recommended water management strategies. The assessment shall also describe the impact of the plan on the unique features cited in the region's recommendation of that segment	Section 8.1
(c)	Unique Sites for Reservoir Construction. An RWPG may recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation and expected beneficiaries of the water supply to be developed at the site. The criteria at §358.2 of this title shall be used to determine if a site is unique for reservoir construction.	Section 8.2
(d)	Any other recommendations that the RWPG believes are needed and desirable to achieve the stated goals of state and regional water planning including to facilitate the orderly development, management, and conservation of water resources and prepare for and respond to drought conditions. This may include recommendations that the RWPG believes would improve thee state and regional water planning process.	Section 8.4
(e)	RWPGs may develop information as to the potential impacts of any proposed changes in law prior to or after changes are enacted.	Section 8.3
(f)	RWPGs should consider making legislative recommendations to facilitate more voluntary water transfers in the region.	Section 8.3
Chapter Nine Infrastructure Financing Report		
357.44	RWPGs shall assess and quantitatively report on how individuallocal governments, regional authorities, and other Political Subdivisionsin their RWPA propose to finance recommended WMSs and associated WMSPs.The assessment shall also describe what role the RWPG proposes forthe state in financing recommended WMSs and associated WMSPs, includingproposed increases in the level of state participation in fundingfor regional projects to meet needs beyond the reasonable financingcapability of local governments, regional authorities, and other politicalsubdivisions involved in building water infrastructure.	Chapter 9; Appendix G

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
Chapter Ten Public Participation and Plan Adoption		
31 TAC §357.21		
357.21 (a)	Each RWPG and any committee or subcommittee of an RWPG are subject to Chapters 551 and 552, Government Code. A copy of all materials presented or discussed at an open meeting shall be made available for public inspection prior to and following the meetings and shall meet the additional notice requirements when specifically referenced as required under other subsections. In addition to the notice requirements of Chapter 551, Government Code, the following requirements apply to RWPGs.	Chapter 10
(b-e)	All public notices required by the TWDB by the RWPG shall comply with 31 TAC §357.21 and shall meet the requirements specified therein.	Chapter 10
31 TAC §357.50		
357.5 (a)	Submit their adopted RWPs to the Board every five years on a date to be disseminated by the EA, as modified by subsection (e)(2) of this section, for approval and inclusion in the state water plan.	The PWPA Water Plan will be submitted to the EA accordingly.
(b)	Prior to the adoption of the RWP, the RWPGs shall submit concurrently to the EA and the public an IPP. The IPP submitted to the EA must be in the electronic and paper format specified by the EA. Each RWPG must certify that the IPP is complete and adopted by the RWPG. In the instance of a recommended WMS proposed to be supplied from a different RWPA, the RWPG recommending such strategy shall submit, concurrently with the submission of the IPP to the EA, a copy of the IPP, or a letter identifying the WMS in the other region along with an internet link to the IPP, to the RWPG associated with the location of such strategy.	Chapter 10
(c)	The RWPGs shall distribute the IPP in accordance with §357.21(d)(4) of this title (relating to Notice and Public Participation).	Section 10.9
(d)	Within 60 days of the submission of IPPs to the EA, the RWPGs shall submit to the EA, and the other affected RWPG, in writing, the identification of potential Interregional Conflicts by:	Section 10.7; There are no known interregional conflicts between RWPs.
(d) (1)	identifying the specific recommended WMS from another RWPG's IPP;	See above
(d) (2)	providing a statement of why the RWPG considers there to be an Interregional Conflict; and	
(d) (3)	providing any other information available to the RWPG that is relevant to the Board's decision.	
(e)	The RWPGs shall seek to resolve conflicts with other RWPGs and shall promptly and actively participate in any Board sponsored efforts to resolve Interregional Conflicts.	See above
(f)	The RWPGs shall solicit, and consider the following comments when adopting an RWP:	
(f) (1)	the EA's written comments, which shall be provided to the RWPG within 120 days of receipt of the IPP;	Comments are included in Chapter 10 and Appendix H.
(f) (2)	written comments received from any federal agency or Texas state agency, which the RWPGs shall accept after the first public hearing notice is published pursuant to §357.21(d) of this title until at least 90 days after the public hearing is held pursuant to §357.21(d) of this title; and	
(f) (3)	any written or oral comments received from the public after the first public hearing notice is published pursuant to §357.21(d) of this title until at least 60 days after the public hearing is held pursuant to §357.21(d) of this title.	
(f) (4)	The RWPGs shall revise their IPPs to incorporate negotiated resolutions or Board resolutions of any Interregional Conflicts into their final adopted RWPs.	N/A. There are no interregional conflicts.

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(f) (5)	In the event that the Board has not resolved an Interregional Conflict sufficiently early to allow an involved RWPG to modify and adopt its final RWP by the statutory deadline, all RWPGs involved in the conflict shall proceed with adoption of their RWP by excluding the relevant recommended WMS and all language relevant to the conflict and include language in the RWP explaining the unresolved Interregional Conflict and acknowledging that the RWPG may be required to revise or amend its RWP in accordance with a negotiated or Board resolution of an Interregional Conflict.	N/A
(g)	Submittal of RWPs. RWPGs shall submit the IPP and the adopted RWPs and amendments to approved RWPs to the EA in conformance with this section.	The PWPA Water Plan was submitted to the EA accordingly.
(g) (1)	RWPs shall include:	
(g) (1) (A)	The technical report and data prepared in accordance with this chapter and the EA's specifications;	All chapters and appendices
(g) (1) (B)	An executive summary that documents key RWP findings and recommendations; and	Executive Summary, Attachments ES-1, ES-2
(g) (1) (C)	Summaries of all written and oral comments received pursuant to subsection (f) of this section, with a response by the RWPG explaining how the plan was revised or why changes were not warranted in response to written comments received under subsection (f) of this section.	Appendix H
(g) (2)	RWPGs shall submit RWPs to the EA according to the following schedule:	
(g) (2) (A)	IPPs are due every five years on a date disseminated by the EA unless an extension is approved, in writing, by the EA.	IPP was submitted by March 3, 2020 deadline
(g) (2) (B)	Prior to submission of the IPP, the RWPGs shall upload the data, metadata and all other relevant digital information supporting the plan to the Board's State Water Planning Database. All changes and corrections to this information must be entered into the Board's State Water Planning Database prior to submittal of a final adopted plan.	All changes to DB22 have been incorporated and all electronic data will be sent to the TWDB with the final plan submission.
(g) (2) (C)	The RWPG shall transfer copies of all data, models, and reports generated by the planning process and used in developing the RWP to the EA. To the maximum extent possible, data shall be transferred in digital form according to specifications provided by the EA. One copy of all reports prepared by the RWPG shall be provided in digital format according to specifications provided by the EA. All digital mapping shall use a geographic information system according to specifications provided by the EA. The EA shall seek the input from the State Geographic Information Officer regarding specifications mentioned in this section.	All data, models, and reports will be submitted with the final submittal.
(g) (2) (D)	Adopted RWPs are due to the EA every five years on a date disseminated by the EA unless, at the discretion of the EA, a time extension is granted consistent with the timelines in Texas Water Code §16.053(i).	The PWPA Water Plan was submitted to the EA accordingly.
(g) (2) (E)	Once approved by the Board, RWPs shall be made available on the Board website.	The PWPA Water Plan is available on the PRPC website and will be available on the TWDB website after TWDB Board approval.
(h)	Upon receipt of an RWP adopted by the RWPG, the Board shall consider approval of such plan based on the following criteria:	
(h) (1)	verified adoption of the RWP by the RWPG; and	Plan was adopted on Spetember 25, 2020.
(h) (2)	verified incorporation of any negotiated resolution or Board resolution of any Interregional Conflicts, or in the event that an Interregional Conflict is not yet resolved, verified exclusion of the relevant recommended WMS and all language relevant to the conflict.	N/A for Panhandle Plan
(i)	Approval of RWPs by the Board. The Board may approve an RWP only after it has determined that the RWP complies with statute and rules.	
(j)	The Board shall consider approval of an RWP that includes unmet municipal Water Needs provided that the RWPG includes adequate justification, including that the RWP:	

Regulatory Citation	Summary of Requirement	Location(s) in Regional Plan and/or Commentary
(j) (1)	documents that the RWPG considered all potentially feasible WMSs, including Drought Management WMSs and contains an explanation why additional conservation and/or Drought Management WMSs were not recommended to address the need;	N/A. There are no unmet municipal needs.
(j) (2)	describes how, in the event of a repeat of the Drought of Record, the municipal WUGs associated with the unmet need shall ensure the public health, safety, and welfare in each Planning Decade that has an unmet need; and	
(j) (3)	explains whether there may be occasion, prior to development of the next IPP, to amend the RWP to address all or a portion of the unmet need.	
(k)	Board Adoption of State Water Plan. RWPs approved by the Board pursuant to this chapter shall be incorporated into the State Water Plan as outlined in §358.4 of this title (relating to Guidelines).	
Chapter Eleven Implementation and Comparison to the Previous Regional Water Plan		
31 TAC §357.45		
357.45 (a)	RWPGs shall describe the level of implementation of previously recommended WMSs and associated impediments to implementation in accordance with guidance provided by the board. Information on the progress of implementation of all WMSs that were recommended in the previous RWP, including conservation and Drought Management WMSs; and the implementation of WMSPs that have affected progress in meeting the state's future water needs.	Chapter 11, Appendix I
(b)	RWPGs shall assess the progress of the RWPA in encouraging cooperation between WUGs for the purpose of achieving economies of scale and otherwise incentivizing WMSs that benefit the entire RWPA.	Section 11.4
(c)	RWPGs shall provide a brief summary of how the RWP differs from the previously adopted RWP.	Chapter 11
(c) (1)	Water demand projections	Section 11.2
(c) (2)	Drought of record and hydrologic and modeling assumptions used in planning for the region	Section 11.2
(c) (3)	Groundwater and surface water availability, existing water supplies, and identified water needs for WUGs and MWPs	Section 11.2
(c) (4)	Recommended and Alternative WMSs and WMSPs.	Sections 11.2, 11.3

APPENDIX F

SOCIO-ECONOMIC MATRIX

Socioeconomic Impacts of Projected Water Shortages

for the Panhandle (Region A) Regional Water Planning Area

Prepared in Support of the 2021 Region A Regional Water Plan

Texas Water Development Board

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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 analysis in the regional water planning process. The Texas Water Development Board (TWDB) estimates these impacts for regional water planning groups (RWPGs) and summarizes the impacts in the state water plan. The analysis presented is for the Panhandle Regional Water Planning Group (Region A).

Based on projected water demands and existing water supplies, Region A identified water needs (potential shortages) that could occur within its region under a repeat of the drought of record for six water use categories (irrigation, livestock, manufacturing, mining, municipal and steam-electric power). The TWDB then estimated the annual socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

This analysis was performed using an economic impact 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 repeat of the drought of record with the further caveat that no mitigation strategies are implemented. Decade specific impact estimates assume that growth occurs, and future shocks are imposed on an economy at 10-year intervals. The estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

For regional economic impacts, income losses and job losses are estimated within each planning decade (2020 through 2070). 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 are estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

IMPLAN data reported that Region A generated more than $25 billion in gross domestic product (GDP) (2018 dollars) and supported more than 245,000 jobs in 2016. The Region A estimated total population was approximately 392,000 in 2016.

It is estimated that not meeting the identified water needs in Region A would result in an annually combined lost income impact of approximately $80 million in 2020, increasing to $3.5 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 800 jobs, and by 2070 job losses would increase to approximately 38,000 if anticipated needs are not mitigated.

All impact estimates are in year 2018 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and the Texas Municipal League.

Table ES-1 Region A socioeconomic impact summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$80	$432	$867	$2,262	$3,225	$3,511
Job losses	770	4,380	9,535	23,417	33,968	37,964
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$4	$23	$58	$171	$249	$272
Water trucking costs ($ millions)*	$4	$4	$8	$10	$19	$25
Utility revenue losses ($ millions)*	$3	$21	$45	$73	$101	$119
Utility tax revenue losses ($ millions)*	$0	$0	$1	$1	$2	$2
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$6	$13	$29	$72	$168	$198
Population losses	141	804	1,751	4,299	6,236	6,970
School enrollment losses	27	154	335	822	1,193	1,333

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated 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 the regional economy in the short term, 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.

As part of the regional water planning process, RWPGs must evaluate the social and economic impacts of not meeting water needs (31 Texas Administrative Code §357.33 (c)). Due to the complexity of the analysis and limited resources of the planning groups, the TWDB has historically performed this analysis for the RWPGs upon their request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of Region A, and those efforts for this region as well as the other 15 regions allow consistency and a degree of comparability in the approach.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 provides a snapshot of the region's economy and summarizes the identified water needs in each water use category, which were calculated based on the RWPG's water supply and demand established during the regional water planning process. Section 2 defines each of ten impact assessment measures used in this analysis. Section 3 describes the methodology for the impact assessment and the approaches and assumptions specific to each water use category (i.e., irrigation, livestock, manufacturing, mining, municipal, and steam-electric power). Section 4 presents the impact estimates for each water use category with results summarized for the region as a whole. Appendix A presents a further breakdown of the socioeconomic impacts by county.

1.1 Regional Economic Summary

The Region A Regional Water Planning Area generated more than $25 billion in gross domestic product (2018 dollars) and supported more than 245,000 jobs in 2016, according to the IMPLAN dataset utilized in this socioeconomic analysis. This activity accounted for approximately 1.5 percent of the state's total gross domestic product of 1.73 trillion dollars for the year based on IMPLAN. Table 1-1 lists all economic sectors ranked by the total value-added to the economy in Region A. The manufacturing and mining sectors generated 35 percent of the region's total value-added and were also significant sources of tax revenue. The top employers in the region were in the public administration, retail trade, and manufacturing sectors. Region A's estimated total population was roughly 392,000 in 2016, approximately 1.5 percent of the state's total.

This represents a snapshot of the regional economy as a whole, and it is important to note that not all economic sectors were included in the TWDB socioeconomic impact analysis. Data considerations prompted use of only the more water-intensive sectors within the economy because damage estimates could only be calculated for those economic sectors which had both reliable income and water use estimates.

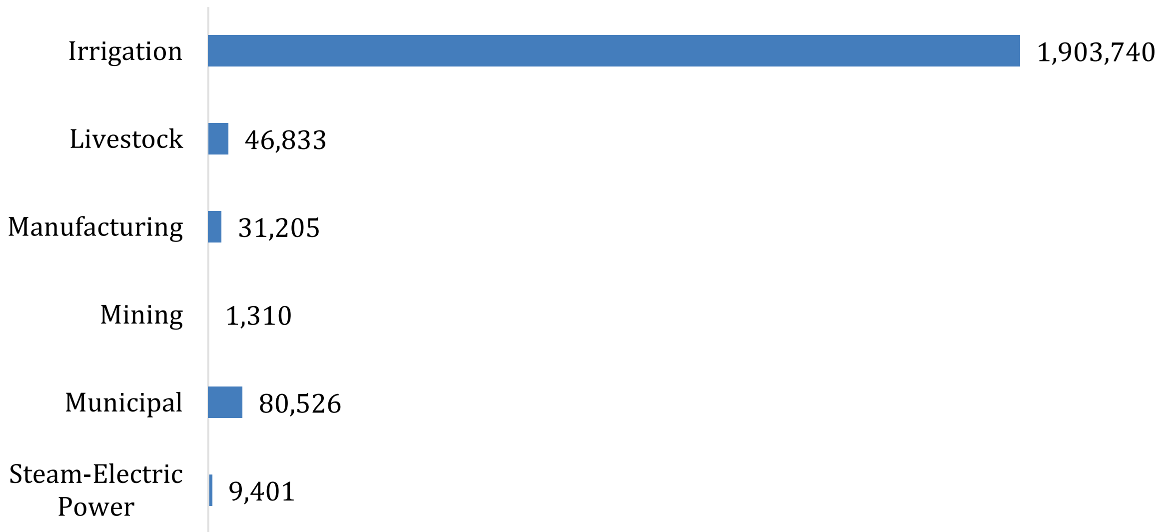
Table 1-1 Region A regional economy by economic sector*

Economic sector	Value-added ($ millions)	Tax ($ millions)	Jobs
Manufacturing	$5,220.6	$201.8	22,224
Mining, Quarrying, and Oil and Gas Extraction	$3,694.1	$717.4	15,105
Public Administration	$2,311.6	$(7.9)	31,018
Real Estate and Rental and Leasing	$1,675.2	$276.6	7,602
Wholesale Trade	$1,469.7	$268.4	9,129
Health Care and Social Assistance	$1,462.2	$18.7	21,017
Retail Trade	$1,357.5	$341.1	25,255
Construction	$1,293.2	$17.5	15,848
Agriculture, Forestry, Fishing and Hunting	$993.8	$33.8	13,087
Finance and Insurance	$915.5	$74.9	12,846
Transportation and Warehousing	$903.4	$46.9	10,337
Professional, Scientific, and Technical Services	$782.9	$23.0	10,390
Utilities	$762.1	$142.3	1,391
Other Services (except Public Administration)	$723.0	$79.3	15,408
Accommodation and Food Services	$659.8	$108.6	18,206
Information	$379.8	$122.6	2,108
Management of Companies and Enterprises	$317.1	$4.4	1,573
Administrative and Support and Waste Management and Remediation Services	$311.7	$12.6	7,994
Arts, Entertainment, and Recreation	$79.0	$19.9	3,034
Educational Services	$37.2	$1.4	1,445
Grand Total	$25,349.3	$2,503.2	245,016

*Source: 2016 IMPLAN for 536 sectors aggregated by 2-digit NAICS (North American Industry Classification System)

While the manufacturing and mining sectors led the region in economic output, the majority (92 percent) of water use occurred in irrigated agriculture in 2016. In fact, almost 25 percent of the state's irrigation water use occurred within Region A. Figure 1-1 illustrates Region A's breakdown of the 2016 water use estimates by TWDB water use category.

Figure 1-1 Region A 2016 water use estimates by water use category (in acre-feet)



Source: TWDB Annual Water Use Estimates (all values in acre-feet)

1.2 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for water user groups (WUG) in Region A with input from the planning group. WUG-level demand projections were established for utilities that provide more than 100 acre-feet of annual water supply, combined rural areas (designated as county-other), and county-wide water demand projections for five non-municipal categories (irrigation, livestock, manufacturing, mining and steam-electric power). The RWPG then compared demands to the existing water supplies of each WUG to determine potential shortages, or needs, by decade.

Table 1-2 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 address 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 growth, economic growth, or declining supplies. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are also presented in aggregate in Table 1-2. Projected needs for individual water user groups within the aggregate can vary greatly and may reach 100% for a given WUG and water use category. A detailed summary of water needs by WUG and county appears in Chapter 4 of the 2021 Region A Regional Water Plan.

Table 1-2 Regional water needs summary by water use category*

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	water needs (acre-feet per year)	146,064	381,557	385,041	351,667	309,784	310,602
	% of the category's total water demand	8%	20%	22%	23%	23%	23%
Livestock	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Manufacturing	water needs (acre-feet per year)	1,008	2,553	4,390	8,061	10,999	11,638
	% of the category's total water demand	2%	5%	8%	15%	21%	22%
Mining	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Municipal**	water needs (acre-feet per year)	1,387	10,521	22,623	36,710	50,568	59,412
	% of the category's total water demand	2%	11%	21%	32%	41%	44%
Steam-electric power	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Total water needs (acre-feet per year)		**148,459**	**394,631**	**412,054**	**396,438**	**371,351**	**381,652**

*Entries denoted by a dash (-) indicate no identified water need for a given water use category.
** Municipal category consists of residential and non-residential (commercial and institutional) subcategories.

2 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic and social impacts of potential water shortages during a repeat of the drought of record. Consistent with previous water plans, ten impact measures 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 gross domestic product (GDP) made by an individual producer, industry, sector, or group of sectors within a year. Value-added measures used in this report have been adjusted to include 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. These values have been adjusted to include the direct, indirect, and induced employment impacts on the region.
Financial transfer impacts	**Description**
Tax losses on production and imports	Sales and excise taxes not collected due to the shortage, in addition to customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. These values have been adjusted to include the direct, indirect and induced tax impacts on the region.
Water trucking costs	Estimated cost of 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 restricted water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1 Regional Economic Impacts

The two key measures used to assess regional economic impacts are income losses and job losses. The income losses presented consist of the sum of value-added losses and the additional purchase costs of electrical power.

Income Losses - Value-added Losses

Value-added is the value of total output less the value of the intermediate inputs also used in the production of the final product. Value-added is similar to GDP, a familiar measure of the productivity of an economy. The loss of value-added due to water shortages is estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region. The indirect and induced effects are measures of reduced income as well as reduced employee spending for those input sectors which provide resources to the water shortage impacted production sectors.

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 are represented in this analysis by estimated additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employs additional power purchase costs as a proxy for the value-added impacts for the steam-electric power water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it is 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 that occurred during the recent drought period in 2011. This price is assumed to be comparable to those prices which would prevail in the event of another drought of record.

Job Losses

The number of jobs lost due to the economic impact is estimated using IMPLAN output associated with each TWDB water use category. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates are not calculated for the steam-electric power category.

2.2 Financial Transfer Impacts

Several impact measures evaluated in this analysis are presented to provide additional detail concerning potential impacts on a portion of the economy or government. These financial transfer impact measures 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. 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 is used to estimate reduced tax collections associated with the reduced output in the economy. Impact estimates for this measure include the direct, indirect, and induced impacts for the affected sectors.

Water Trucking Costs

In instances where water shortages for a municipal water user group are estimated by RWPGs to exceed 80 percent of water demands, it is assumed that water would need to be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed, maximum of $35,000[1] per acre-foot of water applied as an economic cost. This water trucking cost was utilized for both the residential and non-residential portions of municipal water needs.

Utility Revenue Losses

Lost utility income is calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates are obtained from utility-specific pricing data provided by the Texas Municipal League, where available, for both water and wastewater. These water rates are applied to the potential water shortage to estimate forgone utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses include estimates of forgone 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.

2.3 Social Impacts

Consumer Surplus Losses for 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

[1] Based on staff survey of water hauling firms and historical data concerning transport costs for potable water in the recent drought in California for this estimate. There are many factors and variables that would determine actual water trucking costs including distance to, cost of water, and length of that drought.

willing and able to pay for a 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. Consumer surplus may also be viewed as an estimate of how much consumers would be willing to pay to keep the original quantity of water which they used prior to the drought. Lost consumer surplus estimates within this analysis only apply to the residential portion of municipal demand, with estimates being made for reduced outdoor and indoor residential use. Lost consumer surplus estimates varied widely by location and degree of water shortage.

Population and School Enrollment Losses

Population loss due to water shortages, as well as the associated decline in school enrollment, are based upon the job loss estimates discussed in Section 2.1. A simplified ratio of job and net population losses are calculated for the state as a whole based on a recent study of how job layoffs impact the labor market population.[2] For every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses are estimated as a proportion of the population lost based upon public school enrollment data from the Texas Education Agency concerning the age K-12 population within the state (approximately 19%).

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[2] 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/papers/150194. 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 the change in the population as the result of a job layoff event. The study found that layoffs impact both out-migration and in-migration into a region, and that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county.

3 Socioeconomic Impact Assessment Methodology

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, and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts are based on the overall composition of the economy divided into many underlying economic sectors. Sectors in this analysis refer to one or more of the 536 specific production sectors of the economy designated within IMPLAN, the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 330 of these sectors, with the focus on the more water-intensive production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple, related IMPLAN economic sectors.

3.1 Analysis Context

The context of this socioeconomic impact analysis involves situations where there are physical shortages of groundwater or surface water due to a recurrence of drought of record conditions. Anticipated shortages for specific water users 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.

3.2 IMPLAN Model and Data

Input-Output analysis using the IMPLAN software package was the primary means of estimating the value-added, jobs, and tax related impact measures. This analysis employed regional level models to determine key economic 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 2016 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 536 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their appropriate planning water user categories (irrigation, livestock, manufacturing, mining, and municipal). Estimates of value-added for a water use category were obtained by summing value-added estimates across the relevant IMPLAN sectors associated with that water use category. These calculations were also performed for job losses as well as tax losses on production and imports.

The adjusted value-added estimates used as an income measure in this analysis, 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.

Input-output models such as IMPLAN only capture backward linkages and do not include forward linkages in the economy.

3.3 Elasticity of Economic Impacts

The economic impact of a water need is based on the size of the water need relative to the total water demand for each water user group. Smaller water shortages, for example, less than 5 percent, are generally 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 intensifies, 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 these characteristics, an elasticity adjustment function is used to estimate impacts for the income, tax and job loss measures. Figure 3-1 illustrates this general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage reaches the lower bound 'b1' (5 percent in Figure 3-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound reaches the 'b2' level shortage (40 percent in Figure 3-1).

To illustrate this, if the total annual value-added for manufacturing in the region was $2 million and the reported annual volume of water used in that industry is 10,000 acre-feet, the estimated economic measure of the water shortage would be $200 per acre-foot. The economic impact of the shortage would then be estimated using this value-added amount as the maximum impact estimate ($200 per acre-foot) applied to the anticipated shortage volume and then adjusted by the elasticity function. Using the sample elasticity function shown in Figure 3-1, an approximately 22 percent shortage in the livestock category would indicate an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments are not required in estimating consumer surplus, utility revenue losses, or utility tax losses. Estimates of lost consumer surplus rely on utility-specific demand curves with the lost consumer surplus estimate calculated based on the relative percentage of the utility's water shortage. Estimated changes in population and school enrollment are indirectly related to the elasticity of job losses.

Assumed values for the lower and upper bounds 'b1' and 'b2' vary by water use category and are presented in Table 3-1.

Figure 3-1 Example economic impact elasticity function (as applied to a single water user's shortage)

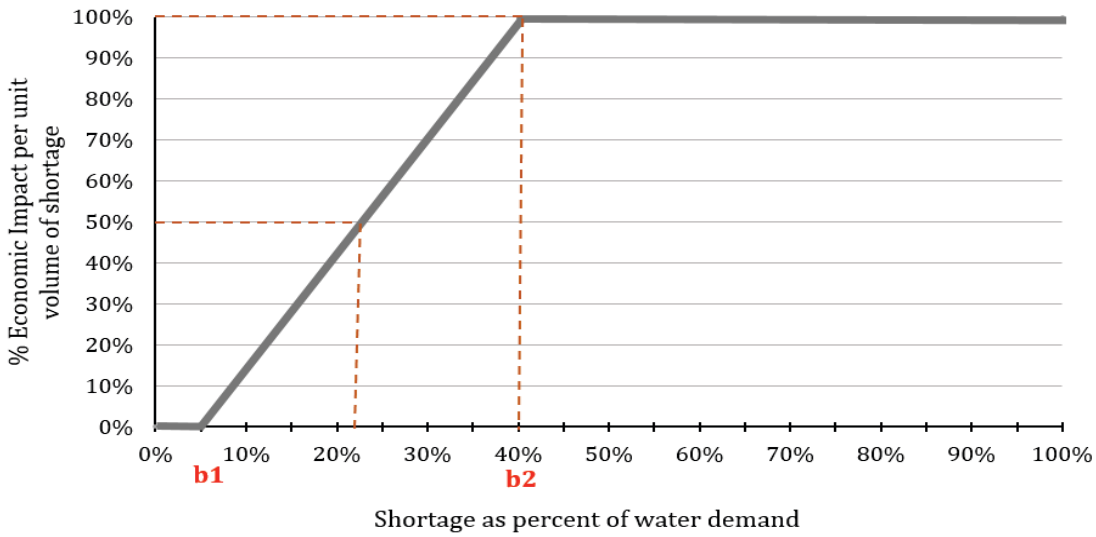

Table 3-1 Economic impact elasticity function lower and upper bounds

Water use category	Lower bound (b1)	Upper bound (b2)
Irrigation	**5%**	**40%**
Livestock	**5%**	**10%**
Manufacturing	**5%**	**40%**
Mining	**5%**	**40%**
Municipal (non-residential water intensive subcategory)	**5%**	**40%**
Steam-electric power	**N/A**	**N/A**

3.4 Analysis Assumptions and Limitations

The modeling of complex systems requires making many assumptions and acknowledging the model's uncertainty and limitations. This is particularly true when attempting to estimate a wide range of socioeconomic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of this methodology include:

1. The foundation for estimating the socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified by RWPGs as part of the

regional water planning process. These needs have some uncertainty associated with them but serve as a reasonable basis for evaluating the potential impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshots 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 a single year recurrence of drought of record conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water 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, availability of limited resources, and other structural changes to the economy that may occur in the future. Changes in water use efficiency will undoubtedly take place in the future as supplies become more stressed. Use of the static IMPLAN structure 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 is not a form of 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 methods to weigh future costs differently through time.

5. All monetary values originally based upon year 2016 IMPLAN and other sources are reported in constant year 2018 dollars to be consistent with the water management strategy requirements in the State Water Plan.

6. IMPLAN based loss estimates (income-value-added, jobs, and taxes on production and imports) are calculated only for those IMPLAN sectors for which the TWDB's Water Use Survey (WUS) data was available and deemed reliable. Every effort is made in the annual WUS effort to capture all relevant firms who are significant water users. Lack of response to the WUS, or omission of relevant firms, impacts the loss estimates.

7. Impacts are annual estimates. The socioeconomic analysis 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.

8. 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 measures (value-added and consumer surplus) are both valid impacts but ideally should not be summed.

9. The value-added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects to capture backward linkages in the economy described in Section 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.

10. The majority of impacts estimated in this analysis may be more conservative (i.e., smaller) than those that might actually occur under drought of record conditions due to not including impacts in the forward linkages in the economy. 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 this type of economic modeling effort, 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, resulting in conservative impact estimates.

11. The model does 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 some industries immediately following a drought, such as landscaping;
    b. The cost and time to rebuild liquidated livestock herds (a major capital investment 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 necessarily 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.

14. The methodology does not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

15. The methodology that the TWDB has developed for estimating the economic impacts of unmet water needs, and the assumptions and models used in the analysis, are specifically designed to estimate potential economic effects at the regional and county levels. Although it may be tempting to add the regional impacts together in an effort to produce a statewide result, the TWDB cautions against that approach for a number of reasons. The IMPLAN modeling (and corresponding economic multipliers) are all derived from regional models – a statewide model of Texas would produce somewhat different multipliers. As noted in point 14 within this section, the regional modeling used by TWDB does not capture spillover losses that could result in other regions from unmet needs in the region analyzed, or potential spillover gains if decreased production in one region leads to increases in production elsewhere. The assumed drought of record may also not occur in every region of Texas at the same time, or to the same degree.

4 Analysis Results

This section presents estimates of potential economic impacts 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. Projected economic impacts for the six water use categories (irrigation, livestock, manufacturing, mining, municipal, and steam-electric power) are reported by decade.

4.1 Impacts for Irrigation Water Shortages

Seven of the 21 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-1. 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. However, it was not considered realistic to report increasing tax revenues during a drought of record.

Table 4-1 Impacts of water shortages on irrigation in Region A

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$30	$151	$147	$136	$121	$121
Job losses	386	1,951	1,897	1,744	1,557	1,558

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.2 Impacts for Livestock Water Shortages

None of the 21 counties in the region are projected to experience water shortages in the livestock water use category. Estimated impacts to this water use category appear in Table 4-2.

Table 4-2 Impacts of water shortages on livestock in Region A

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$-	$-	$-	$-	$-	$-
Jobs losses	-	-	-	-	-	-
Tax losses on production and imports ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.3 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in five of the 21 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 4-3.

Table 4-3 Impacts of water shortages on manufacturing in Region A

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$47	$248	$575	$1,760	$2,546	$2,728
Job losses	319	1,838	5,016	15,037	22,310	24,393
Tax losses on production and Imports ($ millions)*	$4	$20	$43	$134	$193	$205

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.4 Impacts of Mining Water Shortages

None of the 21 counties in the region are projected to experience water shortages in the mining water use category. Estimated impacts to this water use type appear in Table 4-4.

Table 4-4 Impacts of water shortages on mining in Region A

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$-	$-	$-	$-	$-	$-
Job losses	-	-	-	-	-	-
Tax losses on production and Imports ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.5 Impacts for Municipal Water Shortages

Sixteen of the 21 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 two sub-categories within municipal water use: residential and non-residential. Non-residential municipal water use includes commercial and institutional users, which are further divided into non-water-intensive and water-intensive subsectors including car wash, laundry, hospitality, health care, recreation, and education. Lost consumer surplus estimates were made only for needs in the residential portion of municipal water use. Available IMPLAN and TWDB Water Use Survey data for the non-residential, water-intensive portion of municipal demand allowed these sectors to be included in income, jobs, and tax loss impact estimate.

Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed, maximum cost of $35,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 4-5.

Table 4-5 Impacts of water shortages on municipal water users in Region A

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$4	$33	$145	$366	$557	$663
Job losses[1]	66	592	2,621	6,637	10,100	12,014
Tax losses on production and imports[1] ($ millions)*	$0	$3	$15	$37	$56	$67
Trucking costs ($ millions)*	$4	$4	$8	$10	$19	$25
Utility revenue losses ($ millions)*	$3	$21	$45	$73	$101	$119
Utility tax revenue losses ($ millions)*	$0	$0	$1	$1	$2	$2

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.6 Impacts of Steam-Electric Water Shortages

None of the 21 counties in the region are projected to experience water shortages in the steam-electric water category. Estimated impacts to this water use category appear in Table 4-6.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of estimated additional purchasing costs for power from the electrical grid to replace power 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.
- Do 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 4-6 Impacts of water shortages on steam-electric power in Region A

Impacts measure	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	$-	$-	$-	$-	$-	$-

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

4.7 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 4-7.

Table 4-7 Region-wide social impacts of water shortages in Region A

Impacts measure	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$6	$13	$29	$72	$168	$198
Population losses	141	804	1,751	4,299	6,236	6,970
School enrollment losses	27	154	335	822	1,193	1,333

* Year 2018 dollars, rounded. Entries denoted by a dash (-) indicate no estimated economic impact. Entries denoted by a zero ($0) indicate estimated income losses less than $500,000.

Appendix A - County Level Summary of Estimated Economic Impacts for Region A

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2018 dollars, rounded). Values are presented only for counties with projected economic impacts for at least one decade.
(* Entries denoted by a dash (-) indicate no estimated economic impact)

		Income losses (Million $)*						Job losses					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
CARSON	MUNICIPAL	-	$4.04	$5.14	$5.09	$5.09	$5.09	-	73	93	92	92	92
CARSON Total		**-**	**$4.04**	**$5.14**	**$5.09**	**$5.09**	**$5.09**	**-**	**73**	**93**	**92**	**92**	**92**
CHILDRESS	MUNICIPAL	-	-	-	-	$0.29	$2.04	-	-	-	-	5	37
CHILDRESS Total		**-**	**-**	**-**	**-**	**$0.29**	**$2.04**	**-**	**-**	**-**	**-**	**5**	**37**
COLLINGSWORTH	IRRIGATION	$1.37	$4.01	$3.59	$4.06	$4.94	$4.22	18	54	49	55	67	57
COLLINGSWORTH	MUNICIPAL	$1.49	$1.53	$1.56	$1.61	$1.65	$1.69	27	28	28	29	30	31
COLLINGSWORTH Total		**$2.86**	**$5.55**	**$5.15**	**$5.67**	**$6.59**	**$5.91**	**45**	**82**	**77**	**84**	**97**	**88**
DALLAM	IRRIGATION	$1.31	$41.18	$43.22	$39.36	$31.89	$31.89	17	520	546	497	403	403
DALLAM	MUNICIPAL	$1.12	$5.72	$8.45	$11.31	$14.17	$15.51	20	104	153	205	257	281
DALLAM Total		**$2.43**	**$46.90**	**$51.67**	**$50.68**	**$46.06**	**$47.41**	**37**	**624**	**699**	**703**	**660**	**684**
DONLEY	MUNICIPAL	-	-	-	-	$0.03	$0.19	-	-	-	-	1	3
DONLEY Total		**-**	**-**	**-**	**-**	**$0.03**	**$0.19**	**-**	**-**	**-**	**-**	**1**	**3**
GRAY	IRRIGATION	-	-	-	-	$0.10	$0.10	-	-	-	-	1	1
GRAY	MUNICIPAL	-	-	$2.49	$6.33	$10.93	$16.06	-	-	45	115	198	291
GRAY Total		**-**	**-**	**$2.49**	**$6.33**	**$11.03**	**$16.16**	**-**	**-**	**45**	**115**	**200**	**293**
HALL	IRRIGATION	$9.59	$8.78	$6.16	$2.98	$1.04	$1.75	123	113	79	38	13	22
HALL	MUNICIPAL	-	$0.01	$0.09	$0.30	$0.62	$0.65	-	0	2	5	11	12
HALL Total		**$9.59**	**$8.79**	**$6.25**	**$3.28**	**$1.65**	**$2.40**	**123**	**113**	**81**	**44**	**25**	**34**
HANSFORD	MUNICIPAL	-	$0.00	$0.18	$1.18	$2.43	$2.58	-	0	3	21	44	47
HANSFORD Total		**-**	**$0.00**	**$0.18**	**$1.18**	**$2.43**	**$2.58**	**-**	**0**	**3**	**21**	**44**	**47**
HARTLEY	IRRIGATION	$17.44	$87.72	$80.81	$72.60	$64.35	$64.35	228	1,145	1,054	947	840	840
HARTLEY	MUNICIPAL	$0.52	$2.48	$3.34	$4.11	$4.78	$4.89	10	45	61	75	87	89
HARTLEY Total		**$17.97**	**$90.19**	**$84.15**	**$76.71**	**$69.13**	**$69.24**	**237**	**1,189**	**1,115**	**1,022**	**926**	**928**
HUTCHINSON	MANUFACTURING	-	-	-	-	$12.18	$35.53	-	-	-	-	41	120
HUTCHINSON	MUNICIPAL	-	$1.56	$3.21	$6.35	$9.24	$10.30	-	28	58	115	168	187
HUTCHINSON Total		**-**	**$1.56**	**$3.21**	**$6.35**	**$21.43**	**$45.83**	**-**	**28**	**58**	**115**	**209**	**307**

		Income losses (Million $)*						Job losses					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
LIPSCOMB	MANUFACTURING	-	-	$1.50	$13.33	$27.21	$30.95	-	-	21	187	382	434
LIPSCOMB	MUNICIPAL	-	-	$0.06	$0.57	$1.23	$1.43	-	-	1	10	22	26
LIPSCOMB Total		**-**	**-**	**$1.55**	**$13.90**	**$28.44**	**$32.38**	**-**	**-**	**22**	**197**	**404**	**460**
MOORE	IRRIGATION	-	$9.58	$12.29	$12.60	$13.01	$13.01	-	119	153	156	161	161
MOORE	MANUFACTURING	$46.63	$187.54	$316.42	$1,140.20	$1,592.31	$1,596.73	319	1,281	2,162	7,789	10,878	10,908
MOORE	MUNICIPAL	$0.49	$4.84	$17.34	$26.53	$34.85	$38.75	9	88	314	481	632	703
MOORE Total		**$47.11**	**$201.97**	**$346.05**	**$1,179.34**	**$1,640.17**	**$1,648.48**	**327**	**1,488**	**2,629**	**8,427**	**11,671**	**11,772**
OCHILTREE	MUNICIPAL	-	-	$0.00	$0.03	$0.57	$1.24	-	-	0	1	10	22
OCHILTREE Total		**-**	**-**	**$0.00**	**$0.03**	**$0.57**	**$1.24**	**-**	**-**	**0**	**1**	**10**	**22**
POTTER	MANUFACTURING	-	$10.78	$135.77	$392.58	$662.23	$794.03	-	145	1,827	5,282	8,910	10,684
POTTER	MUNICIPAL	-	$6.85	$55.50	$161.98	$246.67	$294.00	-	124	1,006	2,937	4,473	5,331
POTTER Total		**-**	**$17.63**	**$191.27**	**$554.56**	**$908.90**	**$1,088.03**	**-**	**269**	**2,833**	**8,219**	**13,383**	**16,015**
RANDALL	MANUFACTURING	-	$49.51	$121.17	$214.00	$252.52	$270.35	-	411	1,007	1,778	2,098	2,247
RANDALL	MUNICIPAL	-	$5.60	$47.21	$140.57	$224.12	$267.66	-	101	856	2,549	4,064	4,854
RANDALL Total		**-**	**$55.11**	**$168.38**	**$354.57**	**$476.64**	**$538.01**	**-**	**513**	**1,863**	**4,327**	**6,163**	**7,100**
SHERMAN	IRRIGATION	-	-	$1.31	$3.93	$5.74	$5.81	-	-	16	49	72	73
SHERMAN Total		**-**	**-**	**$1.31**	**$3.93**	**$5.74**	**$5.81**	**-**	**-**	**16**	**49**	**72**	**73**
WHEELER	MUNICIPAL	-	-	-	$0.02	$0.32	$0.42	-	-	-	0	6	8
WHEELER Total		**-**	**-**	**-**	**$0.02**	**$0.32**	**$0.42**	**-**	**-**	**-**	**0**	**6**	**8**
REGION A Total		**$79.95**	**$431.74**	**$866.81**	**$2,261.64**	**$3,224.51**	**$3,511.22**	**770**	**4,380**	**9,535**	**23,417**	**33,968**	**37,964**

APPENDIX G

INFRASTRUCTURE FINANCING SURVEY RESULTS

Table G-1
Summary of PWPA Infrastructure Finance Report (IFR) Survey Responses

Sponsor	Project Name	IFR Element Name	IFR Element Value	Year of Need
AMARILLO	ADVANCED METERING INFRASTRUCTURE - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$2,500,000	2020
AMARILLO	ADVANCED METERING INFRASTRUCTURE - AMARILLO	CONSTRUCTION FUNDING	$28,500,000	2020
AMARILLO	ADVANCED METERING INFRASTRUCTURE - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	92%	
AMARILLO	AMARILLO WELLFIELD TO CRMWAII TRANSMISSION PIPELINE - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$7,400,000	2029
AMARILLO	AMARILLO WELLFIELD TO CRMWAII TRANSMISSION PIPELINE - AMARILLO	CONSTRUCTION FUNDING	$8,556,000	2030
AMARILLO	AMARILLO WELLFIELD TO CRMWAII TRANSMISSION PIPELINE - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	AQUIFER STORAGE AND RECOVERY - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$841,200	2028
AMARILLO	AQUIFER STORAGE AND RECOVERY - AMARILLO	CONSTRUCTION FUNDING	$9,673,800	2030
AMARILLO	AQUIFER STORAGE AND RECOVERY - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE I (OGALLALA AQUIFER) - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$2,368,000	
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE I (OGALLALA AQUIFER) - AMARILLO	CONSTRUCTION FUNDING	$27,232,000	
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE I (OGALLALA AQUIFER) - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE II (OGALLALA AQUIFER) - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$2,368,000	2049
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE II (OGALLALA AQUIFER) - AMARILLO	CONSTRUCTION FUNDING	$27,232,000	2050
AMARILLO	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE II (OGALLALA AQUIFER) - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,610,000	2069
AMARILLO	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	CONSTRUCTION FUNDING	$18,516,000	2070
AMARILLO	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	DIRECT POTABLE REUSE - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$4,101,600	2039
AMARILLO	DIRECT POTABLE REUSE - AMARILLO	CONSTRUCTION FUNDING	$47,168,400	2040
AMARILLO	DIRECT POTABLE REUSE - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	100%	
AMARILLO	WATER AUDIT AND LEAK REPAIR - AMARILLO	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$13,667,992	2030
AMARILLO	WATER AUDIT AND LEAK REPAIR - AMARILLO	CONSTRUCTION FUNDING	$157,181,908	2030
AMARILLO	WATER AUDIT AND LEAK REPAIR - AMARILLO	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	50%	
BOOKER	DEVELOP OGALLALA AQUIFER SUPPLIES - BOOKER	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
BOOKER	DEVELOP OGALLALA AQUIFER SUPPLIES - BOOKER	CONSTRUCTION FUNDING		
BOOKER	DEVELOP OGALLALA AQUIFER SUPPLIES - BOOKER	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
CACTUS	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
CACTUS	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	CONSTRUCTION FUNDING		
CACTUS	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
CANYON	DEVELOP DOCKUM AQUIFER SUPPLIES - CANYON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
CANYON	DEVELOP DOCKUM AQUIFER SUPPLIES - CANYON	CONSTRUCTION FUNDING		
CANYON	DEVELOP DOCKUM AQUIFER SUPPLIES - CANYON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
CANYON	DEVELOP OGALLALA AQUIFER SUPPLIES - CANYON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
CANYON	DEVELOP OGALLALA AQUIFER SUPPLIES - CANYON	CONSTRUCTION FUNDING		
CANYON	DEVELOP OGALLALA AQUIFER SUPPLIES - CANYON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
CANYON	WATER AUDIT AND LEAK REPAIR - CANYON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
CANYON	WATER AUDIT AND LEAK REPAIR - CANYON	CONSTRUCTION FUNDING		
CANYON	WATER AUDIT AND LEAK REPAIR - CANYON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	AQUIFER STORAGE AND RECOVERY - CRMWA	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$5,500,000	2028
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	AQUIFER STORAGE AND RECOVERY - CRMWA	CONSTRUCTION FUNDING	$22,315,000	2030
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	AQUIFER STORAGE AND RECOVERY - CRMWA	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II CRMWA PIPELINE	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$15,000,000	2024
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II CRMWA PIPELINE	CONSTRUCTION FUNDING	$85,489,000	2027
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II CRMWA PIPELINE	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II SHARED PIPELINE	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$45,200,000	2024
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II SHARED PIPELINE	CONSTRUCTION FUNDING	$256,155,000	2027

Table G-1
Summary of PWPA Infrastructure Finance Report (IFR) Survey Responses

Sponsor	Project Name	IFR Element Name	IFR Element Value	Year of Need
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	CRMWA II SHARED PIPELINE	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$10,002,000	2024
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA3	CONSTRUCTION FUNDING	$56,677,000	2027
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA4	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$3,000,000	2040
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	CONSTRUCTION FUNDING	$12,474,800	2042
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
DALHART	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
DALHART	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	CONSTRUCTION FUNDING		
DALHART	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
DUMAS	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
DUMAS	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	CONSTRUCTION FUNDING		
DUMAS	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
DUMAS	WATER AUDIT AND LEAK REPAIR - DUMAS	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
DUMAS	WATER AUDIT AND LEAK REPAIR - DUMAS	CONSTRUCTION FUNDING		
DUMAS	WATER AUDIT AND LEAK REPAIR - DUMAS	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
GREEENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
GREEENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	CONSTRUCTION FUNDING		
GREEENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
GRUVER	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
GRUVER	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	CONSTRUCTION FUNDING		
GRUVER	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
HIGGINS	WATER AUDIT AND LEAK REPAIR - HIGGINS	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
HIGGINS	WATER AUDIT AND LEAK REPAIR - HIGGINS	CONSTRUCTION FUNDING		
HIGGINS	WATER AUDIT AND LEAK REPAIR - HIGGINS	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
MCLEAN	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
MCLEAN	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	CONSTRUCTION FUNDING		
MCLEAN	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
MEMPHIS	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
MEMPHIS	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	CONSTRUCTION FUNDING	$1,128,000	2020
MEMPHIS	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0%	
PAMPA	AQUIFER STORAGE AND RECOVERY - PAMPA	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
PAMPA	AQUIFER STORAGE AND RECOVERY - PAMPA	CONSTRUCTION FUNDING		
PAMPA	AQUIFER STORAGE AND RECOVERY - PAMPA	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
PAMPA	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
PAMPA	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	CONSTRUCTION FUNDING		
PAMPA	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
PANHANDLE	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
PANHANDLE	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	CONSTRUCTION FUNDING		
PANHANDLE	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
PERRYTON	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
PERRYTON	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	CONSTRUCTION FUNDING		
PERRYTON	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		

Table G-1
Summary of PWPA Infrastructure Finance Report (IFR) Survey Responses

Sponsor	Project Name	IFR Element Name	IFR Element Value	Year of Need
SPEARMAN	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
SPEARMAN	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	CONSTRUCTION FUNDING		
SPEARMAN	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
STINNETT	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
STINNETT	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	CONSTRUCTION FUNDING		
STINNETT	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
SUNRAY	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
SUNRAY	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	CONSTRUCTION FUNDING		
SUNRAY	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
TCW SUPPLY	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
TCW SUPPLY	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	CONSTRUCTION FUNDING		
TCW SUPPLY	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
TEXLINE	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
TEXLINE	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	CONSTRUCTION FUNDING		
TEXLINE	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
TURKEY MUNICIPAL WATER SYSTEM	NEW GROUNDWATER SOURCE - TURKEY	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
TURKEY MUNICIPAL WATER SYSTEM	NEW GROUNDWATER SOURCE - TURKEY	CONSTRUCTION FUNDING		
TURKEY MUNICIPAL WATER SYSTEM	NEW GROUNDWATER SOURCE - TURKEY	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
TURKEY MUNICIPAL WATER SYSTEM	WATER AUDIT AND LEAK REPAIR - TURKEY	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
TURKEY MUNICIPAL WATER SYSTEM	WATER AUDIT AND LEAK REPAIR - TURKEY	CONSTRUCTION FUNDING		
TURKEY MUNICIPAL WATER SYSTEM	WATER AUDIT AND LEAK REPAIR - TURKEY	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
WELLINGTON MUNICIPAL WATER SYSTEM	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
WELLINGTON MUNICIPAL WATER SYSTEM	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	CONSTRUCTION FUNDING		
WELLINGTON MUNICIPAL WATER SYSTEM	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
WELLINGTON MUNICIPAL WATER SYSTEM	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
WELLINGTON MUNICIPAL WATER SYSTEM	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	CONSTRUCTION FUNDING		
WELLINGTON MUNICIPAL WATER SYSTEM	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		
WHEELER	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING		
WHEELER	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	CONSTRUCTION FUNDING		
WHEELER	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY		

APPENDIX H

COMMENTS RECEIVED ON THE IPP AND RESPONSES

INTRODUCTION

The 2021 Panhandle Initially Prepared Water Plan was provided to the TWDB on March 3, 2020 and made publicly available before March 23, 2020. The PWPG held a public hearing on April 23, 2020, to present a brief overview of the plan and solicit public comments. No public comments were received at the hearing or during the 60-day public comment period following the hearing. The PWPG did receive comments from the Texas Water Development Board, Texas Parks and Wildlife Department, and the Texas State Soil and Water Conservation Board. These comments are included in full in this appendix, along with responses to the comments.

In addition to these formal comments, various Water User Groups (WUGs) provided informal comments on the Initially Prepared Plan. These comments were primarily focused on requests to adjust Water Management Strategy assumptions. Table H-1 below summarizes the informal comments received from Major Water Providers (MWPs) and Water User Groups (WUGs).

Table H-1: Comments from MWPs and WUGs on the Initially Prepared Plan

WUG	County	Comment
Perryton	Ochiltree	Changed the transmission pipeline length from 2 miles to 10 miles on Perryton's "Drill Additional Groundwater Well(s)" WMS.
Turkey	Hall	Received Turkey's 2019 Drought Contingency Plan and incorporated into the final 2021 Regional Water Plan
Amarillo	Potter/Randall	Changed the capital cost of the Advanced Metering Infrastructure WMS from $43 million to $31 million.

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Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

Mr. C.E. Williams, Chair
c/o Panhandle GCD
P.O. Box 637
White Deer, Texas 79097

Mr. Dustin Meyer
Panhandle Regional Planning Commission
415 SW 8th Ave
Amarillo, Texas 79101

Re: Texas Water Development Board Comments for the Panhandle (Region A) Regional Water Planning Group Initially Prepared Plan, Contract No. 1548301829

Dear Mr. Williams and Mr. Meyer:

Texas Water Development Board (TWDB) staff have completed their review of the Initially Prepared Plan (IPP) submitted by March 3, 2020 on behalf of the Panhandle Regional Water Planning Group (RWPG). The attached comments follow this format:

- **Level 1:** Comments, questions, and data 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.

Please note that rule references are based on recent revisions to 31 Texas Administrative Code (TAC) Chapter 357, adopted by the TWDB Board on June 4, 2020. 31 TAC § 357.50(f) requires the RWPG to consider timely agency and public comment. Section 357.50(g) 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 (*Contract Exhibit C, Section 13.1.2)*.

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, please be sure to also incorporate the following:

a) Completed results from the RWPG's infrastructure financing survey for sponsors of recommended projects with capital costs, including an electronic version of the survey spreadsheet *[31 TAC § 357.44]*;
b) Completed results from the implementation survey, including an electronic version of the survey spreadsheet *[31 TAC § 357.45(a)]*;
c) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC § 357.50(f)]*; and
d) Evidence, such as a certification in the form of a cover letter, that the final, adopted regional water plan is complete and adopted by the RWPG *[31 TAC § 357.50(h)(1)]*.

Please ensure that the final plan includes updated State Water Planning Database (DB22) reports, and that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB22. For the purpose of development of the 2022 State Water Plan, water management strategy and other data entered by the RWPG in DB22 shall take precedence over any conflicting data presented in the final regional water plan *[Contract Exhibit C, Sections 13.1.3 and 13.2.2]*.

Additionally, subsequent review of DB22 data is being performed. If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve. Please anticipate the need to respond to additional comments regarding data integrity, including any source overallocations, prior to the adoption of the final regional water plans.

The 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 also be incorporated in hard copy format within each plan *[31 TAC § 357.50(g)(2)(C), Contract Exhibit C, Section 13.1.2 and 13.2.1]*.

The following items must accompany, the submission of the final, adopted regional water plan:

1. The prioritized list of all recommended projects in the regional water plan, including an electronic version of the prioritization spreadsheet *[31 TAC § 357.46];* and,
2. All hydrologic modeling files and GIS files, including any remaining 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(g)(2)(C), Contract Exhibit C, Section 13.1.2, and 13.2.1].*

The following general requirements that apply to recommended water management strategies must be adhered to in all final regional water plans including:

1. Regional water plans must not include any recommended strategies or project 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(39), § 357.34(e)(3)(A), Contract Exhibit C, Sections 5.5.2 and 5.5.3]*; and,

2. Regional water plans must not include the costs of any retail distribution lines or other infrastructure costs that are not directly associated with the development of additional supply volumes (e.g., via treatment) other than those line replacement costs related to projects that are for the primary purpose of achieving conservation savings via water loss reduction *[§ 357.34(e)(3)(A), Contract Exhibit C, Section 5.5.3]*.

Please provide the TWDB with information on how you intend to address all Level 1 comments well in advance of your adoption the regional water plan to ensure that the response is adequate for the Executive Administrator to recommend the plan to the TWDB Board for consideration in a timely and efficient manner. Your TWDB project manager will review and provide feedback to ensure all IPP comments and associated plan revisions have been addressed adequately. Failure to adequately address any Level 1 comment may result in the delay of the TWDB Board approval of your final regional water plan.

As a reminder, the deadline to submit the final, adopted regional water plan and associated material to the TWDB is **October 14, 2020**. Any remaining data revisions to DB22 must be communicated to Sabrina Anderson at Sabrina.Anderson@twdb.texas.gov by **September 14, 2020.**

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 William Alfaro at (512) 463-4741 or William.Alfaro@twdb.texas.gov. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Date: 6/16/2020

Jessica Zuba
Deputy Executive Administrator
Water Supply and Infrastructure

Attachment

c w/att.: Mr. Kyle Ingham, Panhandle Regional Planning Commission
Ms. Simone Kiel, Freese & Nichols, Inc.

Response to TWDB Comments

The TWDB sent a cover letter with a list of requirements for the final 2021 Panhandle Water Plan. In addition, TWDB included an attachment to their letter with specific comments on the plan. Responses to specific comments are included below each comment within the TWDB attachment letter. Below is the list of requirements in the cover letter and documentation that these requirements are met.

List of Requirements specified in the TWDB Cover letter:

a) Completed results from the RWPG's infrastructure financing survey for sponsors of recommended projects with capital costs, including an electronic version of the survey spreadsheet; **The infrastructure financing survey is discussed in Chapter 9 and the survey spreadsheet is included in Appendix G.**
b) Completed results from the implementation survey, including an electronic version of the survey spreadsheet; **The implementation survey is included in Appendix I.**
c) Documentation that comments received on the IPP were considered in the development of the final plan; **All comments received were considered for the final plan. Documentation of responses to the comments is included in this appendix, Appendix H.**
d) Evidence, such as a certification in the form of a cover letter, that the final, adopted regional water plan is complete and adopted by the RWPG. **A cover letter certifying the adoption of the final plan accompanied the submittal to the TWDB on November 5, 2020.**
e) Ensure that the final plan includes updated State Water Planning Database (DB22) reports, and that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB22. **The DB22 reports are included in Appendix J. The data are consistent between the DB22 reports and the plan.**

The following items must accompany, the submission of the final, adopted regional water plan:

1. The prioritized list of all recommended projects in the regional water plan, including an electronic version of the prioritization spreadsheet;
2. All hydrologic modeling files and GIS files, including any remaining 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.

The final deliverables included the written plan and all electronic files as required by the TWDB. A separate submittal of the prioritization of the recommended projects in the PWPA was included with the submittal to the TWDB on November 5, 2020.

TWDB comments on the Initially Prepared 2021 Panhandle (Region A) Regional Water Plan.

Level 1: Comments, questions, and data revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Chapter 5 and the State Water Planning Database (DB22). The plan includes six recommended *groundwater wells & other* water management strategies (WMS) providing supply in 2020. **Strategy supply with an online decade of 2020 must be constructed and delivering water by January 5, 2023**. Please confirm that all strategies shown as providing supply in 2020 are expected to be providing water by January 5, 2023. *[31 § TAC 357.10(21); Contract Exhibit C, Section 5.2]*

   Response: *Several strategies had the wrong online date reported in tables in the IPP and in the Regional Water Plan Database (DB22). This was corrected in the final plan. Strategies corrected in the final plan include new groundwater for Memphis, TCW, and Wheeler. Both the cities of Cactus and Dalhart show groundwater strategies online in 2020. For these strategies, groundwater can be provided by January 2023. The supply may be developed over time with a smaller quantity in 2020 and expanding to meet needs. However, the PWPG was not given direction on phasing these projects.*

2. Section 3.1.2, Table 3-5, page 3-13. The plan presents groundwater availability for the non-relevant Ogallala Aquifer in Collingsworth County and Blaine Aquifer in Wheeler County, however the plan does not appear to describe the methodology used to estimate the availability. Please provide the methodology used to estimate the groundwater availability for these aquifer/county splits in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.5.2]*

   Response. *A description of the methodology to estimate groundwater availability from these sources was added to Section 3.1.2. For the portions of recognized aquifers declared non-relevant, availability was based on the historic use estimates from TWDB from 2007 through 2016, if reported. Otherwise, availability was estimated from the hydrogeologic properties of the non-relevant aquifer.*

3. Section 3.1.5, page 3-19. The plan refers the reader to Appendix C for the complete list of water rights, however Appendix C includes agricultural water management strategies (WMS). Appendix B refers the reader to the 2016 RWP for the list of water rights. Please correct the reference to Appendix C and include a list of water rights in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.7]*

   Response: *This reference was updated.*

4. Section 3.1.7, page 3-23. The plan does not appear to provide information on the methodology used to calculate direct reuse supplies. Please provide the methodology used to calculate direct reuse supplies in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.4]*

Response: *The methodology was added to Section 3.1.7.*

5. Section 3.1.8, page 3-25. Please include a description of how the historical water use data from the TWDB was used to estimate yields for local surface water supplies and clarify the anticipated reliability of the estimates during drought of record conditions in the final, adopted regional water plan. *[Contract Exhibit C, Section 3.2]*

Response: *The methodology used to develop local surface water supplies, which represent stock tanks, was added in Section 3.18. Reliability during drought is predicated on the continuity of use.*

6. Chapter 5. Please clarify whether all potentially feasible WMS were evaluated under drought of record conditions and document this information in the final, regional water plan. *[3 TAC § 357.35(a)].*

Response: *All potentially feasible WMSs were evaluated under drought of record conditions. This was clarified in Chapter 5A.*

7. Chapter 5. The plan does not appear to include the documented process used by the planning group to identify potentially feasible WMSs, as presented to the planning group in accordance with 31 TAC § 357.21(b). Please include this information in the final, adopted regional water plan. *[Contract Exhibit C, Section 5.1]*

Response: *Chapter 5A provides a high-level overview of the process to identify potentially feasible strategies. For a more complete description, a memorandum documenting this process is included in Attachment 5A-1. This memorandum, along with a presentation on the Methodology to Identify Potentially Feasible Water Management Strategies, was presented to the PWPG on March 23, 2018.*

8. Chapter 5. Please include documentation of why brackish groundwater or seawater desalination was not selected as recommended WMSs in the final, adopted regional water plan. *[TWC § 16.053(e)(5)(j); Contract Exhibit C, Section 5.2; 31 § TAC 357.34(g)]*

Response: *Brackish groundwater is considered a potentially feasible strategy (see p. 5A-2) but was not identified for any user due to the availability of non-brackish groundwater. Desalination of surface water is considered for CRMWA. Seawater desalination is not recommended for users in the PWPA since it is infeasible. Further discussion on brackish groundwater and seawater desalination was added to Chapter 5A (see Section 5.10) and is discussed in the documented process now included in Attachment 5A-1.*

9. Section 5D.8.1, page 5D-20. The WMS evaluation for Memphis, Drill Additional Groundwater Wells, states that the strategy would be implemented by 2030, yet supply is shown online in 2020. Strategy supply with an online decade of 2020 must be developed and providing supply by January 5, 2023. Please reconcile accordingly in the final, adopted regional water plan. *[31 TAC § 357.10(21); Contract Exhibit C, Section 5.2]*

Response: *The supply should be online by 2030, not 2020. This was corrected for the* *final plan.*

10. Section 5D.12.3, page 5D-36. The WMS evaluation for TCW Supply, Drill Additional Groundwater Wells appears to include conflicting information. The evaluation states that it is uncertain where the new wells would be located yet also states that the wells will be completed prior to 2020. If the well locations are unknown and not yet completed, please revise the estimated completion date accordingly. Additionally, if the strategy will not be providing water prior to January 5, 2023, the strategy should reflect supply beginning in a later decade. *[31 TAC § 357.10(21); Contract Exhibit C, Section 5.2]*

Response: *The supply should be online by 2030, not 2020. This was corrected for the final plan.*

11. Chapter 7. The plan does not appear to indicate how the planning group considered the identification of unnecessary or counterproductive variations in specific drought response strategies, among user groups in the regional water planning area that may confuse the public or otherwise impede drought response efforts. Please include this information in the final, adopted regional water plan. *[TWC § 16.053(e)(3)(E), 31 TAC § 357.42(b)(2)]*

Response: *This discussion was added to Section 7.2.1.*

12. Chapter 7. The plan does not appear to include a discussion of whether drought contingency measures have been recently implemented (for example, since adoption of the last regional water plan) in response to drought conditions. Please describe this information in the final, adopted regional water plan*. [ContractScope of Work, Task 7, subtask 3]*

Response: *No drought contingency measures have been initiated in the PWPA since the publication of the last regional water plan in December 2015. This was added to Table 7-2 in Chapter 7.*

13. Section 10.2. The plan notes that all meetings were held in accordance with the Texas Open Meetings Act but does not discuss compliance with the Texas Public Information Act. Please address how the planning group complied with the Texas Public Information Act in the final, adopted regional water plan. *[31 TAC § 357.21; 31 TAC § 357.50(f)]*

Response: *This was added in Chapter 10.*

14. Section 11.2. Please provide a brief summary of how the 2016 Plan differs from the 2021 Plan with regards to recommended and alternative WMS *projects* in the final, adopted regional water plan. *[31 TAC § 357.45(c)(4)]*

Response: *The difference between a WMS and a WMS project is DB22 related, and not understood by most readers of the regional water plan. To most readers, a WMS and WMS project are one and the same. To avoid confusion, the Panhandle Water Plan largely does not distinguish between the two. The term "and projects" was added to the footnote under Tables 11-10 and 11-11.*

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

Response: *All Level 2 comments were addressed and corrected in the final regional water plan.*

1. Page ES-4, Highlight Box. The 4th bullet states there is 4 Billion acre-feet per year of supply. Please consider revising this to 4 Million acre-feet per year of supply in the final, adopted regional water plan.

2. Page ES-4, 3rd line from the bottom: Suggest inserting a space between "2017" and "and".

3. Page 3-1, Definitions Box. Please consider revising the term 'Managed Available Groundwater' to 'Modeled Available Groundwater' in the final, adopted regional water plan.

4. Section 3.1.3, page 3-14, 1st paragraph refers to the critical period of a reservoir. Please consider referring the reader to Chapter 7, Table 7-1 which includes drought of record information for the PWPA reservoirs.

5. Chapter 5. In Sections 5B.1 (page 5B-1) and 5B.3 (page 5B-20), please consider correcting the first sentence under each that states, "Each public water supplier is required to update and submit a Water Conservation Plan (WCP) . . . every five years." Only public water suppliers meeting certain requirements are required to submit a WCP, as noted on TCEQ's website: https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserve.html.

6. Chapter 5. In Section 5B.3 (pages 5B-20 and 5B-21), please consider including information that entities that have a financial obligation with the TWDB greater than $500,000 are also required to submit a water conservation plan to the TWDB.

7. Page 5C-8 states that the recommended strategies for CRMWA would provide up to 96,000 acre-feet of supply per. However, Table 5C-2 shows a supply up to 102,688 acre-feet per year. Please review this apparent discrepancy between these supply volumes and consider revising the final plan accordingly.

8. Page 5D-1 states that the detailed costs are provided as Appendix E, however the Cost Estimates are presented in Appendix D. Please consider revising the appendix reference in the final plan.

9. Section 6.9, page 6-11. Please consider revising the reference to the regulatory matrix as being Appendix F, to Appendix E in the final plan.

10. Please consider updating the Consistency Matrix to reflect updated rule references, based on amendments to 31 TAC Chapter 357 adopted by the TWDB Board on June 4, 2020.

11. The GIS files submitted for water management strategy projects do not include minimum metadata requirements. Please include at a minimum, metadata about the data's projection, with the final GIS data submitted. *[Contract Exhibit D, Section 2.4.1]*

June 23, 2020

Mr. Dustin Meyer, Local Government Services Director
Panhandle Regional Water Planning Group
P.O. Box 9257
Amarillo, TX 79105

Re: 2021 Panhandle Region A Initially Prepared Plan

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2021 Initially Prepared Regional Water Plan (IPP) for the Panhandle Water Planning Group (PWPA) Region A. Water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. Although TPWD has limited regulatory authority over the use of state waters, we are the agency charged with primary responsibility for protecting the state's fish and wildlife resources. To that end, TPWD offers these comments intended to help 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?
- Does the IPP address concerns raised by TPWD in connection with the 2016 Water Plan?

The population of the 21 counties that comprise the Panhandle Regional Water Planning Area (PWPA) Regional population is currently 418,345 and is expected to grow to 637,412 in 2070. Although the population in the region accounted for 1.5 percent of the State's total population, its water demand is approximately 15 percent of the State's annual water demand. Projected water demands in the region are expected to decline from 2.1 million acre-feet to 1.6 million acre-feet due in part to declining groundwater availability but also due to increased irrigation efficiency and water conservation measures. The region's largest water need by far is for irrigated agriculture (87 percent), followed by municipal demand (5 percent).

Water conservation, the most environmentally benign water management strategy, is expected to provide approximately 570,000 acre-feet per year of water savings to users in the PWPA by 2070. New groundwater development is recommended to provide approximately 9,300 acre-feet per year in 2020, increasing to approximately 78,000 acre-feet per year by 2070, with additional new groundwater supplies provided to users outside of the PWPA. These two strategy types account for 98 percent of the supplies from the recommended water management strategies to water user groups. Other strategies include aquifer storage and recovery, direct potable reuse, brush control and water quality improvements.

As in the 2016 Plan, Chapter 1 includes a brief description of natural resources in the region, recognizing the importance of playa basins. In addition to their biological importance as wetlands, playas also provide local recharge to the Ogallala aquifer. The IPP discusses the importance of springs as transitions between groundwater and surface water but notes that the 16 significant springs located in the PWPA have been in decline over the past several decades due to groundwater development, the spread of high water use plant species such as mesquite and salt cedar, or the loss of native grasses and other plant cover. Table 1-15 lists federal and state threatened or endangered species that occur in the Region. As there have been recent updates (March 30, 2020) to the list of federal and state listed species we recommend table 1-15 be updated with the latest information that is available at:

https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/.

Water-related threats to natural resources, primarily insufficient groundwater and water quality concerns, are also described in the IPP. Surface and groundwater development as well as brush encroachment have altered natural stream flow patterns in the PWPA. In addition, spring flows have declined over the past several decades. However, according to the IPP, continued depletion of the local aquifers will likely continue to impact base flows of local streams and rivers in the PWPA. Salt cedar removal in the Lake Meredith watershed is a recommended strategy to increase flow into the Canadian River, improve water quality, and improve habitat. The North American Waterfowl Management Joint Venture is discussed as a means of protecting playas as wildlife habitat. As previously mentioned, new groundwater development is envisioned. TPWD concurs that large transfers of groundwater may have impacts to surface water and springs and adhering to Modeled Available Groundwater limits will protect desired future conditions (DFCs), only a few Groundwater Management Areas (GMAs) have adopted protection of spring flows as a desired future condition. Ultimately TPWD would like to see other GMAs adopt additional DFCs designed to protect springs.

Drought contingency plans are also included in the IPP. The planning group has proposed water conservation strategies for all municipal and irrigation water users. As appropriate all municipal users are encouraged to reduce per capita water use to achieve the Texas Water Conservation Task Force goal of 140 gallons per person per day (gpcd). Even though conservation is expected to provide 570,000 acre-feet per year of water savings by 2070, the average gpcd for the PWPA is projected to be 197 in 2020, slowly declining slightly to around 185 by 2070.

TPWD continues to support the planning group's consideration of brush control/management as an additional means of conserving water if done in a manner that can also benefit wildlife habitat. TPWD also supports the inclusion of direct potable reuse of treated municipal effluent for meeting future water needs however consideration should be given to the impact reduced return flows will have on water bodies like the Prairie Dog Town Fork of the Red River. In addition, disposal of brine concentrate from reverse osmosis treatment associated with direct potable reuse projects may have impacts to aquatic ecosystems if not disposed of properly.

The IPP includes an Environmental Quantification Matrix which provides a quantitative reporting of environmental factors (Attachment 5-2), scoring impacts on a scale of 1-5, where 5 is no or positive impact and 1 is highest impact. The evaluation of Environmental Factors considers multiple aspects of the potential impacts of the project as it relates to habitats, stream flow, water quality, threatened and endangered species and cultural resources. All proposed Water Management Strategies received scores of 4 or 5.

TPWD notes that the plan does not recommend nomination of any stream segments as ecologically unique. TPWD has identified several stream segments in the region that meet at least one of the criteria for classification as ecologically unique should the regional planning group decide to pursue nomination of an ecologically significant stream in the future. We are happy to assist the regional planning group should they elect to go in this direction.

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 me at (512) 389-8715 or Cindy.Loeffler@TPWD.Texas.gov if you have any questions or comments.

Sincerely,

Cindy Loeffler

Cindy Loeffler,
Chief, Water Resources Branch

RM: CL

Cc: Craig Bonds, Division Director, Inland Fisheries Division, TPWD
Caleb Huber, Inland Fisheries Division, TPWD

Response to Texas Parks and Wildlife Comments

There have been recent updates (March 30, 2020) to the list of federal and state listed species we recommend table 1-15 be updated with the latest information.

Response: *Table 1-15 has been updated and evaluations of projects related to threatened and endangered species in Attachment 5-2 have been updated.*

TPWD would like to see other GMAs adopt additional DFCs designed to protect springs.

Response: *Comment noted.*

Consideration should be given to the impact reduced return flows will have on water bodies like the Prairie Dog Town Fork of the Red River. In addition, disposal of brine concentrate from reverse osmosis treatment associated with direct potable reuse projects may have impacts to aquatic ecosystems if not disposed of properly.

Response: *The City of Amarillo has a contract with Xcel Energy for the City's wastewater effluent. Most of the wastewater effluent identified for this project is projected future effluent. Therefore, reuse of the effluent will have no to small impact to wastewater discharges to streams. The Panhandle Water Plan does acknowledge additional information and studies are needed to confirm the brine concentrate can be discharged to Prairie Dog Town Fork. All discharges would comply with permitting requirements.*

TEXAS STATE SOIL AND WATER CONSERVATION BOARD
Protecting and Enhancing Natural Resources for Tomorrow

June 18, 2020

Mr. Dustin Meyer
Region A Administrator

Dear Mr. Meyer;

For the past 2 years the Texas State Soil and Water Conservation Board (TSSWCB) has been participating in the Texas Water Development Board's (TWDB) Regional Water Planning meetings as directed by Senate Bill 1511, passed in the 2017 legislative session. We appreciate being included in the process and offer these constructive comments to the regional water plans and ultimately the State water plan. Attached you will find some specific comments to the Region A water plan as they pertain to the TSSWCB.

As you may know 82% of Texas' land area is privately-owned and are working lands, involved in agricultural, timber, and wildlife operations. These lands are important as they provide substantial economic, environmental, and recreational resources that benefit both the landowners and public. They also provide ecosystem services that we all rely on for everyday necessities, such as air and water quality, carbon sequestration, and wildlife habitat.

With that said, these working lands are where the vast majority of our rain falls and ultimately supply the water for all of our needs, such as municipal, industrial, wildlife, and agricultural to name a few. Texas' private working lands are a valuable resource for all Texans.

Over the years, the private landowners of these working lands have been good stewards of their property. In an indirect way they have been assisting the 16 TWDB's Regional Water Planning Groups in achieving their goals through voluntary incentive-based land conservation practices.

It has been proven over time if a raindrop is controlled where it hits the ground there can be a benefit to both water quality and water quantity. Private landowners have been providing benefits to our water resources by implementing Best Management Practices (BMP) that slow water runoff and provide for soil stabilization, which also slows the sedimentation of our reservoirs and allows for more water infiltration into our aquifers.

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http://www.tsswcb.texas.gov

Some common BMPs include brush management, prescribed grazing, fencing, grade stabilization, irrigation land leveling, terrace, contour farming, cover crop, residue and tillage management, and riparian herbaceous cover.

The TSSWCB has been active with agricultural producers since 1939 as the lead agency for planning, implementing, and managing coordinated natural resource conservation programs for preventing and abating agricultural and sivicultural nonpoint sources of water pollution.

The TSSWCB also works to ensure that the State's network of over 2,000 flood control dams are protecting lives and property by providing operation, maintenance, and structural repair grants to local government sponsors.

The TSSWCB successfully delivers technical and financial assistance to private landowners of Texas through Texas' 216 local Soil and Water Conservation Districts (SWCD) which are led by 1,080 locally elected district directors who are active in agriculture. Through the TSSWCB Water Quality Management Plan Program (WQMP), farmers, ranchers, and silviculturalists receive technical and financial assistance to voluntarily conserve and protect our natural resources. Participants receive assistance with conservation practices, BMPs, that address water quality, water quantity, and soil erosion while promoting the productivity of agricultural lands. This efficient locally led conservation delivery system ensures that those most affected by conservation programs can make decisions on how and what programs will be implemented voluntarily on their private lands.

Over time, lands change ownership and many larger tracts are broken up into smaller parcels. Most new landowners did not grow up on working lands and therefore may not have a knowledge of land management techniques. The TSSWCB is writing new WQMPs for these new landowners who are implementing BMPs on their land. Education and implementation of proper land management and BMPs continues to be essential. Voluntary incentive-based programs are essential to continue to address soil and water conservation in Texas.

These BMPs implemented for soil and water conservation provide benefits not only to the landowner but ultimately to all Texans and our water supply.

Respectfully,

Barry Mahler
Chairman

Rex Isom
Executive Director

Attachment

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Region A (Panhandle)

- Page 5A-6: 5A. 1.10 Brush Control

"In 2011, the 82nd legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP)."

    - Unfortunately, the WSEP is not a funded program at this time.

- Page 5C-6

"This strategy recommends that CRMWA continue with its program with support from the State Water Supply Enhancement Program to control salt cedar in the Lake Meredith watershed."

    - Unfortunately, the Water Supply Enhancement Program is not a funded program at this time.

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Response to Texas State Soil and Water Conservation Board

- Page 5A-6: 5A. 1.10 Brush Control

"In 2011, the 82nd legislature replaced the Brush Control Program with the Water Supply Enhancement Program (WSEP)."

  - Unfortunately, the WSEP is not a funded program at this time.

- Page 5C-6

"This strategy recommends that CRMWA continue with its program with support from the State Water Supply Enhancement Program to control salt cedar in the Lake Meredith watershed."

  - Unfortunately, the Water Supply Enhancement Program is not a funded program at this time.

Response: *The funding status of this program was noted in Sections 5A and 5C. Also, funding of this program was recommended in Chapter 8.*

APPENDIX I

IMPLEMENTATION SURVEY

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)
ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	2020	PROJECT SPONSOR(S): WELLINGTON	No			Not implemented	Financing	Unknown			$ 3,679,700.00
ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HALL)	No			Not implemented	Financing	Unknown			$ 1,600,800.00
DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	2020	PROJECT SPONSOR(S): COUNTY-OTHER (POTTER)	No			Not implemented	If other, please describe. Project no longer needed.	Not applicable	Not applicable		$ 3,345,600.00
DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	2020	PROJECT SPONSOR(S): CANYON	Yes		2030	Feasibility study ongoing			507		$ 11,614,100.00
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	2020	PROJECT SPONSOR(S): BORGER	Yes			Currently operating			6,000		$ 26,070,400.00
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	2020	PROJECT SPONSOR(S): CACTUS	No			Not implemented	If other, please describe. Unknown	Unknown			$ 18,191,900.00
DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	2020	PROJECT SPONSOR(S): GREENBELT MUNICIPAL AND INDUSTRIAL WATER AUTHORITY	Yes	2019	2030	Sponsor has taken official action to initiate project			2,000		$ 12,617,000.00
DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	2020	PROJECT SPONSOR(S): DALHART	No			Not implemented	If other, please describe. Unknown	Unknown			$ 4,197,900.00
DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	2020	PROJECT SPONSOR(S): DUMAS	No			Not implemented	If other, please describe. Unknown	Unknown			$ 12,544,700.00
DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	2020	PROJECT SPONSOR(S): LAKE TANGLEWOOD	No			Not implemented	If other, please describe. Project no longer needed.	Not applicable	Not applicable		$ 2,976,400.00
DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	2020	PROJECT SPONSOR(S): MCLEAN	No			Not implemented	If other, please describe. Unknown	Unknown			$ 789,400.00
DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	2020	PROJECT SPONSOR(S): PANHANDLE	No			Not implemented	If other, please describe. Unknown	Unknown			$ 3,217,800.00
DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	2020	PROJECT SPONSOR(S): PERRYTON	Yes	2015	2020	Sponsor has taken official action to initiate project			1,400		$ 10,584,100.00
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	2020	WMS SUPPLY RECIPIENT: COUNTY-OTHER, POTTER	No			Not implemented	If other, please describe. Project no longer needed.	Not applicable	Not applicable	$ -	$ -
DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	2020	PROJECT SPONSOR(S): MANUFACTURING (RANDALL)	No			Not implemented	If other, please describe. Project no longer needed.	Not applicable	Not applicable		$ 746,000.00
DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	2020	PROJECT SPONSOR(S): TCW SUPPLY INC	No			Not implemented	If other, please describe. Unknown	Unknown			$ 3,890,200.00
DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	2020	PROJECT SPONSOR(S): WHEELER	No			Not implemented	If other, please describe. Unknown	Unknown			$ 2,795,600.00
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	2020	PROJECT SPONSOR(S): AMARILLO	Yes	Ongoing	2030	Feasibility study ongoing					$ 53,397,000.00
DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	2020	PROJECT SPONSOR(S): WELLINGTON	No			Not implemented	Financing	Unknown			$ 2,589,800.00
IRRIGATION CONSERVATION - ARMSTRONG COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (ARMSTRONG)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 154,200.00
IRRIGATION CONSERVATION - CARSON COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (CARSON)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 2,047,700.00
IRRIGATION CONSERVATION - CHILDRESS COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (CHILDRESS)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 268,700.00
IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (COLLINGSWORTH)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 659,600.00
IRRIGATION CONSERVATION - DALLAM COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (DALLAM)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 13,596,900.00
IRRIGATION CONSERVATION - DONLEY COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (DONLEY)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 885,200.00
IRRIGATION CONSERVATION - GRAY COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (GRAY)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 782,700.00
IRRIGATION CONSERVATION - HALL COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (HALL)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 372,500.00
IRRIGATION CONSERVATION - HANSFORD COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (HANSFORD)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 4,959,300.00
IRRIGATION CONSERVATION - HARTLEY COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (HARTLEY)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 12,696,300.00
IRRIGATION CONSERVATION - HEMPHILL COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (HEMPHILL)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 70,100.00
IRRIGATION CONSERVATION - HUTCHINSON COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (HUTCHINSON)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,470,800.00
IRRIGATION CONSERVATION - LIPSCOMB COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (LIPSCOMB)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 735,600.00
IRRIGATION CONSERVATION - MOORE COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (MOORE)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 5,258,000.00
IRRIGATION CONSERVATION - OCHILTREE COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (OCHILTREE)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 2,104,300.00
IRRIGATION CONSERVATION - OLDHAM COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (OLDHAM)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 144,700.00
IRRIGATION CONSERVATION - POTTER COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (POTTER)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 126,000.00
IRRIGATION CONSERVATION - RANDALL COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (RANDALL)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 661,700.00
IRRIGATION CONSERVATION - ROBERTS COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (ROBERTS)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 219,000.00
IRRIGATION CONSERVATION - SHERMAN COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (SHERMAN)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 8,123,100.00
IRRIGATION CONSERVATION - WHEELER COUNTY	2020	PROJECT SPONSOR(S): IRRIGATION (WHEELER)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 301,500.00
MUNICIPAL CONSERVATION - AMARILLO	2020	WUG REDUCING DEMAND: AMARILLO	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - BOOKER	2020	WUG REDUCING DEMAND: BOOKER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - BORGER	2020	WUG REDUCING DEMAND: BORGER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - CACTUS	2020	WUG REDUCING DEMAND: CACTUS	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - CANADIAN	2020	PROJECT SPONSOR(S): CANADIAN	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 2,294,900.00
MUNICIPAL CONSERVATION - CANADIAN	2020	WUG REDUCING DEMAND: CANADIAN	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - CANYON	2020	WUG REDUCING DEMAND: CANYON	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - CHILDRESS	2020	PROJECT SPONSOR(S): CHILDRESS	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 4,098,000.00
MUNICIPAL CONSERVATION - CHILDRESS	2020	WUG REDUCING DEMAND: CHILDRESS	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -

WMS or WMS Project Name	Year the project is online?*	Is this a phased project?*	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON								Yes	No	No	
ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)								Yes	No	No	
DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER								No	No	No	No singular entity that is considered a Sponsor for this strategy.
DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON								Yes	No	No	
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER								No	No	No	
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS								Yes	No	No	
DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD								No	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	2020					Commercial/Bank loan		Yes	No	No	Perryton is in the process of expanding its wellfield.
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER								No	No	No	No singular entity that is considered a Sponsor for this strategy.
DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING								Yes	No	No	No singular entity that is considered a Sponsor for this strategy.
DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER								Yes	No	No	
DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	2014	Yes	20,000			TWDB - Other		Yes	No	No	This WMS and "Develop Carson County Well Field (Ogallala Aquifer) - Amarillo" (ID 882) have been combined in the 2021 Plan. Online date shown is for Phase I, which is considered current supply. Phase II is under design.
DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON								Yes	No	No	
IRRIGATION CONSERVATION - ARMSTRONG COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - CARSON COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - CHILDRESS COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - DALLAM COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - DONLEY COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - GRAY COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - HALL COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - HANSFORD COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - HARTLEY COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - HEMPHILL COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - HUTCHINSON COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - LIPSCOMB COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - MOORE COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - OCHILTREE COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - OLDHAM COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - POTTER COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - RANDALL COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - ROBERTS COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - SHERMAN COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
IRRIGATION CONSERVATION - WHEELER COUNTY	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - AMARILLO	2014	Yes	Not measured		2070	TWDB - Other		Yes	No	No	Amarillo's AMI is pursuing TWDB funding for its AMI program.
MUNICIPAL CONSERVATION - BOOKER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - BORGER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CACTUS	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CANADIAN	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CANADIAN	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CANYON	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CHILDRESS	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CHILDRESS	2020	Yes	Not measured		2070			Yes	No	No	

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)
MUNICIPAL CONSERVATION - CLARENDON	2020	WUG REDUCING DEMAND: CLARENDON	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - CLAUDE	2020	PROJECT SPONSOR(S): CLAUDE	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 721,800.00
MUNICIPAL CONSERVATION - CLAUDE	2020	WUG REDUCING DEMAND: CLAUDE	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - DALHART	2020	WUG REDUCING DEMAND: DALHART	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - DUMAS	2020	WUG REDUCING DEMAND: DUMAS	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - FRITCH	2020	PROJECT SPONSOR(S): FRITCH	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,367,000.00
MUNICIPAL CONSERVATION - FRITCH	2020	WUG REDUCING DEMAND: FRITCH	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - GROOM	2020	WUG REDUCING DEMAND: GROOM	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - GRUVER	2020	PROJECT SPONSOR(S): GRUVER	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 964,600.00
MUNICIPAL CONSERVATION - GRUVER	2020	WUG REDUCING DEMAND: GRUVER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - HALL COUNTY OTHER	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HALL)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 660,000.00
MUNICIPAL CONSERVATION - HALL COUNTY OTHER	2020	WUG REDUCING DEMAND: COUNTY-OTHER, HALL	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	2020	PROJECT SPONSOR(S): LAKE TANGLEWOOD	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 492,000.00
MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	2020	WUG REDUCING DEMAND: LAKE TANGLEWOOD	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - MCLEAN	2020	PROJECT SPONSOR(S): MCLEAN	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 669,900.00
MUNICIPAL CONSERVATION - MCLEAN	2020	WUG REDUCING DEMAND: MCLEAN	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - MEMPHIS	2020	PROJECT SPONSOR(S): MEMPHIS	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 470,000.00
MUNICIPAL CONSERVATION - MEMPHIS	2020	WUG REDUCING DEMAND: MEMPHIS	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - MIAMI	2020	PROJECT SPONSOR(S): MIAMI	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 373,200.00
MUNICIPAL CONSERVATION - MIAMI	2020	WUG REDUCING DEMAND: MIAMI	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - MOORE COUNTY OTHER	2020	WUG REDUCING DEMAND: COUNTY-OTHER, MOORE	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - PAMPA	2020	WUG REDUCING DEMAND: PAMPA	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - PANHANDLE	2020	PROJECT SPONSOR(S): PANHANDLE	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,559,800.00
MUNICIPAL CONSERVATION - PANHANDLE	2020	WUG REDUCING DEMAND: PANHANDLE	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - PERRYTON	2020	WUG REDUCING DEMAND: PERRYTON	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	2020	PROJECT SPONSOR(S): COUNTY-OTHER (POTTER)	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 13,409,600.00
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	2020	WUG REDUCING DEMAND: COUNTY-OTHER, POTTER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - RANDALL COUNTY OTHER	2020	WUG REDUCING DEMAND: COUNTY-OTHER, RANDALL	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - SHAMROCK	2020	PROJECT SPONSOR(S): SHAMROCK	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,301,900.00
MUNICIPAL CONSERVATION - SHAMROCK	2020	WUG REDUCING DEMAND: SHAMROCK	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - SPEARMAN	2020	WUG REDUCING DEMAND: SPEARMAN	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - STINNETT	2020	PROJECT SPONSOR(S): STINNETT	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,212,200.00
MUNICIPAL CONSERVATION - STINNETT	2020	WUG REDUCING DEMAND: STINNETT	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - STRATFORD	2020	PROJECT SPONSOR(S): STRATFORD	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,489,900.00
MUNICIPAL CONSERVATION - STRATFORD	2020	WUG REDUCING DEMAND: STRATFORD	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - SUNRAY	2020	PROJECT SPONSOR(S): SUNRAY	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,822,300.00
MUNICIPAL CONSERVATION - SUNRAY	2020	WUG REDUCING DEMAND: SUNRAY	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - TCW SUPPLY	2020	PROJECT SPONSOR(S): TCW SUPPLY INC	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,346,700.00
MUNICIPAL CONSERVATION - TCW SUPPLY	2020	WUG REDUCING DEMAND: TCW SUPPLY INC	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - TEXLINE	2020	PROJECT SPONSOR(S): TEXLINE	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 464,500.00
MUNICIPAL CONSERVATION - TEXLINE	2020	WUG REDUCING DEMAND: TEXLINE	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - VEGA	2020	PROJECT SPONSOR(S): VEGA	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 608,100.00
MUNICIPAL CONSERVATION - VEGA	2020	WUG REDUCING DEMAND: VEGA	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - WELLINGTON	2020	PROJECT SPONSOR(S): WELLINGTON	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 1,533,900.00
MUNICIPAL CONSERVATION - WELLINGTON	2020	WUG REDUCING DEMAND: WELLINGTON	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - WHEELER	2020	WUG REDUCING DEMAND: WHEELER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -
MUNICIPAL CONSERVATION - WHITE DEER	2020	PROJECT SPONSOR(S): WHITE DEER	Yes	Ongoing	Ongoing	Currently operating			Not measured		$ 704,400.00
MUNICIPAL CONSERVATION - WHITE DEER	2020	WUG REDUCING DEMAND: WHITE DEER	Yes	Ongoing	Ongoing	Currently operating			Not measured	$ -	$ -

WMS or WMS Project Name	Year the project is online?*	Is this a phased project?*	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
MUNICIPAL CONSERVATION - CLARENDON	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CLAUDE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - CLAUDE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - DALHART	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - DUMAS	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - FRITCH	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - FRITCH	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - GROOM	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - GRUVER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - GRUVER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - HALL COUNTY OTHER	2020	Yes	Not measured		2070			No	No	No	The project sponsor is now Red River Authority.
MUNICIPAL CONSERVATION - HALL COUNTY OTHER	2020	Yes	Not measured		2070			No	No	No	The project sponsor is now Red River Authority.
MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MCLEAN	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MCLEAN	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MEMPHIS	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MEMPHIS	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MIAMI	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MIAMI	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - MOORE COUNTY OTHER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - PAMPA	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - PANHANDLE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - PANHANDLE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - PERRYTON	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	2020	Yes	Not measured		2070			No	No	No	
MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	2020	Yes	Not measured		2070			No	No	No	
MUNICIPAL CONSERVATION - RANDALL COUNTY OTHER	2020	Yes	Not measured		2070			No	No	No	
MUNICIPAL CONSERVATION - SHAMROCK	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - SHAMROCK	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - SPEARMAN	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - STINNETT	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - STINNETT	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - STRATFORD	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - STRATFORD	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - SUNRAY	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - SUNRAY	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - TCW SUPPLY	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - TCW SUPPLY	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - TEXLINE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - TEXLINE	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - VEGA	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - VEGA	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - WELLINGTON	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - WELLINGTON	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - WHEELER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - WHITE DEER	2020	Yes	Not measured		2070			Yes	No	No	
MUNICIPAL CONSERVATION - WHITE DEER	2020	Yes	Not measured		2070			Yes	No	No	

WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HALL)	No			Not implemented	Financing	Unknown			$ 299,300.00
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HALL)	No			Not implemented	Financing	Unknown			$ 141,100.00
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)	2020	PROJECT SPONSOR(S): COUNTY-OTHER (HALL)	No			Not implemented	Financing	Unknown			$ 1,345,300.00
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, ARMSTRONG	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, CARSON	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, DONLEY	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, GRAY	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, HUTCHINSON	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, POTTER	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, ROBERTS	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)	2020	WMS SUPPLY RECIPIENT: IRRIGATION, WHEELER	Yes	Ongoing	Current program ongoing	Currently operating			Not measured	$ -	$ -
ASR - CRMWA	2030	PROJECT SPONSOR(S): CANADIAN RIVER MUNICIPAL WATER AUTHORITY	No			Not implemented	Too soon	Needs more study			$ 67,649,300.00
DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	2030	PROJECT SPONSOR(S): PAMPA	No			Not implemented	Too soon	Not applicable	Not applicable		$ 8,618,100.00
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	2030	PROJECT SPONSOR(S): COUNTY-OTHER (POTTER)	No			Not implemented	If other, please describe. This project is no longer needed.	Not applicable	Not applicable		$ 3,979,400.00
DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	2030	PROJECT SPONSOR(S): COUNTY-OTHER (RANDALL)	No			Not implemented	If other, please describe. This project is no longer needed.	Not applicable	Not applicable		$ 5,299,300.00
DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	2030	PROJECT SPONSOR(S): SUNRAY	No			Not implemented	If other, please describe. Unknown	Unknown			$ 3,526,100.00
EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	2030	PROJECT SPONSOR(S): CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Yes		2027	Acquisition and design phase			65,000		$ 250,299,000.00
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA	2030	PROJECT SPONSOR(S): CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Yes		2030	Sponsor has taken official action to initiate project			Unknown		$ 8,267,250.00
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	2040	PROJECT SPONSOR(S): AMARILLO	No			Not implemented	If other, please describe. This project has been replaced by the Potter/Carson County Well field	Not applicable	Not applicable		$ 37,528,000.00
DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	2040	PROJECT SPONSOR(S): BOOKER	No			Not implemented	Too soon	Not applicable	Not applicable		$ 1,489,400.00
DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	2040	PROJECT SPONSOR(S): CLAUDE	No			Not implemented	If other, please describe. This project is no longer needed.	Not applicable	Not applicable		$ 2,891,100.00
DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	2040	PROJECT SPONSOR(S): GRUVER	No			Not implemented	Too soon	Not applicable	Not applicable		$ 1,385,600.00
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	2040	PROJECT SPONSOR(S): CANADIAN RIVER MUNICIPAL WATER AUTHORITY	No			Not implemented	Too soon	Not applicable	Not applicable		$ 16,533,500.00
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	2050	PROJECT SPONSOR(S): MANUFACTURING (MOORE)	No			Not implemented	Too soon	Not applicable	Not applicable		$ 11,244,800.00
DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	2050	PROJECT SPONSOR(S): MEMPHIS	No			Not implemented	Too soon	Not applicable	Not applicable		$ 1,183,900.00
DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	2050	PROJECT SPONSOR(S): SPEARMAN	No			Not implemented	Too soon	Not applicable	Not applicable		$ 3,665,600.00
DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	2050	PROJECT SPONSOR(S): STINNETT	No			Not implemented	Too soon	Not applicable	Not applicable		$ 908,000.00
DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	2050	PROJECT SPONSOR(S): TEXLINE	No			Not implemented	Too soon	Not applicable	Not applicable		$ 1,056,000.00
DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	2070	PROJECT SPONSOR(S): AMARILLO	Yes	Ongoing	2065	Feasibility study ongoing			20,000		$ 170,217,000.00

WMS or WMS Project Name	Year the project is online?*	Is this a phased project?*	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)								Yes	No	No	This is an alternate strategy in the 2021 Plan.
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)								Yes	No	No	This is an alternate strategy in the 2021 Plan.
NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)								Yes	No	No	
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)									No	No	No singular entity that is considered a Sponsor for this strategy.
ASR - CRMWA						TWDB - SWIFT		Yes	No	No	CRMWA is also looking at other TWDB funding sources, along with market solutions.
DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA								Yes	No	No	Pampa has two existing operating wellfields, but no immediate plans to expand.
DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER								No	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER								No	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY								Yes	No	No	
EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2						TWDB - SWIFT		Yes	No	No	CRMWA is also looking at other TWDB funding sources, along with market solutions.
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA						Other			No	No	This assumes CRMWA2 begins design in 2027. If this schedule changes, so do implementation dates.
DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO									No	No	County Well Field (Ogallala Aquifer) - Amarillo" (ID 881) have been combined in the 2021 Plan.
DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE								No	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER								Yes	No	No	
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA						Other			No	No	This assumes CRMWA2 begins design in 2027. If this schedule
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY								Yes	No	No	No singular entity that is considered a Sponsor for this strategy.
DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT								Yes	No	No	
DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE								Yes	No	No	
DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO		Yes				TWDB - Other		Yes	No	No	

APPENDIX J

DATA TABLES

The Texas Water Development Board (TWDB) hosts a statewide database, known as DB22, which houses all the data and information from each of the 16 Regional Water Plans across the state. TWDB uses this data to assist in the development of the State Water Plan. In order to facilitate statewide data collection, there are specific requirements in how the data must be entered and reflected in DB22. In some cases, the aggregation and reporting of this data from the database differs from how the data is aggregated and reported in the written Regional Water Plan. The Regional Water Plan aims to present the data in a format that is easily understandable to stakeholders and the public. Divergence between the numbers in tables in the Plan and the DB22 reports do not necessarily represent errors.

Examples of these differences include:

- Total strategy water volumes are aggregated by water user group in the DB22 reports. If a strategy is not fully allocated to a water user group or multiple water user groups, then the total volumes may differ between the DB22 report and the Plan. This is the case for several strategies developed by major water providers.

- The Aquifer Storage and Recovery strategies require the source water to be assigned to ASR. If the source water is also part of another strategy, such as Amarillo's potable reuse strategy, the quantity that is assumed as part of the ASR strategy is not shown in the summary tables as part of the Reuse strategy.

There are two DB22 reports that do not have relevant data. Those are "Recommended Water Management Strategies Requiring a New or Amended IBT Permit" and "WUG Recommended Conservation WMS Associated with Recommended IBT WMS".

Region A Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
CLAUDE MUNICIPAL WATER SYSTEM	1,209	1,209	1,209	1,209	1,209	1,209
COUNTY-OTHER	702	702	702	702	702	702
RED BASIN TOTAL	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**
ARMSTRONG COUNTY TOTAL	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**
WHITE DEER	520	539	549	549	549	549
COUNTY-OTHER	1,198	1,215	1,238	1,238	1,238	1,238
CANADIAN BASIN TOTAL	**1,718**	**1,754**	**1,787**	**1,787**	**1,787**	**1,787**
GROOM MUNICIPAL WATER SYSTEM	568	568	568	568	568	568
PANHANDLE MUNICIPAL WATER SYSTEM	2,509	2,601	2,650	2,650	2,650	2,650
WHITE DEER	681	707	720	720	720	720
COUNTY-OTHER	878	890	907	907	907	907
RED BASIN TOTAL	**4,636**	**4,766**	**4,845**	**4,845**	**4,845**	**4,845**
CARSON COUNTY TOTAL	**6,354**	**6,520**	**6,632**	**6,632**	**6,632**	**6,632**
CHILDRESS	6,303	6,543	6,743	6,938	7,132	7,321
RED RIVER AUTHORITY OF TEXAS*	942	978	1,007	1,036	1,066	1,094
COUNTY-OTHER	24	25	26	27	27	28
RED BASIN TOTAL	**7,269**	**7,546**	**7,776**	**8,001**	**8,225**	**8,443**
CHILDRESS COUNTY TOTAL	**7,269**	**7,546**	**7,776**	**8,001**	**8,225**	**8,443**
RED RIVER AUTHORITY OF TEXAS*	576	642	701	759	815	860
WELLINGTON MUNICIPAL WATER SYSTEM	2,318	2,441	2,522	2,616	2,689	2,753
COUNTY-OTHER	342	325	299	278	251	231
RED BASIN TOTAL	**3,236**	**3,408**	**3,522**	**3,653**	**3,755**	**3,844**
COLLINGSWORTH COUNTY TOTAL	**3,236**	**3,408**	**3,522**	**3,653**	**3,755**	**3,844**
DALHART	5,986	6,741	7,534	8,317	9,069	9,794
TEXLINE	566	615	666	714	759	801
COUNTY-OTHER	1,166	1,312	1,467	1,619	1,766	1,908
CANADIAN BASIN TOTAL	**7,718**	**8,668**	**9,667**	**10,650**	**11,594**	**12,503**
DALLAM COUNTY TOTAL	**7,718**	**8,668**	**9,667**	**10,650**	**11,594**	**12,503**
CLARENDON	2,053	2,053	2,053	2,053	2,053	2,053
RED RIVER AUTHORITY OF TEXAS*	950	1,059	1,156	1,252	1,345	1,432
COUNTY-OTHER	785	676	579	483	390	303
RED BASIN TOTAL	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**
DONLEY COUNTY TOTAL	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**
PAMPA MUNICIPAL WATER SYSTEM	19,384	21,451	23,928	27,115	29,654	32,305
COUNTY-OTHER	2,781	3,079	3,433	3,890	4,256	4,635
CANADIAN BASIN TOTAL	**22,165**	**24,530**	**27,361**	**31,005**	**33,910**	**36,940**
MCLEAN MUNICIPAL WATER SUPPLY	868	960	1,071	1,214	1,327	1,447
COUNTY-OTHER	1,406	1,556	1,736	1,967	2,151	2,343
RED BASIN TOTAL	**2,274**	**2,516**	**2,807**	**3,181**	**3,478**	**3,790**
GRAY COUNTY TOTAL	**24,439**	**27,046**	**30,168**	**34,186**	**37,388**	**40,730**
MEMPHIS	2,338	2,402	2,402	2,402	2,402	2,402
RED RIVER AUTHORITY OF TEXAS*	364	406	442	479	442	470
TURKEY MUNICIPAL WATER SYSTEM	408	418	418	418	418	418
COUNTY-OTHER	283	261	225	188	225	197
RED BASIN TOTAL	**3,393**	**3,487**	**3,487**	**3,487**	**3,487**	**3,487**
HALL COUNTY TOTAL	**3,393**	**3,487**	**3,487**	**3,487**	**3,487**	**3,487**
GRUVER	1,480	1,640	1,779	1,896	2,014	2,122

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
SPEARMAN MUNICIPAL WATER SYSTEM	3,501	3,644	3,755	3,869	3,987	4,109
COUNTY-OTHER	978	1,084	1,176	1,252	1,329	1,403
CANADIAN BASIN TOTAL	**5,959**	**6,368**	**6,710**	**7,017**	**7,330**	**7,634**
HANSFORD COUNTY TOTAL	**5,959**	**6,368**	**6,710**	**7,017**	**7,330**	**7,634**
DALHART	2,816	2,923	2,980	3,021	3,058	3,087
HARTLEY WSC	652	697	722	739	754	767
COUNTY-OTHER	2,813	3,011	3,115	3,190	3,257	3,310
CANADIAN BASIN TOTAL	**6,281**	**6,631**	**6,817**	**6,950**	**7,069**	**7,164**
HARTLEY COUNTY TOTAL	**6,281**	**6,631**	**6,817**	**6,950**	**7,069**	**7,164**
CANADIAN	3,160	3,542	3,867	4,201	4,500	4,773
COUNTY-OTHER	729	742	751	762	771	780
CANADIAN BASIN TOTAL	**3,889**	**4,284**	**4,618**	**4,963**	**5,271**	**5,553**
COUNTY-OTHER	320	325	330	334	338	342
RED BASIN TOTAL	**320**	**325**	**330**	**334**	**338**	**342**
HEMPHILL COUNTY TOTAL	**4,209**	**4,609**	**4,948**	**5,297**	**5,609**	**5,895**
BORGER	13,514	13,998	14,122	14,122	14,122	14,122
FRITCH	2,968	3,075	3,102	3,102	3,102	3,102
STINNETT	1,987	2,058	2,077	2,077	2,077	2,077
TCW SUPPLY	2,027	2,098	2,118	2,118	2,118	2,118
COUNTY-OTHER	2,461	2,550	2,571	2,571	2,571	2,571
CANADIAN BASIN TOTAL	**22,957**	**23,779**	**23,990**	**23,990**	**23,990**	**23,990**
HUTCHINSON COUNTY TOTAL	**22,957**	**23,779**	**23,990**	**23,990**	**23,990**	**23,990**
BOOKER	1,740	1,948	2,071	2,232	2,344	2,436
DARROUZETT	428	459	477	500	517	531
FOLLETT	425	456	474	497	514	527
HIGGINS MUNICIPAL WATER SYSTEM	433	464	482	506	523	537
COUNTY-OTHER	573	531	507	476	452	434
CANADIAN BASIN TOTAL	**3,599**	**3,858**	**4,011**	**4,211**	**4,350**	**4,465**
LIPSCOMB COUNTY TOTAL	**3,599**	**3,858**	**4,011**	**4,211**	**4,350**	**4,465**
CACTUS MUNICIPAL WATER SYSTEM	4,232	4,824	5,455	6,095	6,763	7,444
DUMAS	17,119	19,513	22,063	24,650	27,349	30,115
FRITCH	14	15	16	19	20	23
SUNRAY	1,983	2,042	2,103	2,166	2,230	2,296
COUNTY-OTHER	2,165	2,470	2,792	3,120	3,462	3,812
CANADIAN BASIN TOTAL	**25,513**	**28,864**	**32,429**	**36,050**	**39,824**	**43,690**
MOORE COUNTY TOTAL	**25,513**	**28,864**	**32,429**	**36,050**	**39,824**	**43,690**
BOOKER	22	33	45	58	74	92
PERRYTON MUNICIPAL WATER SYSTEM	9,263	9,954	10,697	11,496	12,353	13,276
COUNTY-OTHER	2,020	2,171	2,333	2,507	2,695	2,896
CANADIAN BASIN TOTAL	**11,305**	**12,158**	**13,075**	**14,061**	**15,122**	**16,264**
OCHILTREE COUNTY TOTAL	**11,305**	**12,158**	**13,075**	**14,061**	**15,122**	**16,264**
VEGA	1,036	1,036	1,036	1,036	1,036	1,036
COUNTY-OTHER	947	1,063	1,063	1,063	1,063	1,063
CANADIAN BASIN TOTAL	**1,983**	**2,099**	**2,099**	**2,099**	**2,099**	**2,099**
COUNTY-OTHER	247	277	277	277	277	277
RED BASIN TOTAL	**247**	**277**	**277**	**277**	**277**	**277**
OLDHAM COUNTY TOTAL	**2,230**	**2,376**	**2,376**	**2,376**	**2,376**	**2,376**

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
AMARILLO	72,959	81,086	89,685	98,247	107,584	117,417
COUNTY-OTHER	8,490	9,435	10,436	11,432	12,518	13,662
CANADIAN BASIN TOTAL	**81,449**	**90,521**	**100,121**	**109,679**	**120,102**	**131,079**
AMARILLO	48,035	53,386	59,047	64,685	70,831	77,305
COUNTY-OTHER	4,547	5,053	5,589	6,122	6,705	7,317
RED BASIN TOTAL	**52,582**	**58,439**	**64,636**	**70,807**	**77,536**	**84,622**
POTTER COUNTY TOTAL	**134,031**	**148,960**	**164,757**	**180,486**	**197,638**	**215,701**
AMARILLO	98,242	109,855	121,479	133,386	146,055	159,215
CANYON	14,802	16,552	18,304	20,097	22,006	23,989
HAPPY*	68	76	84	93	101	111
LAKE TANGLEWOOD	1,129	1,129	1,129	1,129	1,129	1,129
COUNTY-OTHER	20,028	22,432	24,839	27,305	29,928	32,651
RED BASIN TOTAL	**134,269**	**150,044**	**165,835**	**182,010**	**199,219**	**217,095**
RANDALL COUNTY TOTAL	**134,269**	**150,044**	**165,835**	**182,010**	**199,219**	**217,095**
MIAMI	617	627	628	628	628	628
COUNTY-OTHER	383	417	416	416	416	416
CANADIAN BASIN TOTAL	**1,000**	**1,044**	**1,044**	**1,044**	**1,044**	**1,044**
COUNTY-OTHER	3	3	3	3	3	3
RED BASIN TOTAL	**3**	**3**	**3**	**3**	**3**	**3**
ROBERTS COUNTY TOTAL	**1,003**	**1,047**	**1,047**	**1,047**	**1,047**	**1,047**
STRATFORD	2,317	2,511	2,617	2,710	2,778	2,828
TEXHOMA	347	376	392	406	416	424
COUNTY-OTHER	630	684	711	737	755	768
CANADIAN BASIN TOTAL	**3,294**	**3,571**	**3,720**	**3,853**	**3,949**	**4,020**
SHERMAN COUNTY TOTAL	**3,294**	**3,571**	**3,720**	**3,853**	**3,949**	**4,020**
SHAMROCK MUNICIPAL WATER SYSTEM	1,973	2,051	2,126	2,203	2,288	2,378
WHEELER	1,599	1,662	1,722	1,784	1,853	1,926
COUNTY-OTHER	2,015	2,096	2,171	2,252	2,337	2,429
RED BASIN TOTAL	**5,587**	**5,809**	**6,019**	**6,239**	**6,478**	**6,733**
WHEELER COUNTY TOTAL	**5,587**	**5,809**	**6,019**	**6,239**	**6,478**	**6,733**
REGION A POPULATION TOTAL	**418,345**	**460,448**	**502,685**	**545,895**	**590,781**	**637,412**

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
CLAUDE MUNICIPAL WATER SYSTEM	360	354	349	347	347	347
COUNTY-OTHER	88	84	82	82	82	82
LIVESTOCK	332	449	467	485	504	524
IRRIGATION	6,244	6,244	6,244	6,244	6,244	6,244
RED BASIN TOTAL	**7,024**	**7,131**	**7,142**	**7,158**	**7,177**	**7,197**
ARMSTRONG COUNTY TOTAL	**7,024**	**7,131**	**7,142**	**7,158**	**7,177**	**7,197**
WHITE DEER	113	114	114	114	114	114
COUNTY-OTHER	157	155	155	153	152	152
MANUFACTURING	17	18	18	18	18	18
MINING	14	14	14	14	14	14
LIVESTOCK	236	322	334	346	358	372
IRRIGATION	22,518	22,518	22,518	22,518	22,518	22,518
CANADIAN BASIN TOTAL	**23,055**	**23,141**	**23,153**	**23,163**	**23,174**	**23,188**
GROOM MUNICIPAL WATER SYSTEM	177	174	172	171	171	171
PANHANDLE MUNICIPAL WATER SYSTEM	576	585	586	581	580	580
WHITE DEER	147	150	150	149	149	149
COUNTY-OTHER	115	113	113	112	112	112
MANUFACTURING	1,038	1,118	1,118	1,118	1,118	1,118
LIVESTOCK	79	108	112	116	120	124
IRRIGATION	64,771	64,771	64,771	64,771	64,771	64,771
RED BASIN TOTAL	**66,903**	**67,019**	**67,022**	**67,018**	**67,021**	**67,025**
CARSON COUNTY TOTAL	**89,958**	**90,160**	**90,175**	**90,181**	**90,195**	**90,213**
CHILDRESS	1,624	1,657	1,685	1,722	1,767	1,814
RED RIVER AUTHORITY OF TEXAS*	232	236	239	245	252	258
COUNTY-OTHER	5	5	5	5	5	6
LIVESTOCK	342	460	478	497	517	538
IRRIGATION	14,142	14,142	14,142	14,142	14,142	14,142
RED BASIN TOTAL	**16,345**	**16,500**	**16,549**	**16,611**	**16,683**	**16,758**
CHILDRESS COUNTY TOTAL	**16,345**	**16,500**	**16,549**	**16,611**	**16,683**	**16,758**
RED RIVER AUTHORITY OF TEXAS*	142	155	167	179	192	203
WELLINGTON MUNICIPAL WATER SYSTEM	524	540	548	566	581	595
COUNTY-OTHER	71	66	60	55	50	46
LIVESTOCK	459	583	607	633	660	688
IRRIGATION	47,471	42,542	39,713	38,215	33,451	33,451
RED BASIN TOTAL	**48,667**	**43,886**	**41,095**	**39,648**	**34,934**	**34,983**
COLLINGSWORTH COUNTY TOTAL	**48,667**	**43,886**	**41,095**	**39,648**	**34,934**	**34,983**
DALHART	1,814	2,014	2,228	2,447	2,665	2,877
TEXLINE	219	235	252	269	286	302
COUNTY-OTHER	140	150	165	181	197	213
MANUFACTURING	6	6	6	6	6	6
LIVESTOCK	4,521	4,860	5,115	5,390	5,686	6,006
IRRIGATION	343,830	343,830	286,928	228,243	174,217	174,217
CANADIAN BASIN TOTAL	**350,530**	**351,095**	**294,694**	**236,536**	**183,057**	**183,621**
DALLAM COUNTY TOTAL	**350,530**	**351,095**	**294,694**	**236,536**	**183,057**	**183,621**
CLARENDON	371	362	354	350	349	349
RED RIVER AUTHORITY OF TEXAS*	234	255	275	296	318	338
COUNTY-OTHER	113	94	78	65	52	40

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Region A Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LIVESTOCK	971	994	1,019	1,046	1,073	1,102
IRRIGATION	30,910	30,910	30,910	30,910	30,910	30,910
RED BASIN TOTAL	**32,599**	**32,615**	**32,636**	**32,667**	**32,702**	**32,739**
DONLEY COUNTY TOTAL	**32,599**	**32,615**	**32,636**	**32,667**	**32,702**	**32,739**
PAMPA MUNICIPAL WATER SYSTEM	3,685	3,964	4,331	4,892	5,341	5,815
COUNTY-OTHER	472	512	563	634	692	753
MANUFACTURING	459	502	502	502	502	502
MINING	7	7	6	6	5	4
LIVESTOCK	189	214	224	235	247	259
IRRIGATION	8,395	8,395	8,395	8,395	8,395	8,395
CANADIAN BASIN TOTAL	**13,207**	**13,594**	**14,021**	**14,664**	**15,182**	**15,728**
MCLEAN MUNICIPAL WATER SUPPLY	210	227	250	281	307	334
COUNTY-OTHER	239	259	285	320	350	381
MINING	68	67	61	54	48	43
LIVESTOCK	1,706	1,934	2,022	2,117	2,222	2,337
IRRIGATION	23,894	23,894	23,894	23,894	23,894	23,894
RED BASIN TOTAL	**26,117**	**26,381**	**26,512**	**26,666**	**26,821**	**26,989**
GRAY COUNTY TOTAL	**39,324**	**39,975**	**40,533**	**41,330**	**42,003**	**42,717**
MEMPHIS	386	385	375	372	372	372
RED RIVER AUTHORITY OF TEXAS*	89	98	105	113	104	111
TURKEY MUNICIPAL WATER SYSTEM	120	121	119	119	119	119
COUNTY-OTHER	84	76	65	54	65	57
LIVESTOCK	340	357	375	394	414	435
IRRIGATION	31,792	31,792	31,792	31,792	31,792	31,792
RED BASIN TOTAL	**32,811**	**32,829**	**32,831**	**32,844**	**32,866**	**32,886**
HALL COUNTY TOTAL	**32,811**	**32,829**	**32,831**	**32,844**	**32,866**	**32,886**
GRUVER	350	380	407	431	457	481
SPEARMAN MUNICIPAL WATER SYSTEM	670	681	689	703	723	745
COUNTY-OTHER	117	123	133	141	150	158
MANUFACTURING	285	321	321	321	321	321
MINING	577	904	602	309	16	1
LIVESTOCK	4,030	4,204	4,388	4,580	4,783	4,995
IRRIGATION	171,900	171,900	171,900	171,900	171,900	171,900
CANADIAN BASIN TOTAL	**177,929**	**178,513**	**178,440**	**178,385**	**178,350**	**178,601**
HANSFORD COUNTY TOTAL	**177,929**	**178,513**	**178,440**	**178,385**	**178,350**	**178,601**
DALHART	853	873	881	889	899	907
HARTLEY WSC	227	239	246	251	255	260
COUNTY-OTHER	531	557	568	577	588	598
MINING	7	7	6	5	4	3
LIVESTOCK	6,589	7,375	7,924	8,519	9,165	9,866
IRRIGATION	406,990	406,990	345,197	283,865	226,681	226,681
CANADIAN BASIN TOTAL	**415,197**	**416,041**	**354,822**	**294,106**	**237,592**	**238,315**
HARTLEY COUNTY TOTAL	**415,197**	**416,041**	**354,822**	**294,106**	**237,592**	**238,315**
CANADIAN	823	906	978	1,057	1,130	1,199
COUNTY-OTHER	97	95	92	94	95	95
MANUFACTURING	4	4	4	4	4	4
MINING	926	706	498	293	89	27

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Region A Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
LIVESTOCK	663	680	699	718	739	760
IRRIGATION	3,919	3,919	3,919	3,919	3,919	3,919
CANADIAN BASIN TOTAL	**6,432**	**6,310**	**6,190**	**6,085**	**5,976**	**6,004**
COUNTY-OTHER	42	41	41	41	41	42
MANUFACTURING	1	2	2	2	2	2
MINING	1,388	1,057	746	439	134	41
LIVESTOCK	454	466	478	492	505	520
IRRIGATION	1,760	1,760	1,760	1,760	1,760	1,760
RED BASIN TOTAL	**3,645**	**3,326**	**3,027**	**2,734**	**2,442**	**2,365**
HEMPHILL COUNTY TOTAL	**10,077**	**9,636**	**9,217**	**8,819**	**8,418**	**8,369**
BORGER	3,163	3,201	3,182	3,177	3,172	3,172
FRITCH	592	598	591	589	588	588
STINNETT	454	460	456	455	454	454
TCW SUPPLY	690	705	705	701	700	700
COUNTY-OTHER	263	269	270	269	269	269
MANUFACTURING	29,366	31,335	31,335	31,335	31,335	31,335
MINING	184	231	170	113	56	34
LIVESTOCK	600	636	666	699	734	771
IRRIGATION	59,910	59,910	59,910	59,910	59,910	59,910
CANADIAN BASIN TOTAL	**95,222**	**97,345**	**97,285**	**97,248**	**97,218**	**97,233**
HUTCHINSON COUNTY TOTAL	**95,222**	**97,345**	**97,285**	**97,248**	**97,218**	**97,233**
BOOKER	496	547	576	618	648	673
DARROUZETT	124	131	135	141	145	149
FOLLETT	129	137	141	147	152	156
HIGGINS MUNICIPAL WATER SYSTEM	127	134	138	144	149	153
COUNTY-OTHER	137	124	117	109	103	99
MANUFACTURING	362	400	400	400	400	400
MINING	1,098	758	446	142	21	3
LIVESTOCK	605	631	658	688	718	750
IRRIGATION	40,870	40,870	40,870	40,870	40,870	40,870
CANADIAN BASIN TOTAL	**43,948**	**43,732**	**43,481**	**43,259**	**43,206**	**43,253**
LIPSCOMB COUNTY TOTAL	**43,948**	**43,732**	**43,481**	**43,259**	**43,206**	**43,253**
CACTUS MUNICIPAL WATER SYSTEM	985	1,107	1,242	1,382	1,532	1,685
DUMAS	3,584	3,993	4,446	4,930	5,461	6,011
FRITCH	3	3	3	4	4	4
SUNRAY	450	454	461	471	484	499
COUNTY-OTHER	293	323	356	393	435	479
MANUFACTURING	9,277	9,629	9,629	9,629	9,629	9,629
MINING	16	16	16	15	15	15
LIVESTOCK	5,414	6,192	6,698	7,251	7,855	8,515
IRRIGATION	200,550	200,550	171,892	136,086	102,919	102,919
CANADIAN BASIN TOTAL	**220,572**	**222,267**	**194,743**	**160,161**	**128,334**	**129,756**
MOORE COUNTY TOTAL	**220,572**	**222,267**	**194,743**	**160,161**	**128,334**	**129,756**
BOOKER	6	9	13	16	20	25
PERRYTON MUNICIPAL WATER SYSTEM	2,693	2,851	3,030	3,238	3,475	3,734
COUNTY-OTHER	310	322	337	360	386	415
MANUFACTURING	36	41	41	41	41	41
MINING	824	853	503	161	23	3

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Region A Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
LIVESTOCK	2,801	2,962	3,120	3,286	3,462	3,647
IRRIGATION	84,460	84,460	84,460	84,460	84,460	84,460
CANADIAN BASIN TOTAL	**91,130**	**91,498**	**91,504**	**91,562**	**91,867**	**92,325**
OCHILTREE COUNTY TOTAL	**91,130**	**91,498**	**91,504**	**91,562**	**91,867**	**92,325**
VEGA	292	287	284	282	282	282
COUNTY-OTHER	279	309	305	305	304	304
MINING	456	540	613	644	708	776
LIVESTOCK	821	916	938	961	985	1,010
IRRIGATION	3,588	3,588	3,588	3,588	3,588	3,588
CANADIAN BASIN TOTAL	**5,436**	**5,640**	**5,728**	**5,780**	**5,867**	**5,960**
COUNTY-OTHER	73	80	79	79	79	79
MINING	19	23	26	27	29	32
LIVESTOCK	289	323	330	338	347	356
IRRIGATION	1,133	1,133	1,133	1,133	1,133	1,133
RED BASIN TOTAL	**1,514**	**1,559**	**1,568**	**1,577**	**1,588**	**1,600**
OLDHAM COUNTY TOTAL	**6,950**	**7,199**	**7,296**	**7,357**	**7,455**	**7,560**
AMARILLO	16,458	17,919	19,536	21,251	23,234	25,346
COUNTY-OTHER	1,517	1,651	1,801	1,960	2,141	2,336
MANUFACTURING	682	755	755	755	755	755
MINING	640	781	912	988	1,109	1,245
STEAM ELECTRIC POWER	18,554	18,554	18,554	18,554	18,554	18,554
LIVESTOCK	423	440	458	477	498	518
IRRIGATION	1,029	1,029	1,029	1,029	1,029	1,029
CANADIAN BASIN TOTAL	**39,303**	**41,129**	**43,045**	**45,014**	**47,320**	**49,783**
AMARILLO	10,835	11,797	12,863	13,991	15,297	16,687
COUNTY-OTHER	812	884	965	1,049	1,147	1,251
MANUFACTURING	7,214	7,985	7,985	7,985	7,985	7,985
MINING	301	368	429	465	522	586
LIVESTOCK	87	90	94	98	102	107
IRRIGATION	2,147	2,147	2,147	2,147	2,147	2,147
RED BASIN TOTAL	**21,396**	**23,271**	**24,483**	**25,735**	**27,200**	**28,763**
POTTER COUNTY TOTAL	**60,699**	**64,400**	**67,528**	**70,749**	**74,520**	**78,546**
AMARILLO	22,161	24,276	26,462	28,851	31,543	34,369
CANYON	3,632	3,981	4,342	4,735	5,178	5,642
HAPPY*	10	11	12	13	14	16
LAKE TANGLEWOOD	438	433	429	427	427	427
COUNTY-OTHER	3,088	3,379	3,684	4,018	4,394	4,790
MANUFACTURING	621	716	716	716	716	716
LIVESTOCK	2,663	2,705	2,741	2,778	2,819	2,862
IRRIGATION	17,720	17,720	17,720	17,720	17,720	17,720
RED BASIN TOTAL	**50,333**	**53,221**	**56,106**	**59,258**	**62,811**	**66,542**
RANDALL COUNTY TOTAL	**50,333**	**53,221**	**56,106**	**59,258**	**62,811**	**66,542**
MIAMI	225	226	224	223	223	223
COUNTY-OTHER	47	49	47	47	47	47
MINING	1,457	1,010	593	183	19	2
LIVESTOCK	373	391	411	432	453	477
IRRIGATION	8,116	8,116	8,116	8,116	8,116	8,116

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Region A Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
CANADIAN BASIN TOTAL	**10,218**	**9,792**	**9,391**	**9,001**	**8,858**	**8,865**
COUNTY-OTHER	1	1	1	1	1	1
MINING	45	31	18	6	1	0
LIVESTOCK	10	11	11	12	13	13
IRRIGATION	427	427	427	427	427	427
RED BASIN TOTAL	**483**	**470**	**457**	**446**	**442**	**441**
ROBERTS COUNTY TOTAL	**10,701**	**10,262**	**9,848**	**9,447**	**9,300**	**9,306**
STRATFORD	496	526	539	554	567	577
TEXHOMA	122	131	135	139	143	145
COUNTY-OTHER	105	110	112	116	118	121
MANUFACTURING	2	2	2	2	2	2
MINING	35	207	151	98	44	20
LIVESTOCK	3,576	3,813	4,006	4,212	4,432	4,669
IRRIGATION	304,360	304,360	304,360	246,760	182,536	182,536
CANADIAN BASIN TOTAL	**308,696**	**309,149**	**309,305**	**251,881**	**187,842**	**188,070**
SHERMAN COUNTY TOTAL	**308,696**	**309,149**	**309,305**	**251,881**	**187,842**	**188,070**
SHAMROCK MUNICIPAL WATER SYSTEM	350	353	357	369	382	397
WHEELER	493	505	517	533	553	574
COUNTY-OTHER	296	297	299	309	320	332
MINING	3,268	2,329	1,413	503	139	119
LIVESTOCK	1,186	1,321	1,358	1,396	1,436	1,479
IRRIGATION	16,224	16,224	16,224	16,224	16,224	16,224
RED BASIN TOTAL	**21,817**	**21,029**	**20,168**	**19,334**	**19,054**	**19,125**
WHEELER COUNTY TOTAL	**21,817**	**21,029**	**20,168**	**19,334**	**19,054**	**19,125**
REGION A DEMAND TOTAL	**2,130,529**	**2,138,483**	**1,995,398**	**1,788,541**	**1,585,584**	**1,598,115**

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Region A Water User Group (WUG) Category Summary

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	359,431	396,063	432,993	470,777	509,991	550,786
DEMAND (acre-feet per year)	82,954	89,480	96,319	103,925	112,305	121,128
EXISTING SUPPLIES (acre-feet per year)	92,008	84,060	77,595	70,190	64,074	64,131
NEEDS (acre-feet per year)*	1,387	9,949	21,850	35,653	49,339	58,095

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	58,914	64,385	69,692	75,118	80,790	86,626
DEMAND (acre-feet per year)	9,492	10,128	10,778	11,529	12,375	13,258
EXISTING SUPPLIES (acre-feet per year)	11,915	12,466	13,082	13,798	14,580	15,394
NEEDS (acre-feet per year)*	0	12	23	33	41	41

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	49,370	52,834	52,834	52,834	52,834	52,834
EXISTING SUPPLIES (acre-feet per year)	48,707	50,274	48,844	45,927	43,487	43,175
NEEDS (acre-feet per year)*	1,008	2,585	4,015	6,932	9,372	9,684

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	11,330	9,909	7,223	4,465	2,996	2,968
EXISTING SUPPLIES (acre-feet per year)	11,330	9,909	7,223	4,465	2,996	2,968
NEEDS (acre-feet per year)*	0	0	0	0	0	0

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	18,554	18,554	18,554	18,554	18,554	18,554
EXISTING SUPPLIES (acre-feet per year)	18,554	18,554	18,554	18,554	18,554	18,554
NEEDS (acre-feet per year)*	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	39,759	43,437	45,731	48,196	50,847	53,700
EXISTING SUPPLIES (acre-feet per year)	41,177	44,432	46,596	48,933	51,465	54,209
NEEDS (acre-feet per year)*	0	0	0	0	0	0

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	1,919,070	1,914,141	1,763,959	1,549,038	1,335,673	1,335,673
EXISTING SUPPLIES (acre-feet per year)	1,776,392	1,536,167	1,382,492	1,201,096	1,029,554	1,028,811
NEEDS (acre-feet per year)*	146,064	381,557	385,041	351,667	309,784	310,602

*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.

Region A Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
BLAINE AQUIFER	CHILDRESS	RED	FRESH	23,575	23,510	23,575	23,510	23,575	23,510
BLAINE AQUIFER	COLLINGSWORTH	RED	FRESH	2,060	2,054	2,060	2,054	2,060	2,054
BLAINE AQUIFER	HALL	RED	FRESH	5,856	5,840	5,856	5,840	5,856	5,840
BLAINE AQUIFER	WHEELER	RED	FRESH	1,750	1,750	1,750	1,750	1,750	1,750
DOCKUM AQUIFER	ARMSTRONG	RED	FRESH	7,227	9,024	9,588	9,704	9,535	9,535
DOCKUM AQUIFER	CARSON	CANADIAN	FRESH	4	10	15	19	23	23
DOCKUM AQUIFER	CARSON	RED	FRESH	64	98	125	150	175	175
DOCKUM AQUIFER	DALLAM	CANADIAN	FRESH	14,192	14,188	14,186	14,184	14,184	14,184
DOCKUM AQUIFER	HARTLEY	CANADIAN	FRESH	55,249	55,035	54,928	54,864	54,837	54,837
DOCKUM AQUIFER	MOORE	CANADIAN	FRESH	5,219	5,107	5,020	4,926	4,789	4,789
DOCKUM AQUIFER	OLDHAM	CANADIAN	FRESH	128,938	128,771	120,466	111,146	101,365	101,365
DOCKUM AQUIFER	OLDHAM	RED	FRESH	63	58	52	50	48	48
DOCKUM AQUIFER	POTTER	CANADIAN	FRESH	38,641	38,983	36,832	34,409	31,900	31,900
DOCKUM AQUIFER	POTTER	RED	FRESH	183	130	105	96	108	108
DOCKUM AQUIFER	RANDALL	RED	FRESH	11,172	14,016	14,863	15,113	15,069	15,069
DOCKUM AQUIFER	SHERMAN	CANADIAN	FRESH	127	127	127	127	95	95
OGALLALA AND RITA BLANCA AQUIFERS	DALLAM	CANADIAN	FRESH	387,471	287,205	225,573	166,890	112,864	112,864
OGALLALA AND RITA BLANCA AQUIFERS	HARTLEY	CANADIAN	FRESH	417,113	289,162	226,848	165,580	108,423	108,423
OGALLALA AQUIFER	ARMSTRONG	RED	FRESH	59,270	54,462	49,036	44,185	39,470	39,470
OGALLALA AQUIFER	CARSON	CANADIAN	FRESH	77,157	74,542	69,042	62,520	55,902	55,902
OGALLALA AQUIFER	CARSON	RED	FRESH	114,978	109,721	100,889	91,247	81,313	81,313
OGALLALA AQUIFER	COLLINGSWORTH	RED	FRESH	50	50	50	50	50	50
OGALLALA AQUIFER	DONLEY	RED	FRESH	74,808	76,289	72,962	67,873	62,058	62,058
OGALLALA AQUIFER	GRAY	CANADIAN	FRESH	44,778	42,146	37,337	32,130	27,432	27,432
OGALLALA AQUIFER	GRAY	RED	FRESH	136,327	133,121	125,316	116,583	106,999	106,999
OGALLALA AQUIFER	HANSFORD	CANADIAN	FRESH	275,016	272,656	271,226	270,281	269,589	269,589
OGALLALA AQUIFER	HEMPHILL	CANADIAN	FRESH	27,789	30,260	31,999	33,363	34,058	34,058
OGALLALA AQUIFER	HEMPHILL	RED	FRESH	24,407	21,958	20,268	18,942	18,278	18,278
OGALLALA AQUIFER	HUTCHINSON	CANADIAN	FRESH	94,985	95,694	94,161	92,372	90,858	90,858
OGALLALA AQUIFER	LIPSCOMB	CANADIAN	FRESH	266,809	266,710	266,640	266,591	266,559	266,559
OGALLALA AQUIFER	MOORE	CANADIAN	FRESH	223,785	181,219	146,914	111,202	78,172	78,172
OGALLALA AQUIFER	OCHILTREE	CANADIAN	FRESH	243,778	243,932	244,002	244,051	244,082	244,082
OGALLALA AQUIFER	OLDHAM	CANADIAN	FRESH	37,367	34,376	29,078	23,039	17,800	17,800
OGALLALA AQUIFER	OLDHAM	RED	FRESH	7,232	5,827	4,345	3,168	1,790	1,790
OGALLALA AQUIFER	POTTER	CANADIAN	FRESH	9,552	9,196	8,519	7,898	7,214	7,214
OGALLALA AQUIFER	POTTER	RED	FRESH	7,642	6,849	6,148	5,487	4,843	4,843
OGALLALA AQUIFER	RANDALL	RED	FRESH	63,910	61,932	54,341	47,805	42,030	42,030
OGALLALA AQUIFER	ROBERTS	CANADIAN	FRESH	408,968	430,269	401,642	365,119	326,457	326,457
OGALLALA AQUIFER	ROBERTS	RED	FRESH	21,650	24,860	25,576	25,128	24,002	24,002
OGALLALA AQUIFER	SHERMAN	CANADIAN	FRESH	398,056	348,895	281,690	212,744	148,552	148,552
OGALLALA AQUIFER	WHEELER	RED	FRESH	130,425	138,810	137,385	132,312	124,778	124,778
OTHER AQUIFER	ARMSTRONG	RED	FRESH/ BRACKISH	370	370	370	370	370	370
OTHER AQUIFER	CHILDRESS	RED	FRESH/ BRACKISH	233	233	233	233	233	233

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region A Source Availability

GROUNDWATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
OTHER AQUIFER	COLLINGSWORTH	RED	FRESH/ BRACKISH	309	309	309	309	309	309
OTHER AQUIFER	DONLEY	RED	FRESH/ BRACKISH	479	479	479	479	479	479
OTHER AQUIFER	HALL	RED	FRESH/ BRACKISH	1,086	1,086	1,086	1,086	1,086	1,086
OTHER AQUIFER	WHEELER	RED	FRESH/ BRACKISH	276	276	276	276	276	276
SEYMOUR AQUIFER	CHILDRESS	RED	FRESH	2,961	3,246	3,317	3,308	3,317	3,297
SEYMOUR AQUIFER	COLLINGSWORTH	RED	FRESH	41,345	31,492	28,657	27,165	22,395	22,769
SEYMOUR AQUIFER	HALL	RED	FRESH	15,446	16,751	19,666	22,861	25,861	24,595
GROUNDWATER SOURCE AVAILABILITY TOTAL				**3,910,148**	**3,593,084**	**3,274,928**	**2,940,589**	**2,613,268**	**2,612,269**

REUSE SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
DIRECT REUSE	CARSON	RED	FRESH	58	59	59	58	58	58
DIRECT REUSE	CHILDRESS	RED	FRESH	162	166	169	172	177	181
DIRECT REUSE	COLLINGSWORTH	RED	FRESH	52	54	55	57	58	60
DIRECT REUSE	GRAY	CANADIAN	FRESH	220	220	220	220	220	220
DIRECT REUSE	HALL	RED	FRESH	100	100	100	100	100	100
DIRECT REUSE	HUTCHINSON	CANADIAN	FRESH	1,100	1,100	1,100	1,100	1,100	1,100
DIRECT REUSE	POTTER	CANADIAN	FRESH	22,692	24,744	26,692	28,784	31,177	33,708
DIRECT REUSE	POTTER	RED	FRESH	3,500	3,500	3,500	3,500	3,500	3,500
DIRECT REUSE	RANDALL	RED	FRESH	545	597	651	710	777	846
DIRECT REUSE	WHEELER	RED	FRESH	49	51	52	53	55	57
REUSE SOURCE AVAILABILITY TOTAL				**28,478**	**30,591**	**32,598**	**34,754**	**37,222**	**39,830**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	COUNTY	BASIN	SALINITY *	2020	2030	2040	2050	2060	2070
CANADIAN LIVESTOCK LOCAL SUPPLY	CARSON	CANADIAN	FRESH	59	59	59	59	59	59
CANADIAN LIVESTOCK LOCAL SUPPLY	DALLAM	CANADIAN	FRESH	2,488	2,488	2,488	2,488	2,488	2,488
CANADIAN LIVESTOCK LOCAL SUPPLY	GRAY	CANADIAN	FRESH	199	199	199	199	199	199
CANADIAN LIVESTOCK LOCAL SUPPLY	HANSFORD	CANADIAN	FRESH	2,617	2,617	2,617	2,617	2,617	2,617
CANADIAN LIVESTOCK LOCAL SUPPLY	HARTLEY	CANADIAN	FRESH	3,193	3,193	3,193	3,193	3,193	3,193
CANADIAN LIVESTOCK LOCAL SUPPLY	HEMPHILL	CANADIAN	FRESH	248	248	248	248	248	248
CANADIAN LIVESTOCK LOCAL SUPPLY	HUTCHINSON	CANADIAN	FRESH	281	281	281	281	281	281
CANADIAN LIVESTOCK LOCAL SUPPLY	LIPSCOMB	CANADIAN	FRESH	110	110	110	110	110	110
CANADIAN LIVESTOCK LOCAL SUPPLY	MOORE	CANADIAN	FRESH	1,000	1,000	1,000	1,000	1,000	1,000
CANADIAN LIVESTOCK LOCAL SUPPLY	OCHILTREE	CANADIAN	FRESH	421	421	421	421	421	421
CANADIAN LIVESTOCK LOCAL SUPPLY	OLDHAM	CANADIAN	FRESH	626	626	626	626	626	626
CANADIAN LIVESTOCK LOCAL SUPPLY	POTTER	CANADIAN	FRESH	500	500	500	500	500	500
CANADIAN LIVESTOCK LOCAL SUPPLY	ROBERTS	CANADIAN	FRESH	124	124	124	124	124	124
CANADIAN LIVESTOCK LOCAL SUPPLY	SHERMAN	CANADIAN	FRESH	1,052	1,052	1,052	1,052	1,052	1,052
CANADIAN RUN-OF-RIVER	GRAY	CANADIAN	FRESH	1	1	1	1	1	1
CANADIAN RUN-OF-RIVER	HANSFORD	CANADIAN	FRESH	22	22	22	22	22	22
CANADIAN RUN-OF-RIVER	HUTCHINSON	CANADIAN	FRESH	98	98	98	98	98	98

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region A Source Availability

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CANADIAN RUN-OF-RIVER	LIPSCOMB	CANADIAN	FRESH	66	66	66	66	66	66
CANADIAN RUN-OF-RIVER	MOORE	CANADIAN	FRESH	7	7	7	7	7	7
CANADIAN RUN-OF-RIVER	ROBERTS	CANADIAN	FRESH	72	72	72	72	72	72
CANADIAN RUN-OF-RIVER	SHERMAN	CANADIAN	FRESH	32	32	32	32	32	32
GREENBELT LAKE/RESERVOIR	RESERVOIR**	RED	FRESH	3,112	2,941	2,770	2,599	2,428	2,256
MEREDITH LAKE/RESERVOIR	RESERVOIR**	CANADIAN	FRESH	24,669	24,635	24,602	24,568	24,534	24,501
PALO DURO LAKE/RESERVOIR	RESERVOIR**	CANADIAN	FRESH	3,917	3,875	3,833	3,792	3,750	3,708
RED LIVESTOCK LOCAL SUPPLY	ARMSTRONG	RED	FRESH	122	122	122	122	122	122
RED LIVESTOCK LOCAL SUPPLY	CARSON	RED	FRESH	75	75	75	75	75	75
RED LIVESTOCK LOCAL SUPPLY	CHILDRESS	RED	FRESH	49	49	49	49	49	49
RED LIVESTOCK LOCAL SUPPLY	COLLINGSWORTH	RED	FRESH	29	29	29	29	29	29
RED LIVESTOCK LOCAL SUPPLY	DONLEY	RED	FRESH	283	283	283	283	283	283
RED LIVESTOCK LOCAL SUPPLY	GRAY	RED	FRESH	600	600	600	600	600	600
RED LIVESTOCK LOCAL SUPPLY	HALL	RED	FRESH	91	91	91	91	91	91
RED LIVESTOCK LOCAL SUPPLY	HEMPHILL	RED	FRESH	173	173	173	173	173	173
RED LIVESTOCK LOCAL SUPPLY	OLDHAM	RED	FRESH	209	209	209	209	209	209
RED LIVESTOCK LOCAL SUPPLY	POTTER	RED	FRESH	62	62	62	62	62	62
RED LIVESTOCK LOCAL SUPPLY	RANDALL	RED	FRESH	1,312	1,312	1,312	1,312	1,312	1,312
RED LIVESTOCK LOCAL SUPPLY	ROBERTS	RED	FRESH	15	15	15	15	15	15
RED LIVESTOCK LOCAL SUPPLY	WHEELER	RED	FRESH	845	845	845	845	845	845
RED RUN-OF-RIVER	CARSON	RED	FRESH	277	277	277	277	277	277
RED RUN-OF-RIVER	CHILDRESS	RED	FRESH	19	19	19	19	19	19
RED RUN-OF-RIVER	COLLINGSWORTH	RED	FRESH	851	851	851	851	851	851
RED RUN-OF-RIVER	DONLEY	RED	FRESH	166	166	166	166	166	166
RED RUN-OF-RIVER	GRAY	RED	FRESH	55	55	55	55	55	55
RED RUN-OF-RIVER	HALL	RED	FRESH	52	52	52	52	52	52
RED RUN-OF-RIVER	RANDALL	RED	FRESH	217	217	217	217	217	217
RED RUN-OF-RIVER	WHEELER	RED	FRESH	603	603	603	603	603	603
			SURFACE WATER SOURCE AVAILABILITY TOTAL	**51,019**	**50,772**	**50,526**	**50,280**	**50,033**	**49,786**

REGION A SOURCE AVAILABILITY TOTAL	**3,989,645**	**3,674,447**	**3,358,052**	**3,025,623**	**2,700,523**	**2,701,885**

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
CLAUDE MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | ARMSTRONG COUNTY	584	537	464	402	354	354
COUNTY-OTHER	A	DOCKUM AQUIFER | ARMSTRONG COUNTY	16	16	16	16	16	16
COUNTY-OTHER	A	OGALLALA AQUIFER | ARMSTRONG COUNTY	84	84	84	84	84	84
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	122	122	122	122	122	122
LIVESTOCK	A	OGALLALA AQUIFER | ARMSTRONG COUNTY	180	297	315	333	352	372
LIVESTOCK	A	OTHER AQUIFER | ARMSTRONG COUNTY	30	30	30	30	30	30
IRRIGATION	A	DOCKUM AQUIFER | ARMSTRONG COUNTY	54	78	99	119	136	136
IRRIGATION	A	OGALLALA AQUIFER | ARMSTRONG COUNTY	6,244	6,244	6,244	6,244	6,244	6,244
		RED BASIN TOTAL	**7,314**	**7,408**	**7,374**	**7,350**	**7,338**	**7,358**
		ARMSTRONG COUNTY TOTAL	**7,314**	**7,408**	**7,374**	**7,350**	**7,338**	**7,358**
WHITE DEER	A	OGALLALA AQUIFER | CARSON COUNTY	136	137	137	137	137	137
COUNTY-OTHER	A	OGALLALA AQUIFER | CARSON COUNTY	238	226	218	215	199	177
MANUFACTURING	A	OGALLALA AQUIFER | CARSON COUNTY	17	18	18	18	18	18
MINING	A	OGALLALA AQUIFER | CARSON COUNTY	14	14	14	14	14	14
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	59	59	59	59	59	59
LIVESTOCK	A	OGALLALA AQUIFER | CARSON COUNTY	177	263	275	287	299	313
IRRIGATION	A	OGALLALA AQUIFER | CARSON COUNTY	22,518	22,518	22,518	22,518	22,518	22,518
		CANADIAN BASIN TOTAL	**23,159**	**23,235**	**23,239**	**23,248**	**23,244**	**23,236**
GROOM MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | CARSON COUNTY	187	187	187	187	187	187
PANHANDLE MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | CARSON COUNTY	738	124	0	0	0	0
WHITE DEER	A	OGALLALA AQUIFER | CARSON COUNTY	176	180	180	179	179	179
COUNTY-OTHER	A	OGALLALA AQUIFER | CARSON COUNTY	206	196	189	186	172	153
MANUFACTURING	A	OGALLALA AQUIFER | CARSON COUNTY	1,038	1,118	1,118	1,118	1,118	1,118
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	75	75	75	75	75	75
LIVESTOCK	A	OGALLALA AQUIFER | CARSON COUNTY	4	33	37	41	45	49
IRRIGATION	A	DIRECT REUSE	58	59	59	58	58	58
IRRIGATION	A	OGALLALA AQUIFER | CARSON COUNTY	64,771	64,771	64,771	64,771	64,771	64,771
IRRIGATION	A	RED RUN-OF-RIVER	277	277	277	277	277	277
		RED BASIN TOTAL	**67,530**	**67,020**	**66,893**	**66,892**	**66,882**	**66,867**
		CARSON COUNTY TOTAL	**90,689**	**90,255**	**90,132**	**90,140**	**90,126**	**90,103**
CHILDRESS	A	GREENBELT LAKE/RESERVOIR	1,008	1,070	1,127	1,188	1,139	1,071
CHILDRESS	A	OGALLALA AQUIFER | DONLEY COUNTY	616	587	558	534	465	399
RED RIVER AUTHORITY OF TEXAS*	A	GREENBELT LAKE/RESERVOIR	144	152	160	169	163	152
RED RIVER AUTHORITY OF TEXAS*	A	OGALLALA AQUIFER | DONLEY COUNTY	88	84	79	76	66	57
COUNTY-OTHER	A	OTHER AQUIFER | CHILDRESS COUNTY	3	3	3	3	3	3
COUNTY-OTHER	A	SEYMOUR AQUIFER | CHILDRESS COUNTY	3	3	3	3	3	3
LIVESTOCK	A	BLAINE AQUIFER | CHILDRESS COUNTY	180	216	216	226	246	267
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	49	49	49	49	49	49
LIVESTOCK	A	SEYMOUR AQUIFER | CHILDRESS COUNTY	185	222	222	222	222	222
IRRIGATION	A	BLAINE AQUIFER | CHILDRESS COUNTY	13,829	13,829	13,829	13,829	13,829	13,829
IRRIGATION	A	DIRECT REUSE	162	166	169	172	177	181
IRRIGATION	A	OTHER AQUIFER | CHILDRESS COUNTY	230	230	230	230	230	230
IRRIGATION	A	RED RUN-OF-RIVER	19	19	19	19	19	19
IRRIGATION	A	SEYMOUR AQUIFER | CHILDRESS COUNTY	100	100	100	100	100	100

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
		RED BASIN TOTAL	**16,616**	**16,730**	**16,764**	**16,820**	**16,711**	**16,582**
		CHILDRESS COUNTY TOTAL	**16,616**	**16,730**	**16,764**	**16,820**	**16,711**	**16,582**
RED RIVER AUTHORITY OF TEXAS*	A	GREENBELT LAKE/RESERVOIR	10	10	11	11	10	9
RED RIVER AUTHORITY OF TEXAS*	A	OGALLALA AQUIFER | DONLEY COUNTY	6	6	5	5	4	4
RED RIVER AUTHORITY OF TEXAS*	A	SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	126	139	151	163	178	190
WELLINGTON MUNICIPAL WATER SYSTEM	A	SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	0	0	0	0	0	0
COUNTY-OTHER	A	BLAINE AQUIFER | COLLINGSWORTH COUNTY	3	3	2	2	2	2
COUNTY-OTHER	A	OTHER AQUIFER | COLLINGSWORTH COUNTY	9	8	8	7	6	5
COUNTY-OTHER	A	SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	76	68	61	54	48	43
LIVESTOCK	A	BLAINE AQUIFER | COLLINGSWORTH COUNTY	189	254	272	290	307	323
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	29	29	29	29	29	29
LIVESTOCK	A	OTHER AQUIFER | COLLINGSWORTH COUNTY	276	276	276	276	276	276
LIVESTOCK	A	SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	19	24	30	38	48	60
IRRIGATION	A	BLAINE AQUIFER | COLLINGSWORTH COUNTY	1,700	1,700	1,700	1,700	1,700	1,700
IRRIGATION	A	DIRECT REUSE	52	54	55	57	58	60
IRRIGATION	A	OTHER AQUIFER | COLLINGSWORTH COUNTY	24	25	25	26	27	28
IRRIGATION	A	RED RUN-OF-RIVER	851	851	851	851	851	851
IRRIGATION	A	SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	37,977	29,779	27,799	25,986	21,074	21,743
		RED BASIN TOTAL	**41,347**	**33,226**	**31,275**	**29,495**	**24,618**	**25,323**
		COLLINGSWORTH COUNTY TOTAL	**41,347**	**33,226**	**31,275**	**29,495**	**24,618**	**25,323**
DALHART	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	1,435	1,134	928	706	484	492
TEXLINE	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	274	274	274	274	274	274
COUNTY-OTHER	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	140	150	165	181	197	213
MANUFACTURING	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	6	6	6	6	6	6
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	2,488	2,488	2,488	2,488	2,488	2,488
LIVESTOCK	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	2,033	2,372	2,627	2,902	3,198	3,518
IRRIGATION	A	DOCKUM AQUIFER | DALLAM COUNTY	11,823	11,899	11,858	11,783	11,668	11,668
IRRIGATION	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	302,421	215,573	167,114	124,816	88,298	88,298
		CANADIAN BASIN TOTAL	**320,620**	**233,896**	**185,460**	**143,156**	**106,613**	**106,957**
		DALLAM COUNTY TOTAL	**320,620**	**233,896**	**185,460**	**143,156**	**106,613**	**106,957**
CLARENDON	A	GREENBELT LAKE/RESERVOIR	230	234	237	242	225	206
CLARENDON	A	OGALLALA AQUIFER | DONLEY COUNTY	141	128	117	108	92	77
RED RIVER AUTHORITY OF TEXAS*	A	GREENBELT LAKE/RESERVOIR	19	19	20	21	19	18
RED RIVER AUTHORITY OF TEXAS*	A	OGALLALA AQUIFER | DONLEY COUNTY	215	236	255	275	299	320
COUNTY-OTHER	A	GREENBELT LAKE/RESERVOIR	35	36	37	39	36	33
COUNTY-OTHER	A	OGALLALA AQUIFER | DONLEY COUNTY	134	114	97	82	67	52
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	283	283	283	283	283	283
LIVESTOCK	A	OGALLALA AQUIFER | DONLEY COUNTY	305	328	353	380	407	436
LIVESTOCK	A	OTHER AQUIFER | DONLEY COUNTY	383	383	383	383	383	383
IRRIGATION	A	OGALLALA AQUIFER | DONLEY COUNTY	30,910	30,910	30,910	30,910	30,910	30,910

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
IRRIGATION	A	RED RUN-OF-RIVER	166	166	166	166	166	166
		RED BASIN TOTAL	**32,821**	**32,837**	**32,858**	**32,889**	**32,887**	**32,884**
		DONLEY COUNTY TOTAL	**32,821**	**32,837**	**32,858**	**32,889**	**32,887**	**32,884**
PAMPA MUNICIPAL WATER SYSTEM	A	MEREDITH LAKE/RESERVOIR	481	570	681	812	935	943
PAMPA MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | GRAY COUNTY	1,724	1,431	1,135	903	713	713
PAMPA MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,666	1,803	1,679	1,833	1,899	1,918
COUNTY-OTHER	A	OGALLALA AQUIFER | GRAY COUNTY	472	512	563	634	692	753
MANUFACTURING	A	OGALLALA AQUIFER | GRAY COUNTY	482	527	527	527	527	527
MINING	A	OGALLALA AQUIFER | GRAY COUNTY	7	7	6	6	5	4
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	199	199	199	199	199	199
LIVESTOCK	A	OGALLALA AQUIFER | GRAY COUNTY	61	61	61	61	61	61
IRRIGATION	A	CANADIAN RUN-OF-RIVER	1	1	1	1	1	1
IRRIGATION	A	DIRECT REUSE	220	220	220	220	220	220
IRRIGATION	A	OGALLALA AQUIFER | GRAY COUNTY	8,395	8,395	8,395	8,395	5,487	5,487
		CANADIAN BASIN TOTAL	**13,708**	**13,726**	**13,467**	**13,591**	**10,739**	**10,826**
MCLEAN MUNICIPAL WATER SUPPLY	A	OGALLALA AQUIFER | GRAY COUNTY	315	293	266	241	219	219
COUNTY-OTHER	A	OGALLALA AQUIFER | GRAY COUNTY	239	259	285	320	350	381
MINING	A	OGALLALA AQUIFER | GRAY COUNTY	68	67	61	54	48	43
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	600	600	600	600	600	600
LIVESTOCK	A	OGALLALA AQUIFER | GRAY COUNTY	1,106	1,334	1,422	1,517	1,622	1,737
IRRIGATION	A	OGALLALA AQUIFER | GRAY COUNTY	23,894	23,894	23,894	23,894	23,894	23,894
IRRIGATION	A	RED RUN-OF-RIVER	55	55	55	55	55	55
		RED BASIN TOTAL	**26,277**	**26,502**	**26,583**	**26,681**	**26,788**	**26,929**
		GRAY COUNTY TOTAL	**39,985**	**40,228**	**40,050**	**40,272**	**37,527**	**37,755**
MEMPHIS	A	GREENBELT LAKE/RESERVOIR	23	24	25	25	24	22
MEMPHIS	A	OGALLALA AQUIFER | DONLEY COUNTY	373	333	288	245	206	204
RED RIVER AUTHORITY OF TEXAS*	A	GREENBELT LAKE/RESERVOIR	62	65	67	69	64	59
RED RIVER AUTHORITY OF TEXAS*	A	OGALLALA AQUIFER | DONLEY COUNTY	38	35	33	31	26	22
RED RIVER AUTHORITY OF TEXAS*	A	SEYMOUR AQUIFER | HALL COUNTY	10	10	10	13	14	30
TURKEY MUNICIPAL WATER SYSTEM	A	SEYMOUR AQUIFER | HALL COUNTY	120	121	119	119	119	119
COUNTY-OTHER	A	SEYMOUR AQUIFER | HALL COUNTY	84	76	65	54	65	57
LIVESTOCK	A	BLAINE AQUIFER | HALL COUNTY	0	0	0	0	8	29
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	91	91	91	91	91	91
LIVESTOCK	A	OTHER AQUIFER | HALL COUNTY	300	300	300	300	300	300
LIVESTOCK	A	SEYMOUR AQUIFER | HALL COUNTY	15	15	15	15	15	15
IRRIGATION	A	DIRECT REUSE	100	100	100	100	100	100
IRRIGATION	A	OTHER AQUIFER | HALL COUNTY	786	786	786	786	786	786
IRRIGATION	A	RED RUN-OF-RIVER	52	52	52	52	52	52
IRRIGATION	A	SEYMOUR AQUIFER | HALL COUNTY	15,217	16,529	19,457	22,660	25,648	24,374
		RED BASIN TOTAL	**17,271**	**18,537**	**21,408**	**24,560**	**27,518**	**26,260**
		HALL COUNTY TOTAL	**17,271**	**18,537**	**21,408**	**24,560**	**27,518**	**26,260**
GRUVER	A	OGALLALA AQUIFER | HANSFORD COUNTY	410	360	309	251	201	201

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
SPEARMAN MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | HANSFORD COUNTY	804	817	702	474	228	228
COUNTY-OTHER	A	OGALLALA AQUIFER | HANSFORD COUNTY	170	170	170	170	170	170
MANUFACTURING	A	OGALLALA AQUIFER | HANSFORD COUNTY	285	321	321	321	321	321
MINING	A	OGALLALA AQUIFER | HANSFORD COUNTY	577	904	602	309	16	1
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	2,617	2,617	2,617	2,617	2,617	2,617
LIVESTOCK	A	OGALLALA AQUIFER | HANSFORD COUNTY	1,413	1,587	1,771	1,963	2,166	2,378
IRRIGATION	A	CANADIAN RUN-OF-RIVER	22	22	22	22	22	22
IRRIGATION	A	OGALLALA AQUIFER | HANSFORD COUNTY	171,900	171,900	171,900	171,900	171,900	171,900
		CANADIAN BASIN TOTAL	**178,198**	**178,698**	**178,414**	**178,027**	**177,641**	**177,838**
		HANSFORD COUNTY TOTAL	**178,198**	**178,698**	**178,414**	**178,027**	**177,641**	**177,838**
DALHART	A	OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	675	492	367	256	163	155
HARTLEY WSC	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	250	260	270	280	280	290
COUNTY-OTHER	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	531	557	568	577	588	598
MINING	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	7	7	6	5	4	3
LIVESTOCK	A	DOCKUM AQUIFER | HARTLEY COUNTY	1,035	1,035	1,035	1,035	1,035	1,035
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	3,193	3,193	3,193	3,193	3,193	3,193
LIVESTOCK	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	2,361	3,147	3,696	4,291	4,937	5,638
IRRIGATION	A	DOCKUM AQUIFER | HARTLEY COUNTY	8,349	7,585	7,381	7,411	7,615	7,615
IRRIGATION	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	313,875	206,640	160,229	116,912	77,655	77,655
		CANADIAN BASIN TOTAL	**330,276**	**222,916**	**176,745**	**133,960**	**95,470**	**96,182**
		HARTLEY COUNTY TOTAL	**330,276**	**222,916**	**176,745**	**133,960**	**95,470**	**96,182**
CANADIAN	A	OGALLALA AQUIFER | HEMPHILL COUNTY	988	1,087	1,174	1,268	1,356	1,439
COUNTY-OTHER	A	OGALLALA AQUIFER | HEMPHILL COUNTY	97	95	92	94	95	95
MANUFACTURING	A	OGALLALA AQUIFER | HEMPHILL COUNTY	4	4	4	4	4	4
MINING	A	OGALLALA AQUIFER | HEMPHILL COUNTY	926	706	498	293	89	27
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	248	248	248	248	248	248
LIVESTOCK	A	OGALLALA AQUIFER | HEMPHILL COUNTY	415	432	451	470	491	512
IRRIGATION	A	OGALLALA AQUIFER | HEMPHILL COUNTY	3,919	3,919	3,919	3,919	3,919	3,919
		CANADIAN BASIN TOTAL	**6,597**	**6,491**	**6,386**	**6,296**	**6,202**	**6,244**
COUNTY-OTHER	A	OGALLALA AQUIFER | HEMPHILL COUNTY	42	41	41	41	41	42
MANUFACTURING	A	OGALLALA AQUIFER | HEMPHILL COUNTY	2	2	2	2	2	2
MINING	A	OGALLALA AQUIFER | HEMPHILL COUNTY	1,388	1,057	746	439	134	41
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	173	173	173	173	173	173
LIVESTOCK	A	OGALLALA AQUIFER | HEMPHILL COUNTY	281	293	305	319	332	347
IRRIGATION	A	OGALLALA AQUIFER | HEMPHILL COUNTY	1,760	1,760	1,760	1,760	1,760	1,760
		RED BASIN TOTAL	**3,646**	**3,326**	**3,027**	**2,734**	**2,442**	**2,365**
		HEMPHILL COUNTY TOTAL	**10,243**	**9,817**	**9,413**	**9,030**	**8,644**	**8,609**
BORGER	A	OGALLALA AQUIFER | CARSON COUNTY	800	719	672	634	602	602
BORGER	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	3,470	2,385	2,012	1,537	1,238	1,139
BORGER	A	OGALLALA AQUIFER | ROBERTS COUNTY	2,329	2,129	1,914	1,548	1,298	1,395
FRITCH	A	OGALLALA AQUIFER | CARSON COUNTY	592	598	591	589	588	588
STINNETT	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	581	538	495	457	423	423
TCW SUPPLY	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	691	573	472	386	317	317

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
COUNTY-OTHER	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	316	315	314	313	311	311
MANUFACTURING	A	CANADIAN RUN-OF-RIVER	2	2	2	2	2	2
MANUFACTURING	A	DIRECT REUSE	1,100	1,100	1,100	1,100	1,100	1,100
MANUFACTURING	A	MEREDITH LAKE/RESERVOIR	1,729	1,594	1,506	1,438	1,427	1,423
MANUFACTURING	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	25,038	26,907	26,869	27,016	27,039	27,138
MANUFACTURING	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,500	1,700	1,800	1,700	1,600	1,500
MINING	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	184	231	170	113	56	34
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	281	281	281	281	281	281
LIVESTOCK	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	319	355	385	418	453	490
IRRIGATION	A	CANADIAN RUN-OF-RIVER	96	96	96	96	96	96
IRRIGATION	A	OGALLALA AQUIFER | HUTCHINSON COUNTY	59,910	59,910	59,910	59,910	59,910	59,910
		CANADIAN BASIN TOTAL	**98,938**	**99,433**	**98,589**	**97,538**	**96,741**	**96,749**
		HUTCHINSON COUNTY TOTAL	**98,938**	**99,433**	**98,589**	**97,538**	**96,741**	**96,749**
BOOKER	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	727	577	519	472	435	440
DARROUZETT	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	150	150	150	160	160	160
FOLLETT	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	140	150	160	160	170	170
HIGGINS MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	140	150	150	160	160	170
COUNTY-OTHER	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	137	124	117	109	103	99
MANUFACTURING	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	362	400	360	305	269	261
MINING	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	1,098	758	446	142	21	3
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	110	110	110	110	110	110
LIVESTOCK	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	495	521	548	578	608	640
IRRIGATION	A	CANADIAN RUN-OF-RIVER	66	66	66	66	66	66
IRRIGATION	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	40,870	40,870	40,870	40,870	40,870	40,870
		CANADIAN BASIN TOTAL	**44,295**	**43,876**	**43,496**	**43,132**	**42,972**	**42,989**
		LIPSCOMB COUNTY TOTAL	**44,295**	**43,876**	**43,496**	**43,132**	**42,972**	**42,989**
CACTUS MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | MOORE COUNTY	679	525	423	311	240	256
DUMAS	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	2,274	1,827	1,583	1,234	844	844
DUMAS	A	OGALLALA AQUIFER | MOORE COUNTY	1,907	1,235	855	429	185	185
FRITCH	A	OGALLALA AQUIFER | CARSON COUNTY	5	5	5	5	5	5
SUNRAY	A	OGALLALA AQUIFER | MOORE COUNTY	605	344	125	56	14	14
COUNTY-OTHER	A	OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	50	38	27	17	9	9
COUNTY-OTHER	A	OGALLALA AQUIFER | MOORE COUNTY	243	273	306	343	385	429
MANUFACTURING	A	OGALLALA AQUIFER | MOORE COUNTY	8,269	7,856	7,408	5,498	3,860	3,844
MINING	A	OGALLALA AQUIFER | MOORE COUNTY	16	16	16	15	15	15
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	1,000	1,000	1,000	1,000	1,000	1,000
LIVESTOCK	A	OGALLALA AQUIFER | MOORE COUNTY	4,414	5,192	5,698	6,251	6,855	7,515
IRRIGATION	A	CANADIAN RUN-OF-RIVER	7	7	7	7	7	7
IRRIGATION	A	DOCKUM AQUIFER | MOORE COUNTY	870	722	650	654	739	739
IRRIGATION	A	OGALLALA AQUIFER | MOORE COUNTY	190,465	151,845	121,984	91,564	63,892	63,892
		CANADIAN BASIN TOTAL	**210,804**	**170,885**	**140,087**	**107,384**	**78,050**	**78,754**
		MOORE COUNTY TOTAL	**210,804**	**170,885**	**140,087**	**107,384**	**78,050**	**78,754**
BOOKER	A	OGALLALA AQUIFER | LIPSCOMB COUNTY	9	9	12	12	13	16
PERRYTON MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | OCHILTREE COUNTY	3,488	3,309	3,136	3,045	2,919	2,919
COUNTY-OTHER	A	OGALLALA AQUIFER | OCHILTREE COUNTY	341	354	371	396	425	457

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	A	OGALLALA AQUIFER | OCHILTREE COUNTY	36	41	41	41	41	41
MINING	A	OGALLALA AQUIFER | OCHILTREE COUNTY	824	853	503	161	23	3
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	421	421	421	421	421	421
LIVESTOCK	A	OGALLALA AQUIFER | OCHILTREE COUNTY	2,380	2,541	2,699	2,865	3,041	3,226
IRRIGATION	A	OGALLALA AQUIFER | OCHILTREE COUNTY	84,460	84,460	84,460	84,460	84,460	84,460
		CANADIAN BASIN TOTAL	**91,959**	**91,988**	**91,643**	**91,401**	**91,343**	**91,543**
		OCHILTREE COUNTY TOTAL	**91,959**	**91,988**	**91,643**	**91,401**	**91,343**	**91,543**
VEGA	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DEAF SMITH COUNTY	200	200	200	200	200	200
VEGA	A	OGALLALA AQUIFER | OLDHAM COUNTY	95	95	95	95	95	95
COUNTY-OTHER	A	DOCKUM AQUIFER | OLDHAM COUNTY	387	387	387	387	387	387
COUNTY-OTHER	A	OGALLALA AQUIFER | OLDHAM COUNTY	214	207	208	208	208	208
MINING	A	DOCKUM AQUIFER | OLDHAM COUNTY	283	283	283	283	283	283
MINING	A	OGALLALA AQUIFER | OLDHAM COUNTY	173	257	330	361	425	493
LIVESTOCK	A	DOCKUM AQUIFER | OLDHAM COUNTY	358	358	358	358	358	358
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	626	626	626	626	626	626
LIVESTOCK	A	OGALLALA AQUIFER | OLDHAM COUNTY	134	134	134	134	134	134
IRRIGATION	A	DOCKUM AQUIFER | OLDHAM COUNTY	372	372	372	372	372	372
IRRIGATION	A	OGALLALA AQUIFER | OLDHAM COUNTY	3,216	3,216	3,216	3,216	3,216	3,216
		CANADIAN BASIN TOTAL	**6,058**	**6,135**	**6,209**	**6,240**	**6,304**	**6,372**
COUNTY-OTHER	A	OGALLALA AQUIFER | OLDHAM COUNTY	73	80	79	79	79	79
MINING	A	OGALLALA AQUIFER | OLDHAM COUNTY	19	23	26	27	29	32
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	209	209	209	209	209	209
LIVESTOCK	A	OGALLALA AQUIFER | OLDHAM COUNTY	328	328	328	328	328	328
IRRIGATION	A	OGALLALA AQUIFER | OLDHAM COUNTY	1,133	1,133	1,133	1,133	1,133	1,133
		RED BASIN TOTAL	**1,762**	**1,773**	**1,775**	**1,776**	**1,778**	**1,781**
		OLDHAM COUNTY TOTAL	**7,820**	**7,908**	**7,984**	**8,016**	**8,082**	**8,153**
AMARILLO	A	MEREDITH LAKE/RESERVOIR	3,278	3,264	3,125	3,010	3,056	3,072
AMARILLO	A	OGALLALA AQUIFER | CARSON COUNTY	4,093	3,738	3,260	2,815	2,448	2,449
AMARILLO	A	OGALLALA AQUIFER | POTTER COUNTY	2,321	1,559	1,422	1,305	1,190	1,174
AMARILLO	A	OGALLALA AQUIFER | ROBERTS COUNTY	7,428	7,477	7,162	6,357	5,888	5,956
COUNTY-OTHER	A	DOCKUM AQUIFER | POTTER COUNTY	900	900	900	900	900	900
COUNTY-OTHER	A	OGALLALA AQUIFER | POTTER COUNTY	1,517	1,651	1,801	1,960	2,141	2,336
MANUFACTURING	A	DOCKUM AQUIFER | POTTER COUNTY	682	636	581	530	477	477
MINING	A	OGALLALA AQUIFER | POTTER COUNTY	640	781	912	988	1,109	1,245
STEAM ELECTRIC POWER	A	DIRECT REUSE	18,554	18,554	18,554	18,554	18,554	18,554
LIVESTOCK	A	DOCKUM AQUIFER | POTTER COUNTY	1	1	1	1	1	1
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	500	500	500	500	500	500
LIVESTOCK	A	OGALLALA AQUIFER | POTTER COUNTY	17	17	17	17	17	17
IRRIGATION	A	DIRECT REUSE	700	700	700	700	700	700
IRRIGATION	A	DOCKUM AQUIFER | POTTER COUNTY	73	73	73	73	73	73
IRRIGATION	A	OGALLALA AQUIFER | POTTER COUNTY	547	547	547	547	547	547
		CANADIAN BASIN TOTAL	**41,251**	**40,398**	**39,555**	**38,257**	**37,601**	**38,001**
AMARILLO	A	MEREDITH LAKE/RESERVOIR	2,158	2,149	2,057	1,983	2,012	2,022
AMARILLO	A	OGALLALA AQUIFER | CARSON COUNTY	2,695	2,460	2,148	1,853	1,612	1,613
AMARILLO	A	OGALLALA AQUIFER | POTTER COUNTY	1,529	1,027	937	859	783	772
AMARILLO	A	OGALLALA AQUIFER | ROBERTS COUNTY	4,890	4,922	4,716	4,185	3,877	3,921
COUNTY-OTHER	A	OGALLALA AQUIFER | POTTER COUNTY	812	884	965	1,049	1,147	1,251

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	A	DIRECT REUSE	2,000	2,000	2,000	2,000	2,000	2,000
MANUFACTURING	A	MEREDITH LAKE/RESERVOIR	1,101	1,114	978	867	804	741
MANUFACTURING	A	OGALLALA AQUIFER | ROBERTS COUNTY	4,426	4,361	3,710	3,016	2,508	2,313
MINING	A	OGALLALA AQUIFER | POTTER COUNTY	301	368	429	465	522	586
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	62	62	62	62	62	62
LIVESTOCK	A	OGALLALA AQUIFER | POTTER COUNTY	25	28	32	36	40	45
IRRIGATION	A	DIRECT REUSE	1,500	1,500	1,500	1,500	1,500	1,500
IRRIGATION	A	OGALLALA AQUIFER | POTTER COUNTY	1,217	1,217	1,217	1,217	1,217	1,217
		RED BASIN TOTAL	**22,716**	**22,092**	**20,751**	**19,092**	**18,084**	**18,043**
		POTTER COUNTY TOTAL	**63,967**	**62,490**	**60,306**	**57,349**	**55,685**	**56,044**
AMARILLO	A	MEREDITH LAKE/RESERVOIR	4,414	4,422	4,232	4,088	4,149	4,165
AMARILLO	O	OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | DEAF SMITH COUNTY	100	100	100	100	50	0
AMARILLO	A	OGALLALA AQUIFER | CARSON COUNTY	5,512	5,062	4,418	3,822	3,324	3,322
AMARILLO	A	OGALLALA AQUIFER | POTTER COUNTY	1,338	709	842	907	922	949
AMARILLO	A	OGALLALA AQUIFER | RANDALL COUNTY	1,689	1,304	985	763	641	641
AMARILLO	A	OGALLALA AQUIFER | ROBERTS COUNTY	10,002	10,129	9,701	8,631	7,994	8,076
CANYON	A	DOCKUM AQUIFER | RANDALL COUNTY	1,780	1,691	1,606	1,526	1,450	1,378
CANYON	A	MEREDITH LAKE/RESERVOIR	199	182	160	142	0	0
CANYON	A	OGALLALA AQUIFER | RANDALL COUNTY	1,412	1,341	1,274	1,210	1,150	1,093
CANYON	A	OGALLALA AQUIFER | ROBERTS COUNTY	801	713	606	493	0	0
HAPPY*	O	DOCKUM AQUIFER | SWISHER COUNTY	10	11	12	13	14	16
LAKE TANGLEWOOD	A	DOCKUM AQUIFER | RANDALL COUNTY	500	500	500	500	500	500
LAKE TANGLEWOOD	A	OGALLALA AQUIFER | RANDALL COUNTY	110	87	63	44	32	32
COUNTY-OTHER	A	DOCKUM AQUIFER | RANDALL COUNTY	689	689	689	689	689	689
COUNTY-OTHER	A	MEREDITH LAKE/RESERVOIR	5	5	4	4	3	3
COUNTY-OTHER	A	OGALLALA AQUIFER | RANDALL COUNTY	3,088	3,379	3,684	4,018	4,394	4,790
COUNTY-OTHER	A	OGALLALA AQUIFER | ROBERTS COUNTY	20	17	15	12	11	9
MANUFACTURING	A	MEREDITH LAKE/RESERVOIR	115	105	92	82	76	70
MANUFACTURING	A	OGALLALA AQUIFER | RANDALL COUNTY	50	50	50	50	50	50
MANUFACTURING	A	OGALLALA AQUIFER | ROBERTS COUNTY	461	410	349	284	236	217
LIVESTOCK	A	DOCKUM AQUIFER | RANDALL COUNTY	230	230	230	230	230	230
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	1,312	1,312	1,312	1,312	1,312	1,312
LIVESTOCK	A	OGALLALA AQUIFER | RANDALL COUNTY	1,121	1,163	1,199	1,236	1,277	1,320
IRRIGATION	A	DIRECT REUSE	545	597	651	710	777	846
IRRIGATION	A	DOCKUM AQUIFER | RANDALL COUNTY	101	215	286	355	425	425
IRRIGATION	A	OGALLALA AQUIFER | RANDALL COUNTY	17,720	17,720	17,720	17,720	17,720	17,720
IRRIGATION	A	RED RUN-OF-RIVER	217	217	217	217	217	217
		RED BASIN TOTAL	**53,541**	**52,360**	**50,997**	**49,158**	**47,643**	**48,070**
		RANDALL COUNTY TOTAL	**53,541**	**52,360**	**50,997**	**49,158**	**47,643**	**48,070**
MIAMI	A	OGALLALA AQUIFER | ROBERTS COUNTY	298	298	298	298	298	298
COUNTY-OTHER	A	OGALLALA AQUIFER | ROBERTS COUNTY	50	50	50	50	50	50
MINING	A	OGALLALA AQUIFER | ROBERTS COUNTY	1,457	1,010	593	183	19	2
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	124	124	124	124	124	124
LIVESTOCK	A	OGALLALA AQUIFER | ROBERTS COUNTY	249	267	287	308	329	353
IRRIGATION	A	CANADIAN RUN-OF-RIVER	72	72	72	72	72	72
IRRIGATION	A	OGALLALA AQUIFER | ROBERTS COUNTY	8,044	8,044	8,044	8,044	8,044	8,044
		CANADIAN BASIN TOTAL	**10,294**	**9,865**	**9,468**	**9,079**	**8,936**	**8,943**

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Region A Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
COUNTY-OTHER	A	OGALLALA AQUIFER | ROBERTS COUNTY	1	1	1	1	1	1
MINING	A	OGALLALA AQUIFER | ROBERTS COUNTY	45	31	18	6	1	0
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	15	15	15	15	15	15
LIVESTOCK	A	OGALLALA AQUIFER | ROBERTS COUNTY	1	1	1	1	1	1
IRRIGATION	A	OGALLALA AQUIFER | ROBERTS COUNTY	427	427	427	427	427	427
		RED BASIN TOTAL	**489**	**475**	**462**	**450**	**445**	**444**
		ROBERTS COUNTY TOTAL	**10,783**	**10,340**	**9,930**	**9,529**	**9,381**	**9,387**
STRATFORD	A	OGALLALA AQUIFER | SHERMAN COUNTY	821	821	821	821	633	633
TEXHOMA	A	OGALLALA AQUIFER | SHERMAN COUNTY	130	140	150	150	160	160
COUNTY-OTHER	A	OGALLALA AQUIFER | SHERMAN COUNTY	105	110	112	116	118	121
MANUFACTURING	A	OGALLALA AQUIFER | SHERMAN COUNTY	2	2	2	2	2	2
MINING	A	OGALLALA AQUIFER | SHERMAN COUNTY	35	207	151	98	44	20
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	1,052	1,052	1,052	1,052	1,052	1,052
LIVESTOCK	A	OGALLALA AQUIFER | SHERMAN COUNTY	2,524	2,761	2,954	3,160	3,380	3,617
IRRIGATION	A	CANADIAN RUN-OF-RIVER	32	32	32	32	32	32
IRRIGATION	A	DOCKUM AQUIFER | SHERMAN COUNTY	127	127	127	127	95	95
IRRIGATION	A	OGALLALA AQUIFER | SHERMAN COUNTY	304,360	304,360	274,634	207,770	144,202	143,986
		CANADIAN BASIN TOTAL	**309,188**	**309,612**	**280,035**	**213,328**	**149,718**	**149,718**
		SHERMAN COUNTY TOTAL	**309,188**	**309,612**	**280,035**	**213,328**	**149,718**	**149,718**
SHAMROCK MUNICIPAL WATER SYSTEM	A	OGALLALA AQUIFER | WHEELER COUNTY	842	842	842	842	842	842
WHEELER	A	OGALLALA AQUIFER | WHEELER COUNTY	704	655	574	486	421	421
COUNTY-OTHER	A	BLAINE AQUIFER | WHEELER COUNTY	15	15	15	15	15	15
COUNTY-OTHER	A	OGALLALA AQUIFER | WHEELER COUNTY	348	348	348	348	348	348
COUNTY-OTHER	A	OTHER AQUIFER | WHEELER COUNTY	22	22	22	22	22	22
MINING	A	OGALLALA AQUIFER | WHEELER COUNTY	3,268	2,329	1,413	503	139	119
LIVESTOCK	A	BLAINE AQUIFER | WHEELER COUNTY	19	19	19	19	19	19
LIVESTOCK	A	LOCAL SURFACE WATER SUPPLY	845	845	845	845	845	845
LIVESTOCK	A	OGALLALA AQUIFER | WHEELER COUNTY	803	803	803	803	803	803
LIVESTOCK	A	OTHER AQUIFER | WHEELER COUNTY	28	28	28	28	28	28
IRRIGATION	A	BLAINE AQUIFER | WHEELER COUNTY	15	15	15	15	15	15
IRRIGATION	A	DIRECT REUSE	49	51	52	53	55	57
IRRIGATION	A	OGALLALA AQUIFER | WHEELER COUNTY	15,621	15,621	15,621	15,621	15,621	15,621
IRRIGATION	A	OTHER AQUIFER | WHEELER COUNTY	226	226	226	226	226	226
IRRIGATION	A	RED RUN-OF-RIVER	603	603	603	603	603	603
		RED BASIN TOTAL	**23,408**	**22,422**	**21,426**	**20,429**	**20,002**	**19,984**
		WHEELER COUNTY TOTAL	**23,408**	**22,422**	**21,426**	**20,429**	**20,002**	**19,984**
		REGION A EXISTING WATER SUPPLY TOTAL	**2,000,083**	**1,755,862**	**1,594,386**	**1,402,963**	**1,224,710**	**1,227,242**

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Region A Water User Group (WUG) Needs/Surplus

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus 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. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY - RED BASIN						
CLAUDE MUNICIPAL WATER SYSTEM	224	183	115	55	7	7
COUNTY-OTHER	12	16	18	18	18	18
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	54	78	99	119	136	136
CARSON COUNTY - CANADIAN BASIN						
WHITE DEER	23	23	23	23	23	23
COUNTY-OTHER	81	71	63	62	47	25
MANUFACTURING	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
CARSON COUNTY - RED BASIN						
GROOM MUNICIPAL WATER SYSTEM	10	13	15	16	16	16
PANHANDLE MUNICIPAL WATER SYSTEM	162	(461)	(586)	(581)	(580)	(580)
WHITE DEER	29	30	30	30	30	30
COUNTY-OTHER	91	83	76	74	60	41
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	335	336	336	335	335	335
CHILDRESS COUNTY - RED BASIN						
CHILDRESS	0	0	0	0	(163)	(344)
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	(23)	(49)
COUNTY-OTHER	1	1	1	1	1	0
LIVESTOCK	72	27	9	0	0	0
IRRIGATION	198	202	205	208	213	217
COLLINGSWORTH COUNTY - RED BASIN						
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
WELLINGTON MUNICIPAL WATER SYSTEM	(524)	(540)	(548)	(566)	(581)	(595)
COUNTY-OTHER	17	13	11	8	6	4
LIVESTOCK	54	0	0	0	0	0
IRRIGATION	(6,867)	(10,133)	(9,283)	(9,595)	(9,741)	(9,069)
DALLAM COUNTY - CANADIAN BASIN						
DALHART	(379)	(880)	(1,300)	(1,741)	(2,181)	(2,385)
TEXLINE	55	39	22	5	(12)	(28)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(29,586)	(116,358)	(107,956)	(91,644)	(74,251)	(74,251)
DONLEY COUNTY - RED BASIN						
CLARENDON	0	0	0	0	(32)	(66)
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	56	56	56	56	51	45
LIVESTOCK	0	0	0	0	0	0

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Region A Water User Group (WUG) Needs/Surplus

IRRIGATION	166	166	166	166	166	166
GRAY COUNTY - CANADIAN BASIN						
PAMPA MUNICIPAL WATER SYSTEM	186	(160)	(836)	(1,344)	(1,794)	(2,241)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	23	25	25	25	25	25
MINING	0	0	0	0	0	0
LIVESTOCK	71	46	36	25	13	1
IRRIGATION	221	221	221	221	(2,687)	(2,687)
GRAY COUNTY - RED BASIN						
MCLEAN MUNICIPAL WATER SUPPLY	105	66	16	(40)	(88)	(115)
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	55	55	55	55	55	55
HALL COUNTY - RED BASIN						
MEMPHIS	10	(28)	(62)	(102)	(142)	(146)
RED RIVER AUTHORITY OF TEXAS*	21	12	5	0	0	0
TURKEY MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	66	49	31	12	0	0
IRRIGATION	(15,637)	(14,325)	(11,397)	(8,194)	(5,206)	(6,480)
HANSFORD COUNTY - CANADIAN BASIN						
GRUVER	60	(20)	(98)	(180)	(256)	(280)
SPEARMAN MUNICIPAL WATER SYSTEM	134	136	13	(229)	(495)	(517)
COUNTY-OTHER	53	47	37	29	20	12
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	22	22	22	22	22	22
HARTLEY COUNTY - CANADIAN BASIN						
DALHART	(178)	(381)	(514)	(633)	(736)	(752)
HARTLEY WSC	23	21	24	29	25	30
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(84,766)	(192,765)	(177,587)	(159,542)	(141,411)	(141,411)
HEMPHILL COUNTY - CANADIAN BASIN						
CANADIAN	165	181	196	211	226	240
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	0	0	0	0	0	0
HEMPHILL COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	1	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

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Region A Water User Group (WUG) Needs/Surplus

HUTCHINSON COUNTY - CANADIAN BASIN						
BORGER	3,436	2,032	1,416	542	(34)	(36)
FRITCH	0	0	0	0	0	0
STINNETT	127	78	39	2	(31)	(31)
TCW SUPPLY	1	(132)	(233)	(315)	(383)	(383)
COUNTY-OTHER	53	46	44	44	42	42
MANUFACTURING	3	(32)	(58)	(79)	(167)	(172)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	96	96	96	96	96	96
LIPSCOMB COUNTY - CANADIAN BASIN						
BOOKER	231	30	(57)	(146)	(213)	(233)
DARROUZETT	26	19	15	19	15	11
FOLLETT	11	13	19	13	18	14
HIGGINS MUNICIPAL WATER SYSTEM	13	16	12	16	11	17
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	(40)	(95)	(131)	(139)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	66	66	66	66	66	66
MOORE COUNTY - CANADIAN BASIN						
CACTUS MUNICIPAL WATER SYSTEM	(306)	(582)	(819)	(1,071)	(1,292)	(1,429)
DUMAS	597	(931)	(2,008)	(3,267)	(4,432)	(4,982)
FRITCH	2	2	2	1	1	1
SUNRAY	155	(110)	(336)	(415)	(470)	(485)
COUNTY-OTHER	0	(12)	(23)	(33)	(41)	(41)
MANUFACTURING	(1,008)	(1,773)	(2,221)	(4,131)	(5,769)	(5,785)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(9,208)	(47,976)	(49,251)	(43,861)	(38,281)	(38,281)
OCHILTREE COUNTY - CANADIAN BASIN						
BOOKER	3	0	(1)	(4)	(7)	(9)
PERRYTON MUNICIPAL WATER SYSTEM	795	458	106	(193)	(556)	(815)
COUNTY-OTHER	31	32	34	36	39	42
MANUFACTURING	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
OLDHAM COUNTY - CANADIAN BASIN						
VEGA	3	8	11	13	13	13
COUNTY-OTHER	322	285	290	290	291	291
MINING	0	0	0	0	0	0
LIVESTOCK	297	202	180	157	133	108
IRRIGATION	0	0	0	0	0	0
OLDHAM COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	248	214	207	199	190	181
IRRIGATION	0	0	0	0	0	0

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Region A Water User Group (WUG) Needs/Surplus

POTTER COUNTY - CANADIAN BASIN						
AMARILLO	662	(1,881)	(4,567)	(7,764)	(10,652)	(12,695)
COUNTY-OTHER	900	900	900	900	900	900
MANUFACTURING	0	(119)	(174)	(225)	(278)	(278)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	95	78	60	41	20	0
IRRIGATION	291	291	291	291	291	291
POTTER COUNTY - RED BASIN						
AMARILLO	437	(1,239)	(3,005)	(5,111)	(7,013)	(8,359)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	313	(510)	(1,297)	(2,102)	(2,673)	(2,931)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	570	570	570	570	570	570
RANDALL COUNTY - RED BASIN						
AMARILLO	894	(2,550)	(6,184)	(10,540)	(14,463)	(17,216)
CANYON	560	(54)	(696)	(1,364)	(2,578)	(3,171)
HAPPY*	0	0	0	0	0	0
LAKE TANGLEWOOD	172	154	134	117	105	105
COUNTY-OTHER	714	711	708	705	703	701
MANUFACTURING	5	(151)	(225)	(300)	(354)	(379)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	863	1,029	1,154	1,282	1,419	1,488
ROBERTS COUNTY - CANADIAN BASIN						
MIAMI	73	72	74	75	75	75
COUNTY-OTHER	3	1	3	3	3	3
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
ROBERTS COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	6	5	5	4	3	3
IRRIGATION	0	0	0	0	0	0
SHERMAN COUNTY - CANADIAN BASIN						
STRATFORD	325	295	282	267	66	56
TEXHOMA	8	9	15	11	17	15
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	159	159	(29,567)	(38,831)	(38,207)	(38,423)
WHEELER COUNTY - RED BASIN						
SHAMROCK MUNICIPAL WATER SYSTEM	492	489	485	473	460	445
WHEELER	211	150	57	(47)	(132)	(153)
COUNTY-OTHER	89	88	86	76	65	53
MINING	0	0	0	0	0	0
LIVESTOCK	509	374	337	299	259	216
IRRIGATION	290	292	293	294	296	298

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Region A Water User Group (WUG) Second-Tier Identified Water Needs

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY - RED BASIN						
CLAUDE MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CARSON COUNTY - CANADIAN BASIN						
WHITE DEER	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	0	0	0	0	0	0
CARSON COUNTY - RED BASIN						
GROOM MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
PANHANDLE MUNICIPAL WATER SYSTEM	0	453	578	573	572	572
WHITE DEER	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CHILDRESS COUNTY - RED BASIN						
CHILDRESS	0	0	0	0	141	322
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	12	37
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
COLLINGSWORTH COUNTY - RED BASIN						
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
WELLINGTON MUNICIPAL WATER SYSTEM	517	533	540	558	573	587
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	4,257	6,167	1,328	0	322	0
DALLAM COUNTY - CANADIAN BASIN						
DALHART	361	859	1,277	1,715	2,153	2,355
TEXLINE	0	0	0	0	10	26
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	5,257	73,088	27,937	3,966	0	0
DONLEY COUNTY - RED BASIN						
CLARENDON	0	0	0	0	26	60
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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Region A Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
GRAY COUNTY - CANADIAN BASIN						
PAMPA MUNICIPAL WATER SYSTEM	0	65	730	1,223	1,662	2,097
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	0	0	0	0	0	0
GRAY COUNTY - RED BASIN						
MCLEAN MUNICIPAL WATER SUPPLY	0	0	0	36	84	111
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
HALL COUNTY - RED BASIN						
MEMPHIS	0	21	55	95	135	139
RED RIVER AUTHORITY OF TEXAS*	0	0	0	0	0	0
TURKEY MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	13,739	11,300	5,080	962	0	0
HANSFORD COUNTY - CANADIAN BASIN						
GRUVER	0	15	93	174	250	273
SPEARMAN MUNICIPAL WATER SYSTEM	0	0	0	217	483	504
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	0	0	0	0	0	0
HARTLEY COUNTY - CANADIAN BASIN						
DALHART	169	372	505	624	727	742
HARTLEY WSC	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	57,606	144,713	88,458	60,079	47,166	42,031
HEMPHILL COUNTY - CANADIAN BASIN						
CANADIAN	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	0	0	0	0	0	0
HEMPHILL COUNTY - RED BASIN						
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	0	0	0	0	0	0

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Region A Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
HUTCHINSON COUNTY - CANADIAN BASIN						
BORGER	0	0	0	0	0	0
FRITCH	0	0	0	0	0	0
STINNETT	0	0	0	0	25	25
TCW SUPPLY	0	126	227	309	377	377
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	32	58	79	167	172
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LIPSCOMB COUNTY - CANADIAN BASIN						
BOOKER	0	0	51	139	206	225
DARROUZETT	0	0	0	0	0	0
FOLLETT	0	0	0	0	0	0
HIGGINS MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	40	95	131	139
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
MOORE COUNTY - CANADIAN BASIN						
CACTUS MUNICIPAL WATER SYSTEM	293	567	802	1,052	1,271	1,406
DUMAS	0	743	1,768	2,999	4,135	4,656
FRITCH	0	0	0	0	0	0
SUNRAY	0	104	330	408	463	478
COUNTY-OTHER	0	4	14	23	30	29
MANUFACTURING	1,008	1,773	2,221	4,131	5,769	5,785
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	18,884	0	0	0	0
OCHILTREE COUNTY - CANADIAN BASIN						
BOOKER	0	0	1	4	7	9
PERRYTON MUNICIPAL WATER SYSTEM	0	0	0	158	518	774
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	0	0	0	0	0	0
OLDHAM COUNTY - CANADIAN BASIN						
VEGA	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
OLDHAM COUNTY - RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
OLDHAM COUNTY - RED BASIN						
IRRIGATION	0	0	0	0	0	0
POTTER COUNTY - CANADIAN BASIN						
AMARILLO	0	0	2,076	5,105	7,805	9,649
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	119	174	225	278	278
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
POTTER COUNTY - RED BASIN						
AMARILLO	0	0	1,364	3,360	5,139	6,353
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	510	1,297	2,102	2,673	2,931
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RANDALL COUNTY - RED BASIN						
AMARILLO	0	0	2,811	6,931	10,599	13,086
CANYON	0	0	432	1,048	2,231	2,793
HAPPY*	0	0	0	0	0	0
LAKE TANGLEWOOD	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	151	225	300	354	379
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
ROBERTS COUNTY - CANADIAN BASIN						
MIAMI	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
ROBERTS COUNTY - 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
SHERMAN COUNTY - CANADIAN BASIN						
STRATFORD	0	0	0	0	0	0
TEXHOMA	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	0	0	0	0	0	0
WHEELER COUNTY - RED BASIN						
SHAMROCK MUNICIPAL WATER SYSTEM	0	0	0	0	0	0
WHEELER	0	0	0	42	126	147

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Second-Tier Identified Water Needs

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHEELER COUNTY - 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

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Second-Tier Identified Water Needs Summary

Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	1,340	3,858	13,640	26,770	39,730	47,803
COUNTY-OTHER	0	4	14	23	30	29
MANUFACTURING	1,008	2,585	4,015	6,932	9,372	9,684
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	80,859	254,152	122,803	65,007	47,488	42,031

Region A Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BLAINE AQUIFER	CHILDRESS	RED	FRESH	9,566	9,465	9,530	9,455	9,500	9,414
BLAINE AQUIFER	COLLINGSWORTH	RED	FRESH	168	97	86	62	51	29
BLAINE AQUIFER	HALL	RED	FRESH	5,856	5,840	5,856	5,840	5,848	5,811
BLAINE AQUIFER	WHEELER	RED	FRESH	1,701	1,701	1,701	1,701	1,701	1,701
DOCKUM AQUIFER	ARMSTRONG	RED	FRESH	7,157	8,930	9,473	9,569	9,383	9,383
DOCKUM AQUIFER	CARSON	CANADIAN	FRESH	4	10	15	19	23	23
DOCKUM AQUIFER	CARSON	RED	FRESH	64	98	125	150	175	175
DOCKUM AQUIFER	DALLAM	CANADIAN	FRESH	2,369	2,289	2,328	2,401	2,516	2,516
DOCKUM AQUIFER	HARTLEY	CANADIAN	FRESH	45,865	46,415	46,512	46,418	46,187	46,187
DOCKUM AQUIFER	MOORE	CANADIAN	FRESH	4,349	4,385	4,370	4,272	4,050	4,050
DOCKUM AQUIFER	OLDHAM	CANADIAN	FRESH	127,538	127,371	119,066	109,746	99,965	99,965
DOCKUM AQUIFER	OLDHAM	RED	FRESH	63	58	52	50	48	48
DOCKUM AQUIFER	POTTER	CANADIAN	FRESH	36,985	37,373	35,277	32,905	30,449	30,449
DOCKUM AQUIFER	POTTER	RED	FRESH	183	130	105	96	108	108
DOCKUM AQUIFER	RANDALL	RED	FRESH	7,872	10,691	11,552	11,813	11,775	11,847
DOCKUM AQUIFER	SHERMAN	CANADIAN	FRESH	0	0	0	0	0	0
OGALLALA AND RITA BLANCA AQUIFERS	DALLAM	CANADIAN	FRESH	80,487	67,204	54,092	37,749	20,244	19,908
OGALLALA AND RITA BLANCA AQUIFERS	HARTLEY	CANADIAN	FRESH	97,765	76,686	60,469	42,264	24,106	23,386
OGALLALA AQUIFER	ARMSTRONG	RED	FRESH	52,178	47,300	41,929	37,122	32,436	32,416
OGALLALA AQUIFER	CARSON	CANADIAN	FRESH	47,748	45,633	40,953	35,137	29,010	29,018
OGALLALA AQUIFER	CARSON	RED	FRESH	40,470	36,263	28,222	19,241	9,969	9,984
OGALLALA AQUIFER	COLLINGSWORTH	RED	FRESH	50	50	50	50	50	50
OGALLALA AQUIFER	DONLEY	RED	FRESH	41,017	42,797	39,727	34,851	29,210	29,320
OGALLALA AQUIFER	GRAY	CANADIAN	FRESH	33,637	31,213	26,650	21,604	19,947	19,887
OGALLALA AQUIFER	GRAY	RED	FRESH	110,705	107,274	99,388	90,557	80,866	80,725
OGALLALA AQUIFER	HANSFORD	CANADIAN	FRESH	98,385	96,361	95,451	94,893	94,587	94,390
OGALLALA AQUIFER	HEMPHILL	CANADIAN	FRESH	21,440	24,017	25,861	27,315	28,104	28,062
OGALLALA AQUIFER	HEMPHILL	RED	FRESH	20,934	18,805	17,414	16,381	16,009	16,086
OGALLALA AQUIFER	HUTCHINSON	CANADIAN	FRESH	4,476	4,479	3,532	2,219	1,106	1,091
OGALLALA AQUIFER	LIPSCOMB	CANADIAN	FRESH	222,681	223,001	223,308	223,623	223,750	223,730
OGALLALA AQUIFER	MOORE	CANADIAN	FRESH	17,108	13,933	10,099	6,735	2,726	2,022
OGALLALA AQUIFER	OCHILTREE	CANADIAN	FRESH	152,249	152,374	152,792	153,083	153,173	152,976
OGALLALA AQUIFER	OLDHAM	CANADIAN	FRESH	33,535	30,467	25,095	19,025	13,722	13,654
OGALLALA AQUIFER	OLDHAM	RED	FRESH	5,679	4,263	2,779	1,601	221	218
OGALLALA AQUIFER	POTTER	CANADIAN	FRESH	1,643	2,905	2,041	1,315	505	174
OGALLALA AQUIFER	POTTER	RED	FRESH	5,287	4,352	3,505	2,720	1,917	1,744
OGALLALA AQUIFER	RANDALL	RED	FRESH	38,720	36,888	29,366	22,764	16,766	16,384
OGALLALA AQUIFER	ROBERTS	CANADIAN	FRESH	333,870	355,600	331,696	300,760	267,884	267,877
OGALLALA AQUIFER	ROBERTS	RED	FRESH	21,176	24,400	25,129	24,693	23,572	23,573
OGALLALA AQUIFER	SHERMAN	CANADIAN	FRESH	90,079	40,494	2,866	627	13	13
OGALLALA AQUIFER	WHEELER	RED	FRESH	108,839	118,212	117,784	113,709	106,604	106,624
OTHER AQUIFER	ARMSTRONG	RED	FRESH/ BRACKISH	340	340	340	340	340	340

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region A Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
OTHER AQUIFER	CHILDRESS	RED	FRESH/ BRACKISH	0	0	0	0	0	0
OTHER AQUIFER	COLLINGSWORTH	RED	FRESH/ BRACKISH	0	0	0	0	0	0
OTHER AQUIFER	DONLEY	RED	FRESH/ BRACKISH	96	96	96	96	96	96
OTHER AQUIFER	HALL	RED	FRESH/ BRACKISH	0	0	0	0	0	0
OTHER AQUIFER	WHEELER	RED	FRESH/ BRACKISH	0	0	0	0	0	0
SEYMOUR AQUIFER	CHILDRESS	RED	FRESH	2,673	2,921	2,992	2,983	2,992	2,972
SEYMOUR AQUIFER	COLLINGSWORTH	RED	FRESH	3,147	1,482	616	924	1,047	733
SEYMOUR AQUIFER	HALL	RED	FRESH	0	0	0	0	0	0
GROUNDWATER SOURCE WATER BALANCE TOTAL				**1,936,154**	**1,864,663**	**1,710,290**	**1,568,878**	**1,422,751**	**1,419,159**

REUSE SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
DIRECT REUSE	CARSON	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	CHILDRESS	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	GRAY	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	HALL	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	POTTER	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	POTTER	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	RANDALL	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	WHEELER	RED	FRESH	0	0	0	0	0	0
REUSE SOURCE WATER BALANCE TOTAL				**0**	**0**	**0**	**0**	**0**	**0**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CANADIAN LIVESTOCK LOCAL SUPPLY	CARSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	DALLAM	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	GRAY	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HANSFORD	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HARTLEY	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HEMPHILL	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	LIPSCOMB	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	MOORE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	OCHILTREE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	OLDHAM	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	POTTER	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	ROBERTS	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	SHERMAN	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	GRAY	CANADIAN	FRESH	0	0	0	0	0	0

* Salinity field indicates whether the source availability is considered ‘fresh’ (less than 1,000 mg/L), ‘brackish’ (1,000 to 10,000 mg/L), ‘saline’ (10,001 mg/L to 34,999 mg/L), or ‘seawater’ (35,000 mg/L or greater). Sources can also be labeled as ‘fresh/brackish’ or ‘brackish/saline’, if a combination of the salinity types is appropriate.
** Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region A Source Water Balance (Availability - WUG Supply)

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CANADIAN RUN-OF-RIVER	HANSFORD	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	LIPSCOMB	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	MOORE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	ROBERTS	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	SHERMAN	CANADIAN	FRESH	0	0	0	0	0	0
GREENBELT LAKE/RESERVOIR	RESERVOIR**	RED	FRESH	0	0	0	0	0	0
MEREDITH LAKE/RESERVOIR	RESERVOIR**	CANADIAN	FRESH	0	0	0	0	0	0
PALO DURO LAKE/RESERVOIR	RESERVOIR**	CANADIAN	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	ARMSTRONG	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	CARSON	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	CHILDRESS	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	DONLEY	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	GRAY	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	HALL	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	HEMPHILL	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	OLDHAM	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	POTTER	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	RANDALL	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	ROBERTS	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	WHEELER	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	CARSON	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	CHILDRESS	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	DONLEY	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	GRAY	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	HALL	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	RANDALL	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	WHEELER	RED	FRESH	0	0	0	0	0	0
SURFACE WATER SOURCE WATER BALANCE TOTAL				**0**	**0**	**0**	**0**	**0**	**0**

REGION A SOURCE WATER BALANCE TOTAL	**1,936,154**	**1,864,663**	**1,710,290**	**1,568,878**	**1,422,751**	**1,419,159**

* Salinity field indicates whether the source availability is considered 'fresh' (less than 1,000 mg/L), 'brackish' (1,000 to 10,000 mg/L), 'saline' (10,001 mg/L to 34,999 mg/L), or 'seawater' (35,000 mg/L or greater). Sources can also be labeled as 'fresh/brackish' or 'brackish/saline', if a combination of the salinity types is appropriate.

** Since reservoir sources can exist across multiple counties, the county field value, 'reservoir' is applied to all reservoir sources.

Region A Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARMSTRONG COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	100	100	0.0%	100	100	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	89	88	-1.1%	83	82	-1.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARMSTRONG COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,194	6,298	50.2%	2,472	6,380	158.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,194	6,244	48.9%	2,472	6,244	152.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARMSTRONG COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	645	332	-48.5%	663	524	-21.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	645	332	-48.5%	663	524	-21.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ARMSTRONG COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	463	584	26.1%	235	354	50.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	358	360	0.6%	345	347	0.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	110	0	-100.0%
CARSON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	464	444	-4.3%	345	330	-4.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	284	272	-4.2%	276	264	-4.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CARSON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	55,702	87,624	57.3%	32,517	87,624	169.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	55,702	87,289	56.7%	32,517	87,289	168.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CARSON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	692	315	-54.5%	713	496	-30.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	692	315	-54.5%	713	496	-30.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CARSON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,127	1,055	-6.4%	814	1,136	39.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	419	1,055	151.8%	624	1,136	82.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CARSON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	14	14	0.0%	14	14	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	14	14	0.0%	14	14	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CARSON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,053	1,237	17.5%	561	503	-10.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	995	1,013	1.8%	996	1,014	1.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	89	0	-100.0%	576	580	0.7%
CHILDRESS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	218	6	-97.2%	244	6	-97.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	198	5	-97.5%	227	6	-97.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
CHILDRESS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	7,489	14,340	91.5%	4,601	14,359	212.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	7,308	14,142	93.5%	4,401	14,142	221.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CHILDRESS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	505	414	-18.0%	505	538	6.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	490	342	-30.2%	503	538	7.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
CHILDRESS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,624	1,856	14.3%	1,814	1,679	-7.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,624	1,856	14.3%	1,814	2,072	14.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	393	100.0%
COLLINGSWORTH COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	237	88	-62.9%	237	50	-78.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	191	71	-62.8%	217	46	-78.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
COLLINGSWORTH COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	18,856	40,604	115.3%	11,757	24,382	107.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	17,943	47,471	164.6%	10,837	33,451	208.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	6,867	100.0%	0	9,069	100.0%
COLLINGSWORTH COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	606	513	-15.3%	614	688	12.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	600	459	-23.5%	614	688	12.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
COLLINGSWORTH COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	142	100.0%	0	203	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	525	666	26.9%	595	798	34.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	525	524	-0.2%	595	595	0.0%
DALLAM COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	141	140	-0.7%	214	213	-0.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	141	140	-0.7%	214	213	-0.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DALLAM COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	290,465	314,244	8.2%	144,312	99,966	-30.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	369,864	343,830	-7.0%	212,530	174,217	-18.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	79,399	29,586	-62.7%	68,218	74,251	8.8%
DALLAM COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,437	4,521	1.9%	5,803	6,006	3.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,437	4,521	1.9%	5,803	6,006	3.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DALLAM COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	9	6	-33.3%	11	6	-45.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	9	6	-33.3%	11	6	-45.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
DALLAM COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,533	1,709	11.5%	945	766	-18.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,042	2,033	-0.4%	3,240	3,179	-1.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	509	379	-25.5%	2,295	2,413	5.1%
DONLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	265	169	-36.2%	265	85	-67.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	245	113	-53.9%	227	40	-82.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DONLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	24,246	31,076	28.2%	14,730	31,076	111.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	24,080	30,910	28.4%	14,564	30,910	112.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DONLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,330	971	-27.0%	1,339	1,102	-17.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,330	971	-27.0%	1,339	1,102	-17.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
DONLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	378	605	60.1%	356	621	74.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	378	605	60.1%	356	687	93.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	66	100.0%
GRAY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	693	711	2.6%	1,105	1,134	2.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	693	711	2.6%	1,105	1,134	2.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GRAY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	21,291	32,565	53.0%	12,359	29,657	140.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	21,291	32,289	51.7%	12,359	32,289	161.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	2,687	100.0%
GRAY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,114	1,966	-7.0%	2,114	2,597	22.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,352	1,895	40.2%	1,511	2,596	71.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GRAY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,600	482	-89.5%	4,300	527	-87.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,350	459	-89.4%	4,129	502	-87.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GRAY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	75	75	0.0%	47	47	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	75	75	0.0%	47	47	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
GRAY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,260	4,186	-1.7%	2,193	3,793	73.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,916	3,895	-0.5%	6,181	6,149	-0.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	3,988	2,356	-40.9%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
GRAY COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,409	0	-100.0%	3,320	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,409	0	-100.0%	3,320	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HALL COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	319	84	-73.7%	319	57	-82.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	319	84	-73.7%	319	57	-82.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HALL COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	10,134	16,155	59.4%	6,182	25,312	309.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	10,134	31,792	213.7%	6,182	31,792	414.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	15,637	100.0%	0	6,480	100.0%
HALL COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	406	406	0.0%	406	435	7.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	336	340	1.2%	343	435	26.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HALL COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	428	626	46.3%	236	456	93.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	383	595	55.4%	369	602	63.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	133	146	9.8%
HANSFORD COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	200	170	-15.0%	200	170	-15.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	138	117	-15.2%	186	158	-15.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HANSFORD COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	134,924	171,922	27.4%	77,195	171,922	122.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	134,902	171,900	27.4%	77,173	171,900	122.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HANSFORD COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,432	4,030	17.4%	4,219	4,995	18.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,432	4,030	17.4%	4,219	4,995	18.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HANSFORD COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	90	285	216.7%	120	321	167.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	58	285	391.4%	74	321	333.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HANSFORD COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	577	577	0.0%	1	1	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	577	577	0.0%	1	1	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HANSFORD COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,043	1,214	16.4%	193	429	122.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	982	1,020	3.9%	1,171	1,226	4.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	978	797	-18.5%

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	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
HARTLEY COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	655	531	-18.9%	737	598	-18.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	655	531	-18.9%	737	598	-18.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HARTLEY COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	268,060	322,224	20.2%	126,063	85,270	-32.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	345,365	406,990	17.8%	200,193	226,681	13.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	77,305	84,766	9.7%	74,130	141,411	90.8%
HARTLEY COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	6,498	6,589	1.4%	9,359	9,866	5.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	6,498	6,589	1.4%	9,359	9,866	5.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HARTLEY COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	5	0	-100.0%	5	0	-100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	5	0	-100.0%	5	0	-100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HARTLEY COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	7	7	0.0%	3	3	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	7	7	0.0%	3	3	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HARTLEY COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	614	925	50.7%	234	445	90.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	854	1,080	26.5%	907	1,167	28.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	240	178	-25.8%	673	752	11.7%
HEMPHILL COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	222	139	-37.4%	222	137	-38.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	158	139	-12.0%	164	137	-16.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HEMPHILL COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,907	5,679	197.8%	1,124	5,679	405.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,907	5,679	197.8%	1,124	5,679	405.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HEMPHILL COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,275	1,117	-12.4%	1,302	1,280	-1.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,275	1,117	-12.4%	1,302	1,280	-1.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HEMPHILL COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	6	6	0.0%	6	6	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	6	5	-16.7%	6	6	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HEMPHILL COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,314	2,314	0.0%	68	68	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,314	2,314	0.0%	68	68	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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HEMPHILL COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	786	988	25.7%	1,145	1,439	25.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	786	823	4.7%	1,145	1,199	4.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HUTCHINSON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	455	316	-30.5%	421	311	-26.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	312	263	-15.7%	319	269	-15.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HUTCHINSON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	40,104	60,006	49.6%	23,186	60,006	158.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	40,008	59,910	49.7%	23,090	59,910	159.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HUTCHINSON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	847	600	-29.2%	1,010	771	-23.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	847	600	-29.2%	1,010	771	-23.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HUTCHINSON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	25,357	29,369	15.8%	29,325	31,163	6.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	25,347	29,366	15.9%	33,741	31,335	-7.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	4,416	172	-96.1%
HUTCHINSON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	184	184	0.0%	34	34	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	184	184	0.0%	34	34	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
HUTCHINSON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,724	8,463	79.1%	2,140	4,464	108.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,836	4,899	1.3%	4,852	4,914	1.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	167	0	-100.0%	2,712	450	-83.4%
LIPSCOMB COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	473	137	-71.0%	473	99	-79.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	445	137	-69.2%	464	99	-78.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIPSCOMB COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	20,075	40,936	103.9%	11,833	40,936	245.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	20,009	40,870	104.3%	11,767	40,870	247.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIPSCOMB COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	947	605	-36.1%	1,083	750	-30.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	947	605	-36.1%	1,083	750	-30.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIPSCOMB COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	147	362	146.3%	69	261	278.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	147	362	146.3%	193	400	107.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	124	139	12.1%

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Region A Water User Group (WUG) Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
LIPSCOMB COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,098	1,098	0.0%	3	3	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,098	1,098	0.0%	3	3	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LIPSCOMB COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	496	1,157	133.3%	240	940	291.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	496	876	76.6%	674	1,131	67.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	434	233	-46.3%
MOORE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	362	293	-19.1%	504	438	-13.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	327	293	-10.4%	534	479	-10.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	30	41	36.7%
MOORE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	143,035	191,342	33.8%	76,022	64,638	-15.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	143,028	200,550	40.2%	82,193	102,919	25.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	9,208	100.0%	6,171	38,281	520.3%
MOORE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,676	5,414	47.3%	5,032	8,515	69.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,676	5,414	47.3%	5,032	8,515	69.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MOORE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	7,175	8,269	15.2%	4,191	3,844	-8.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	9,052	9,277	2.5%	11,937	9,629	-19.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	1,877	1,008	-46.3%	7,746	5,785	-25.3%
MOORE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	16	16	0.0%	15	15	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	16	16	0.0%	15	15	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
MOORE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,264	5,470	28.3%	1,657	1,304	-21.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,029	5,022	-0.1%	8,470	8,199	-3.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	873	306	-64.9%	6,814	6,896	1.2%
MOORE COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	200	0	-100.0%	0	0	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	200	0	-100.0%	0	0	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OCHILTREE COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	263	341	29.7%	352	457	29.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	239	310	29.7%	320	415	29.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OCHILTREE COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	57,243	84,460	47.5%	32,942	84,460	156.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	57,243	84,460	47.5%	32,942	84,460	156.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
OCHILTREE COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	4,216	2,801	-33.6%	4,058	3,647	-10.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	4,216	2,801	-33.6%	4,058	3,647	-10.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OCHILTREE COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	36	100.0%	0	41	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	36	100.0%	0	41	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OCHILTREE COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	824	824	0.0%	3	3	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	824	824	0.0%	3	3	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OCHILTREE COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,358	3,497	48.3%	1,145	2,935	156.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,836	2,699	-4.8%	3,948	3,759	-4.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	478	0	-100.0%	2,803	824	-70.6%
OLDHAM COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	674	674	0.0%	674	674	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	375	352	-6.1%	387	383	-1.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OLDHAM COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,937	4,721	19.9%	2,350	4,721	100.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,937	4,721	19.9%	2,350	4,721	100.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OLDHAM COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,740	1,655	-4.9%	1,740	1,655	-4.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,229	1,110	-9.7%	1,243	1,366	9.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OLDHAM COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	475	475	0.0%	808	808	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	475	475	0.0%	808	808	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
OLDHAM COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	290	295	1.7%	290	295	1.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	272	292	7.4%	279	282	1.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
POTTER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,400	3,229	34.5%	2,200	4,487	104.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,083	2,329	-24.5%	4,748	3,587	-24.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	683	0	-100.0%	2,548	0	-100.0%
POTTER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,608	4,037	11.9%	2,587	4,037	56.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,427	3,176	-7.3%	2,061	3,176	54.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
POTTER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	675	605	-10.4%	675	625	-7.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	481	510	6.0%	491	625	27.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
POTTER COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	7,614	8,209	7.8%	3,989	5,531	38.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	9,713	7,896	-18.7%	13,622	8,740	-35.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2,099	0	-100.0%	9,633	3,209	-66.7%
POTTER COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	941	941	0.0%	1,831	1,831	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	941	941	0.0%	1,831	1,831	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
POTTER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	23,854	28,392	19.0%	13,511	20,979	55.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	26,342	27,293	3.6%	40,568	42,033	3.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	2,488	0	-100.0%	27,057	21,054	-22.2%
POTTER COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	25,387	18,554	-26.9%	37,669	18,554	-50.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	25,387	18,554	-26.9%	37,669	18,554	-50.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
RANDALL COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,028	3,802	25.6%	3,013	5,491	82.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,665	3,088	-15.7%	5,651	4,790	-15.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	637	0	-100.0%	2,638	0	-100.0%
RANDALL COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	18,762	18,583	-1.0%	11,713	19,208	64.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	18,000	17,720	-1.6%	10,650	17,720	66.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
RANDALL COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,654	2,663	0.3%	2,719	2,862	5.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,654	2,663	0.3%	2,719	2,862	5.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
RANDALL COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	548	626	14.2%	233	337	44.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	589	621	5.4%	852	716	-16.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	41	0	-100.0%	619	379	-38.8%
RANDALL COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	22,155	27,867	25.8%	12,419	20,172	62.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	25,352	26,241	3.5%	39,140	40,454	3.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	3,201	0	-100.0%	26,722	20,387	-23.7%
ROBERTS COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	65	51	-21.5%	65	51	-21.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	49	48	-2.0%	49	48	-2.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ROBERTS COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	5,958	8,543	43.4%	3,437	8,543	148.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	5,958	8,543	43.4%	3,437	8,543	148.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ROBERTS COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	487	389	-20.1%	487	493	1.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	369	383	3.8%	373	490	31.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ROBERTS COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,502	1,502	0.0%	2	2	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,502	1,502	0.0%	2	2	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
ROBERTS COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	541	298	-44.9%	326	298	-8.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	224	225	0.4%	222	223	0.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SHERMAN COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	184	105	-42.9%	212	121	-42.9%
PROJECTED DEMAND TOTAL (acre-feet per year)	184	105	-42.9%	212	121	-42.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SHERMAN COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	220,998	304,519	37.8%	127,157	144,113	13.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	220,966	304,360	37.7%	127,125	182,536	43.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	38,423	100.0%
SHERMAN COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,449	3,576	3.7%	4,497	4,669	3.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,449	3,576	3.7%	4,497	4,669	3.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SHERMAN COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	2	100.0%	0	2	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	2	100.0%	0	2	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SHERMAN COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	35	35	0.0%	20	20	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	35	35	0.0%	20	20	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
SHERMAN COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,251	951	-24.0%	733	793	8.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	470	618	31.5%	546	722	32.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHEELER COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	385	385	0.0%	385	385	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	290	296	2.1%	325	332	2.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

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WHEELER COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	9,098	16,514	81.5%	5,858	16,522	182.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	8,203	16,224	97.8%	4,955	16,224	227.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHEELER COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,695	1,695	0.0%	1,695	1,695	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,577	1,186	-24.8%	1,689	1,479	-12.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHEELER COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	3,268	3,268	0.0%	119	119	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	3,268	3,268	0.0%	119	119	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHEELER COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,280	1,546	20.8%	849	1,263	48.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	857	843	-1.6%	990	971	-1.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	184	0	-100.0%	453	153	-66.2%
REGION A						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,572,614	2,000,083	27.2%	920,959	1,227,242	33.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,733,659	2,130,529	22.9%	1,166,209	1,598,115	37.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	170,795	148,459	-13.1%	252,616	378,422	49.8%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP 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 county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region A Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
ARMSTRONG COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	46,319	66,867	44.4%	29,682	49,375	66.3%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	122	122	0.0%	122	122	0.0%
CARSON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	171,425	192,203	12.1%	97,616	137,413	40.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	57	58	1.8%	58	58	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	411	411	0.0%	411	411	0.0%
CHILDRESS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	16,171	26,769	65.5%	16,151	27,040	67.4%
REUSE AVAILABILITY TOTAL (acre-feet per year)	162	162	0.0%	181	181	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	68	68	0.0%	68	68	0.0%
COLLINGSWORTH COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	201,695	43,764	-78.3%	194,942	25,182	-87.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	53	52	-1.9%	60	60	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	880	880	0.0%	880	880	0.0%
DALLAM COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	356,508	401,663	12.7%	180,381	127,048	-29.6%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	2,488	2,488	0.0%	2,488	2,488	0.0%
DONLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	75,019	75,287	0.4%	49,301	62,537	26.8%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	449	449	0.0%	449	449	0.0%
GRAY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	160,673	181,105	12.7%	97,177	134,431	38.3%
REUSE AVAILABILITY TOTAL (acre-feet per year)	220	220	0.0%	220	220	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	855	855	0.0%	855	855	0.0%
HALL COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	24,615	22,388	-9.0%	23,855	31,521	32.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	100	100	0.0%	100	100	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	143	143	0.0%	143	143	0.0%
HANSFORD COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	262,271	275,016	4.9%	159,627	269,589	68.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	2,639	2,639	0.0%	2,639	2,639	0.0%
HARTLEY COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	393,115	472,362	20.2%	189,641	163,260	-13.9%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	3,193	3,193	0.0%	3,193	3,193	0.0%
HEMPHILL COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	41,759	52,196	25.0%	43,331	52,336	20.8%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	421	421	0.0%	421	421	0.0%
HUTCHINSON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	136,433	94,985	-30.4%	81,323	90,858	11.7%
REUSE AVAILABILITY TOTAL (acre-feet per year)	1,045	1,100	5.3%	1,045	1,100	5.3%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	379	379	0.0%	379	379	0.0%
LIPSCOMB COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	283,794	266,809	-6.0%	201,900	266,559	32.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	176	176	0.0%	176	176	0.0%
MOORE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	204,749	229,004	11.8%	91,436	82,961	-9.3%

* Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region A Source Data Comparison to 2016 Regional Water Plan (RWP)

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,007	1,007	0.0%	1,007	1,007	0.0%
OCHILTREE COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	246,475	243,778	-1.1%	147,265	244,082	65.7%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	421	421	0.0%	421	421	0.0%
OLDHAM COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	25,454	173,600	582.0%	19,284	121,003	527.5%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	835	835	0.0%	835	835	0.0%
POTTER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	28,552	56,018	96.2%	16,702	44,065	163.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	27,587	26,192	-5.1%	39,869	37,208	-6.7%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	562	562	0.0%	562	562	0.0%
RANDALL COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	87,733	75,082	-14.4%	51,606	57,099	10.6%
REUSE AVAILABILITY TOTAL (acre-feet per year)	545	545	0.0%	846	846	0.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,529	1,529	0.0%	1,529	1,529	0.0%
RESERVOIR* COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	7,767	31,698	308.1%	7,148	30,465	326.2%
ROBERTS COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	390,901	430,618	10.2%	249,609	350,459	40.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	211	211	0.0%	211	211	0.0%
SHERMAN COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	301,499	398,183	32.1%	145,513	148,647	2.2%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,084	1,084	0.0%	1,084	1,084	0.0%
WHEELER COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	218,829	132,451	-39.5%	183,144	126,804	-30.8%
REUSE AVAILABILITY TOTAL (acre-feet per year)	51	49	-3.9%	59	57	-3.4%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	1,448	1,448	0.0%	1,448	1,448	0.0%
REGION A						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	3,673,989	3,910,148	6.4%	2,269,486	2,612,269	15.1%
REUSE AVAILABILITY TOTAL (acre-feet per year)	29,820	28,478	-4.5%	42,438	39,830	-6.1%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	27,088	51,019	88.3%	26,469	49,786	88.1%

* Since reservoir sources can exist across multiple counties, the county field value, ‘reservoir’ is applied to all reservoir sources.

Region A Water User Group (WUG) Unmet Needs

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.

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
COLLINGSWORTH COUNTY - RED BASIN						
IRRIGATION	4,817	6,727	1,888	497	882	0
DALLAM COUNTY - CANADIAN BASIN						
IRRIGATION	5,257	73,088	27,937	3,966	0	0
HALL COUNTY - RED BASIN						
IRRIGATION	13,739	11,300	5,080	962	0	0
HARTLEY COUNTY - CANADIAN BASIN						
IRRIGATION	57,606	144,713	88,458	60,079	47,166	42,031
MOORE COUNTY - CANADIAN BASIN						
IRRIGATION	0	23,884	0	0	0	0

*A single asterisk next to a WUG's name denotes that the WUG is split by two or more planning regions.

Region A Water User Group (WUG) Unmet Needs Summary

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.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	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	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	81,419	259,712	123,363	65,504	48,048	42,031

Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
AMARILLO	A	ADVANCED METERING INFRASTRUCTURE - AMARILLO	DEMAND REDUCTION	$1062	$0	1,485	1,655	1,831	2,008	2,198	2,398
AMARILLO	A	DEVELOP POTTER/CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	N/A	$111	0	10,000	10,000	20,000	20,000	20,000
AMARILLO	A	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$1425	0	0	0	0	0	11,210
AMARILLO	A	DIRECT POTABLE REUSE - AMARILLO	A | DIRECT POTABLE REUSE	N/A	$1228	0	2,000	2,000	2,000	2,000	2,000
AMARILLO	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	4,921	5,472	6,874	6,592	5,083
AMARILLO	A	MUNICIPAL CONSERVATION - AMARILLO	DEMAND REDUCTION	$425	$417	976	1,087	1,202	1,319	1,444	1,575
AMARILLO	A	PWPA ASR	A | OGALLALA AQUIFER ASR | RANDALL COUNTY	N/A	$419	0	5,000	6,500	6,500	6,500	6,500
AMARILLO	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	817	2,153	4,714	5,986
AMARILLO	A	WATER AUDIT AND LEAK REPAIR - AMARILLO	DEMAND REDUCTION	$1570	$1488	2,077	2,268	2,472	2,692	2,943	3,209
BOOKER	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	N/A	$953	0	0	360	305	269	261
BOOKER	A	MUNICIPAL CONSERVATION - BOOKER	DEMAND REDUCTION	$1358	$1218	5	6	6	7	7	8
BORGER	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	1,636	1,678	1,999	1,906	1,728
BORGER	A	MUNICIPAL CONSERVATION - BORGER	DEMAND REDUCTION	$422	$404	41	43	43	43	43	43
BORGER	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	116	304	666	846
CACTUS MUNICIPAL WATER SYSTEM	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	$363	$129	3,992	3,227	2,779	2,390	2,159	2,143
CACTUS MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - CACTUS	DEMAND REDUCTION	$1089	$766	13	15	17	19	21	23
CANADIAN	A	MUNICIPAL CONSERVATION - CANADIAN	DEMAND REDUCTION	$1154	$1067	10	11	12	13	14	15
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A | DOCKUM AQUIFER | RANDALL COUNTY	N/A	$354	0	750	750	750	1,500	1,500
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A | OGALLALA AQUIFER | RANDALL COUNTY	N/A	$354	0	750	750	750	1,500	1,500
CANYON	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	N/A	0	105	234	365	0	0
CANYON	A	MUNICIPAL CONSERVATION - CANYON	DEMAND REDUCTION	$385	$592	45	51	56	89	98	107
CANYON	A	WATER AUDIT AND LEAK REPAIR - CANYON	DEMAND REDUCTION	$878	$886	174	191	208	227	249	271
CHILDRESS	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$114	0	0	0	0	163	344

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Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
CHILDRESS	A	MUNICIPAL CONSERVATION - CHILDRESS	DEMAND REDUCTION	$905	$779	19	20	21	21	22	22
CLARENDON	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$114	0	0	0	0	32	66
CLARENDON	A	MUNICIPAL CONSERVATION - CLARENDON	DEMAND REDUCTION	$1293	$1293	6	6	6	6	6	6
CLAUDE MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - CLAUDE	DEMAND REDUCTION	$1570	$1570	4	4	4	4	4	4
COUNTY-OTHER, DONLEY	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$114	0	0	0	0	5	11
COUNTY-OTHER, MOORE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A | OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	N/A	$56	0	12	23	33	41	41
COUNTY-OTHER, MOORE	A	MUNICIPAL CONSERVATION - MOORE COUNTY OTHER	DEMAND REDUCTION	$1272	$1110	7	8	9	10	11	12
COUNTY-OTHER, RANDALL	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	3	6	9	11	13
DALHART	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	A | OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	$507	$113	3,140	3,140	3,140	3,140	3,140	3,140
DALHART	A	MUNICIPAL CONSERVATION - DALHART	DEMAND REDUCTION	$648	$443	27	30	32	35	37	40
DARROUZETT	A	MUNICIPAL CONSERVATION - DARROUZETT	DEMAND REDUCTION	$2799	$2430	1	1	1	2	2	2
DUMAS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A | OGALLALA AND RITA BLANCA AQUIFERS | HARTLEY COUNTY	N/A	$56	0	4,988	4,977	4,967	4,959	4,959
DUMAS	A	MUNICIPAL CONSERVATION - DUMAS	DEMAND REDUCTION	$333	$554	53	60	98	110	122	134
DUMAS	A	WATER AUDIT AND LEAK REPAIR - DUMAS	DEMAND REDUCTION	$1536	$1566	115	128	142	158	175	192
FOLLETT	A	MUNICIPAL CONSERVATION - FOLLETT	DEMAND REDUCTION	$2813	$2442	1	1	1	2	2	2
FRITCH	A	MUNICIPAL CONSERVATION - FRITCH	DEMAND REDUCTION	$1169	$1157	9	9	10	10	10	10
GROOM MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - GROOM	DEMAND REDUCTION	$2330	$2330	2	2	2	2	2	2
GRUVER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	A | OGALLALA AQUIFER | HANSFORD COUNTY	N/A	$61	0	280	280	280	280	280
GRUVER	A	MUNICIPAL CONSERVATION - GRUVER	DEMAND REDUCTION	$1447	$1280	5	5	5	6	6	7
HARTLEY WSC	A	MUNICIPAL CONSERVATION - HARTLEY	DEMAND REDUCTION	$2146	$1958	2	2	2	2	2	2
HIGGINS MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - HIGGINS	DEMAND REDUCTION	$2777	$2413	1	1	1	2	2	2
HIGGINS MUNICIPAL WATER SYSTEM	A	WATER AUDIT AND LEAK REPAIR - HIGGINS	DEMAND REDUCTION	$1113	$1027	8	9	9	10	10	10
IRRIGATION, ARMSTRONG	A	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	DEMAND REDUCTION	$66	$66	290	542	1,014	1,200	1,314	1,415

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Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
IRRIGATION, CARSON	A	IRRIGATION CONSERVATION - CARSON COUNTY	DEMAND REDUCTION	$66	$66	7,290	12,416	24,597	28,628	30,535	32,317
IRRIGATION, CHILDRESS	A	IRRIGATION CONSERVATION - CHILDRESS COUNTY	DEMAND REDUCTION	$66	$66	655	1,095	2,194	2,547	2,704	2,854
IRRIGATION, COLLINGSWORTH	A	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	DEMAND REDUCTION	$66	$66	2,610	3,966	7,955	9,658	9,419	9,757
IRRIGATION, DALLAM	A	IRRIGATION CONSERVATION - DALLAM COUNTY	DEMAND REDUCTION	$66	$66	24,329	43,270	80,019	87,678	80,502	83,654
IRRIGATION, DONLEY	A	IRRIGATION CONSERVATION - DONLEY COUNTY	DEMAND REDUCTION	$66	$66	1,115	1,888	3,636	4,301	4,681	5,054
IRRIGATION, GRAY	A	IRRIGATION CONSERVATION - GRAY COUNTY	DEMAND REDUCTION	$66	$66	2,222	3,766	7,320	8,612	9,308	9,981
IRRIGATION, HALL	A	IRRIGATION CONSERVATION - HALL COUNTY	DEMAND REDUCTION	$66	$66	1,898	3,025	6,317	7,232	7,518	7,796
IRRIGATION, HANSFORD	A	IRRIGATION CONSERVATION - HANSFORD COUNTY	DEMAND REDUCTION	$66	$66	14,572	25,101	49,532	57,670	61,580	65,189
IRRIGATION, HARTLEY	A	IRRIGATION CONSERVATION - HARTLEY COUNTY	DEMAND REDUCTION	$66	$66	27,160	48,052	89,129	99,463	94,245	99,380
IRRIGATION, HEMPHILL	A	IRRIGATION CONSERVATION - HEMPHILL COUNTY	DEMAND REDUCTION	$66	$66	97	194	294	387	478	569
IRRIGATION, HUTCHINSON	A	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	DEMAND REDUCTION	$66	$66	4,432	7,624	15,285	17,656	18,663	19,562
IRRIGATION, LIPSCOMB	A	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	DEMAND REDUCTION	$66	$66	2,167	3,768	7,135	8,478	9,291	10,074
IRRIGATION, MOORE	A	IRRIGATION CONSERVATION - MOORE COUNTY	DEMAND REDUCTION	$66	$66	16,630	29,092	57,177	64,138	59,240	60,841
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OCHILTREE COUNTY	DEMAND REDUCTION	$66	$66	7,080	12,160	23,955	27,927	29,865	31,668
IRRIGATION, OLDHAM	A	IRRIGATION CONSERVATION - OLDHAM COUNTY	DEMAND REDUCTION	$66	$66	255	495	916	1,085	1,191	1,284
IRRIGATION, POTTER	A	IRRIGATION CONSERVATION - POTTER COUNTY	DEMAND REDUCTION	$66	$66	120	272	505	585	631	661
IRRIGATION, RANDALL	A	IRRIGATION CONSERVATION - RANDALL COUNTY	DEMAND REDUCTION	$66	$66	1,003	2,027	3,820	4,454	4,810	5,089
IRRIGATION, ROBERTS	A	IRRIGATION CONSERVATION - ROBERTS COUNTY	DEMAND REDUCTION	$66	$66	683	1,158	2,283	2,666	2,855	3,034
IRRIGATION, SHERMAN	A	IRRIGATION CONSERVATION - SHERMAN COUNTY	DEMAND REDUCTION	$66	$66	25,895	45,383	88,429	103,368	104,313	111,300
IRRIGATION, WHEELER	A	IRRIGATION CONSERVATION - WHEELER COUNTY	DEMAND REDUCTION	$66	$66	895	1,505	3,008	3,493	3,712	3,918

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Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
LAKE TANGLEWOOD	A	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	DEMAND REDUCTION	$1618	$1618	3	3	3	3	3	3
MANUFACTURING, HUTCHINSON	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	32	58	79	167	172
MANUFACTURING, LIPSCOMB	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	N/A	$953	0	0	40	95	131	139
MANUFACTURING, MOORE	A	DEVELOP DOCKUM/OGALLALA SUPPLIES - MOORE COUNTY MANUFACTURING	A | DOCKUM AQUIFER | MOORE COUNTY	N/A	$60	0	0	0	2,000	2,000	2,000
MANUFACTURING, MOORE	A	DEVELOP DOCKUM/OGALLALA SUPPLIES - MOORE COUNTY MANUFACTURING	A | OGALLALA AQUIFER | MOORE COUNTY	N/A	$60	0	0	0	1,000	1,000	1,000
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	$363	$129	1,008	1,773	2,221	2,610	2,841	2,857
MANUFACTURING, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY MANUFACTURING	A | OGALLALA AQUIFER | POTTER COUNTY	N/A	$100	0	0	150	150	150	150
MANUFACTURING, POTTER	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	643	1,430	2,235	2,805	3,064
MANUFACTURING, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	A | OGALLALA AQUIFER | RANDALL COUNTY	N/A	$130	0	100	100	100	100	100
MANUFACTURING, RANDALL	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	61	135	210	264	289
MCLEAN MUNICIPAL WATER SUPPLY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	A | OGALLALA AQUIFER | GRAY COUNTY	N/A	$20	0	150	150	150	150	150
MCLEAN MUNICIPAL WATER SUPPLY	A	MUNICIPAL CONSERVATION - MCLEAN	DEMAND REDUCTION	$1835	$1459	3	3	3	4	4	4
MEMPHIS	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$114	0	0	0	1	3	7
MEMPHIS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$580	0	150	150	150	150	150
MEMPHIS	A	MUNICIPAL CONSERVATION - MEMPHIS	DEMAND REDUCTION	$1245	$1235	7	7	7	7	7	7
MIAMI	A	MUNICIPAL CONSERVATION - MIAMI	DEMAND REDUCTION	$2216	$2193	2	2	2	2	2	2
PAMPA MUNICIPAL WATER SYSTEM	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	A | OGALLALA AQUIFER | GRAY COUNTY	N/A	$92	0	0	1,100	1,100	1,100	1,100
PAMPA MUNICIPAL WATER SYSTEM	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$299	0	468	285	672	858	759
PAMPA MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - PAMPA	DEMAND REDUCTION	$294	$664	59	95	106	121	132	144
PAMPA MUNICIPAL WATER SYSTEM	A	PWPA ASR	A | OGALLALA AQUIFER ASR | GRAY COUNTY	N/A	$32	0	0	500	500	500	500
PAMPA MUNICIPAL WATER SYSTEM	A	REPLACE WELL CAPACITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	N/A	$123	0	0	52	172	436	560
PANHANDLE MUNICIPAL WATER SYSTEM	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	A | OGALLALA AQUIFER | CARSON COUNTY	N/A	$177	0	600	600	600	600	600

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Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
PANHANDLE MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - PANHANDLE	DEMAND REDUCTION	$1221	$1203	8	8	8	8	8	8
PERRYTON MUNICIPAL WATER SYSTEM	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	A | OGALLALA AQUIFER | OCHILTREE COUNTY	N/A	$174	0	0	0	820	820	820
PERRYTON MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - PERRYTON	DEMAND REDUCTION	$616	$430	28	31	33	35	38	41
RED RIVER AUTHORITY OF TEXAS*	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	N/A	$743	0	0	0	0	38	76
RED RIVER AUTHORITY OF TEXAS*	B	MUNICIPAL CONSERVATION - RED RIVER AUTHORITY	DEMAND REDUCTION	$1184	$124	9	9	10	11	11	12
SHAMROCK MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - SHAMROCK	DEMAND REDUCTION	$1309	$1239	6	6	7	7	7	7
SPEARMAN MUNICIPAL WATER SYSTEM	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	A | OGALLALA AQUIFER | HANSFORD COUNTY	N/A	$115	0	0	0	520	520	520
SPEARMAN MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - SPEARMAN	DEMAND REDUCTION	$1129	$1094	11	11	12	12	12	13
STINNETT	A	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	N/A	$120	0	0	0	50	50	50
STINNETT	A	MUNICIPAL CONSERVATION - STINNETT	DEMAND REDUCTION	$1306	$1288	6	6	6	6	6	6
STRATFORD	A	MUNICIPAL CONSERVATION - STRATFORD	DEMAND REDUCTION	$1248	$1184	7	8	8	8	9	9
SUNRAY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	A | OGALLALA AQUIFER | MOORE COUNTY	N/A	$128	0	500	500	500	500	500
SUNRAY	A	MUNICIPAL CONSERVATION - SUNRAY	DEMAND REDUCTION	$1307	$1251	6	6	6	7	7	7
TCW SUPPLY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	N/A	$173	0	400	400	400	400	400
TCW SUPPLY	A	MUNICIPAL CONSERVATION - TCW SUPPLY	DEMAND REDUCTION	$1298	$1281	6	6	6	6	6	6
TEXHOMA	A	MUNICIPAL CONSERVATION - TEXHOMA	DEMAND REDUCTION	$3244	$2817	1	1	1	1	1	1
TEXLINE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	A | OGALLALA AND RITA BLANCA AQUIFERS | DALLAM COUNTY	N/A	$40	0	0	0	100	100	100
TEXLINE	A	MUNICIPAL CONSERVATION - TEXLINE	DEMAND REDUCTION	$2335	$1913	2	2	2	2	2	2
TURKEY MUNICIPAL WATER SYSTEM	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TURKEY	O | OGALLALA AND EDWARDS-TRINITY-HIGH PLAINS AQUIFERS | BRISCOE COUNTY	N/A	$160	0	100	100	100	100	100
TURKEY MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - TURKEY	DEMAND REDUCTION	$2893	$2845	1	1	1	1	1	1
TURKEY MUNICIPAL WATER SYSTEM	A	WATER AUDIT AND LEAK REPAIR - TURKEY	DEMAND REDUCTION	$2365	$2411	4	4	4	4	4	4

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Region A Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
VEGA	A	MUNICIPAL CONSERVATION - VEGA	DEMAND REDUCTION	$1682	$1682	3	3	3	3	3	3
WELLINGTON MUNICIPAL WATER SYSTEM	A	ADVANCED TREATMENT - WELLINGTON	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	$2116	$1079	560	560	560	560	560	560
WELLINGTON MUNICIPAL WATER SYSTEM	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	N/A	$150	0	100	100	100	100	100
WELLINGTON MUNICIPAL WATER SYSTEM	A	MUNICIPAL CONSERVATION - WELLINGTON	DEMAND REDUCTION	$1248	$1192	7	7	8	8	8	8
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A | OGALLALA AQUIFER | WHEELER COUNTY	N/A	$244	0	0	0	160	160	160
WHEELER	A	MUNICIPAL CONSERVATION - WHEELER	DEMAND REDUCTION	$1406	$1319	5	5	5	5	6	6
WHITE DEER	A	MUNICIPAL CONSERVATION - WHITE DEER	DEMAND REDUCTION	$1574	$1538	4	4	4	4	4	4

	2020	2030	2040	2050	2060	2070
REGION A RECOMMENDED WMS SUPPLY TOTAL	155,372	295,089	529,468	616,241	617,606	658,385

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Region A Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
AMARILLO	YES	2020	ADVANCED METERING INFRASTRUCTURE - AMARILLO	DATA GATHERING/MONITORING TECHNOLOGY	$31,000,000
AMARILLO	YES	2070	AMARILLO WELLFIELD TO CRMWAII TRANSMISSION PIPELINE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE	$92,956,000
AMARILLO	YES	2030	AQUIFER STORAGE AND RECOVERY - AMARILLO	MULTIPLE WELLS/WELL FIELD; INJECTION WELL	$11,472,000
AMARILLO	YES	2030	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE I (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$29,600,000
AMARILLO	YES	2050	DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE II (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$29,600,000
AMARILLO	YES	2070	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	MULTIPLE WELLS/WELL FIELD	$20,126,000
AMARILLO	YES	2040	DIRECT POTABLE REUSE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; WATER TREATMENT PLANT EXPANSION	$51,270,000
AMARILLO	YES	2020	WATER AUDIT AND LEAK REPAIR - AMARILLO	WATER LOSS CONTROL	$170,849,900
BOOKER	YES	2040	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	MULTIPLE WELLS/WELL FIELD	$1,796,000
CACTUS MUNICIPAL WATER SYSTEM	YES	2020	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$16,598,000
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	YES	2030	AQUIFER STORAGE AND RECOVERY - CRMWA	MULTIPLE WELLS/WELL FIELD; INJECTION WELL	$27,815,000
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	YES	2030	CRMWA II CRMWA PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE	$100,489,000
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	YES	2030	CRMWA II SHARED PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE	$301,355,000
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	YES	2030	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	MULTIPLE WELLS/WELL FIELD	$66,679,000
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	YES	2040	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	MULTIPLE WELLS/WELL FIELD	$30,900,000
CANYON	YES	2030	DEVELOP DOCKUM AQUIFER SUPPLIES - CANYON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; STORAGE TANK	$4,472,000
CANYON	YES	2060	DEVELOP OGALLALA AQUIFER SUPPLIES - CANYON	MULTIPLE WELLS/WELL FIELD; STORAGE TANK; CONVEYANCE/TRANSMISSION PIPELINE	$5,093,000
CANYON	YES	2020	WATER AUDIT AND LEAK REPAIR - CANYON	WATER LOSS CONTROL	$11,725,000
DALHART	YES	2020	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	MULTIPLE WELLS/WELL FIELD	$7,279,000
DUMAS	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	MULTIPLE WELLS/WELL FIELD	$5,560,000
DUMAS	YES	2020	WATER AUDIT AND LEAK REPAIR - DUMAS	WATER LOSS CONTROL	$14,179,600
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	YES	2030	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$17,879,000
GRUVER	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	MULTIPLE WELLS/WELL FIELD	$891,000
HIGGINS MUNICIPAL WATER SYSTEM	YES	2020	WATER AUDIT AND LEAK REPAIR - HIGGINS	WATER LOSS CONTROL	$594,500
IRRIGATION, ARMSTRONG	YES	2020	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	CONSERVATION - AGRICULTURAL	$206,924
IRRIGATION, CARSON	YES	2020	IRRIGATION CONSERVATION - CARSON COUNTY	CONSERVATION - AGRICULTURAL	$2,501,489
IRRIGATION, CHILDRESS	YES	2020	IRRIGATION CONSERVATION - CHILDRESS COUNTY	CONSERVATION - AGRICULTURAL	$453,203
IRRIGATION, COLLINGSWORTH	YES	2020	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	CONSERVATION - AGRICULTURAL	$1,271,751
IRRIGATION, DALLAM	YES	2020	IRRIGATION CONSERVATION - DALLAM COUNTY	CONSERVATION - AGRICULTURAL	$8,083,969
IRRIGATION, DONLEY	YES	2020	IRRIGATION CONSERVATION - DONLEY COUNTY	CONSERVATION - AGRICULTURAL	$870,018
IRRIGATION, GRAY	YES	2020	IRRIGATION CONSERVATION - GRAY COUNTY	CONSERVATION - AGRICULTURAL	$987,478
IRRIGATION, HALL	YES	2020	IRRIGATION CONSERVATION - HALL COUNTY	CONSERVATION - AGRICULTURAL	$816,256
IRRIGATION, HANSFORD	YES	2020	IRRIGATION CONSERVATION - HANSFORD COUNTY	CONSERVATION - AGRICULTURAL	$4,742,867
IRRIGATION, HARTLEY	YES	2020	IRRIGATION CONSERVATION - HARTLEY COUNTY	CONSERVATION - AGRICULTURAL	$9,018,439

Region A Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
IRRIGATION, HEMPHILL	YES	2020	IRRIGATION CONSERVATION - HEMPHILL COUNTY	CONSERVATION - AGRICULTURAL	$335,683
IRRIGATION, HUTCHINSON	YES	2020	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	CONSERVATION - AGRICULTURAL	$1,152,269
IRRIGATION, LIPSCOMB	YES	2020	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	CONSERVATION - AGRICULTURAL	$1,121,165
IRRIGATION, MOORE	YES	2020	IRRIGATION CONSERVATION - MOORE COUNTY	CONSERVATION - AGRICULTURAL	$4,675,364
IRRIGATION, OCHILTREE	YES	2020	IRRIGATION CONSERVATION - OCHILTREE COUNTY	CONSERVATION - AGRICULTURAL	$2,341,044
IRRIGATION, OLDHAM	YES	2020	IRRIGATION CONSERVATION - OLDHAM COUNTY	CONSERVATION - AGRICULTURAL	$141,967
IRRIGATION, POTTER	YES	2020	IRRIGATION CONSERVATION - POTTER COUNTY	CONSERVATION - AGRICULTURAL	$44,158
IRRIGATION, RANDALL	YES	2020	IRRIGATION CONSERVATION - RANDALL COUNTY	CONSERVATION - AGRICULTURAL	$500,354
IRRIGATION, ROBERTS	YES	2020	IRRIGATION CONSERVATION - ROBERTS COUNTY	CONSERVATION - AGRICULTURAL	$222,399
IRRIGATION, SHERMAN	YES	2020	IRRIGATION CONSERVATION - SHERMAN COUNTY	CONSERVATION - AGRICULTURAL	$7,394,465
IRRIGATION, WHEELER	YES	2020	IRRIGATION CONSERVATION - WHEELER COUNTY	CONSERVATION - AGRICULTURAL	$420,824
MANUFACTURING, MOORE	YES	2050	DEVELOP DOCKUM AQUIFER SUPPLIES - MOORE COUNTY MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$2,608,000
MANUFACTURING, MOORE	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - MOORE COUNTY MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$1,012,000
MANUFACTURING, POTTER	YES	2040	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$324,000
MANUFACTURING, RANDALL	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$386,000
MCLEAN MUNICIPAL WATER SUPPLY	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	SINGLE WELL	$414,000
MEMPHIS	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	MULTIPLE WELLS/WELL FIELD	$1,128,000
PAMPA MUNICIPAL WATER SYSTEM	YES	2030	AQUIFER STORAGE AND RECOVERY - PAMPA	MULTIPLE WELLS/WELL FIELD; INJECTION WELL	$2,183,000
PAMPA MUNICIPAL WATER SYSTEM	YES	2040	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; STORAGE TANK	$4,091,000
PANHANDLE MUNICIPAL WATER SYSTEM	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	MULTIPLE WELLS/WELL FIELD	$1,814,000
PERRYTON MUNICIPAL WATER SYSTEM	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$9,097,000
SPEARMAN MUNICIPAL WATER SYSTEM	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,604,000
STINNETT	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	SINGLE WELL	$848,000
SUNRAY	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	MULTIPLE WELLS/WELL FIELD; STORAGE TANK	$4,465,000
TCW SUPPLY	YES	2030	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; STORAGE TANK	$3,945,000
TEXLINE	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	SINGLE WELL	$495,000
TURKEY MUNICIPAL WATER SYSTEM	YES	2030	NEW GROUNDWATER SOURCE - TURKEY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$1,597,000
TURKEY MUNICIPAL WATER SYSTEM	YES	2020	WATER AUDIT AND LEAK REPAIR - TURKEY	WATER LOSS CONTROL	$549,800
WELLINGTON MUNICIPAL WATER SYSTEM	YES	2020	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	NEW WATER TREATMENT PLANT; STORAGE TANK	$8,262,000
WELLINGTON MUNICIPAL WATER SYSTEM	YES	2030	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$1,563,000
WHEELER	YES	2050	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,776,000

REGION A RECOMMENDED CAPITAL COST TOTAL	**$1,147,642,886**

Region A Alternative Water User Group (WUG) Water Management Strategies (WMS)

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, HALL	A	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	A | SEYMOUR AQUIFER | HALL COUNTY	N/A	$2560	0	50	50	50	50	50
COUNTY-OTHER, HALL	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - HALL COUNTY OTHER (BRICE-LESLEY)	A | SEYMOUR AQUIFER | HALL COUNTY	N/A	$60	0	50	50	50	50	50
COUNTY-OTHER, HALL	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - HALL COUNTY OTHER (ESTELLINE)	A | SEYMOUR AQUIFER | HALL COUNTY	N/A	$20	0	50	50	50	50	50
REGION A ALTERNATIVE WMS SUPPLY TOTAL						0	150	150	150	150	150

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Region A Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
COUNTY-OTHER, HALL	YES	2020	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	NEW WATER TREATMENT PLANT	$2,592,000
COUNTY-OTHER, HALL	YES	2030	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	SINGLE WELL	$398,000
COUNTY-OTHER, HALL	YES	2030	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	SINGLE WELL	$209,000
PALO DURO RIVER AUTHORITY	YES	2030	CONNECTING TO PALO DURO RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION	$254,938,000

REGION A ALTERNATIVE CAPITAL COST TOTAL	**$258,137,000**

Region A Water User Group (WUG) Management Supply Factor

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. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
AMARILLO	1.1	1.4	1.3	1.3	1.2	1.3
BOOKER	1.5	1.1	1.5	1.3	1.1	1.0
BORGER	2.1	2.2	2.0	1.9	1.8	1.8
CACTUS MUNICIPAL WATER SYSTEM	4.8	3.4	2.6	2.0	1.6	1.4
CANADIAN	1.2	1.2	1.2	1.2	1.2	1.2
CANYON	1.2	1.5	1.3	1.2	1.1	1.0
CHILDRESS	1.0	1.0	1.0	1.0	1.0	1.0
CLARENDON	1.0	1.0	1.0	1.0	1.0	1.0
CLAUDE MUNICIPAL WATER SYSTEM	1.6	1.5	1.3	1.2	1.0	1.0
COUNTY-OTHER, ARMSTRONG	1.1	1.2	1.2	1.2	1.2	1.2
COUNTY-OTHER, CARSON	1.6	1.6	1.5	1.5	1.4	1.3
COUNTY-OTHER, CHILDRESS	1.2	1.2	1.2	1.2	1.2	1.0
COUNTY-OTHER, COLLINGSWORTH	1.2	1.2	1.2	1.1	1.1	1.1
COUNTY-OTHER, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, DONLEY	1.5	1.6	1.7	1.9	2.1	2.4
COUNTY-OTHER, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HALL	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HANSFORD	1.5	1.4	1.3	1.2	1.1	1.1
COUNTY-OTHER, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HUTCHINSON	1.2	1.2	1.2	1.2	1.2	1.2
COUNTY-OTHER, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, MOORE	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, OCHILTREE	1.1	1.1	1.1	1.1	1.1	1.1
COUNTY-OTHER, OLDHAM	1.9	1.7	1.8	1.8	1.8	1.8
COUNTY-OTHER, POTTER	1.4	1.4	1.3	1.3	1.3	1.3
COUNTY-OTHER, RANDALL	1.2	1.2	1.2	1.2	1.2	1.1
COUNTY-OTHER, ROBERTS	1.1	1.0	1.1	1.1	1.1	1.1
COUNTY-OTHER, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, WHEELER	1.3	1.3	1.3	1.2	1.2	1.2
DALHART	2.0	1.7	1.4	1.2	1.1	1.0
DARROUZETT	1.2	1.2	1.1	1.1	1.1	1.1
DUMAS	1.2	2.1	1.7	1.4	1.2	1.1
FOLLETT	1.1	1.1	1.1	1.1	1.1	1.1
FRITCH	1.0	1.0	1.0	1.0	1.0	1.0
GROOM MUNICIPAL WATER SYSTEM	1.1	1.1	1.1	1.1	1.1	1.1
GRUVER	1.2	1.7	1.5	1.2	1.1	1.0
HAPPY*	4.5	4.4	4.3	4.4	4.2	4.0
HARTLEY WSC	1.1	1.1	1.1	1.1	1.1	1.1
HIGGINS MUNICIPAL WATER SYSTEM	1.2	1.2	1.2	1.2	1.2	1.2
IRRIGATION, ARMSTRONG	1.1	1.1	1.2	1.2	1.2	1.2
IRRIGATION, CARSON	1.1	1.1	1.3	1.3	1.4	1.4
IRRIGATION, CHILDRESS	1.1	1.1	1.2	1.2	1.2	1.2
IRRIGATION, COLLINGSWORTH	0.9	0.8	1.0	1.0	1.0	1.0

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region A Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
IRRIGATION, DALLAM	1.0	0.8	0.9	1.0	1.0	1.1
IRRIGATION, DONLEY	1.0	1.1	1.1	1.1	1.2	1.2
IRRIGATION, GRAY	1.1	1.1	1.2	1.3	1.2	1.2
IRRIGATION, HALL	0.6	0.6	0.8	1.0	1.1	1.0
IRRIGATION, HANSFORD	1.1	1.1	1.3	1.3	1.4	1.4
IRRIGATION, HARTLEY	0.9	0.6	0.7	0.8	0.8	0.8
IRRIGATION, HEMPHILL	1.0	1.0	1.1	1.1	1.1	1.1
IRRIGATION, HUTCHINSON	1.1	1.1	1.3	1.3	1.3	1.3
IRRIGATION, LIPSCOMB	1.1	1.1	1.2	1.2	1.2	1.2
IRRIGATION, MOORE	1.0	0.9	1.0	1.1	1.2	1.2
IRRIGATION, OCHILTREE	1.1	1.1	1.3	1.3	1.4	1.4
IRRIGATION, OLDHAM	1.1	1.1	1.2	1.2	1.3	1.3
IRRIGATION, POTTER	1.3	1.4	1.4	1.5	1.5	1.5
IRRIGATION, RANDALL	1.1	1.2	1.3	1.3	1.4	1.4
IRRIGATION, ROBERTS	1.1	1.1	1.3	1.3	1.3	1.4
IRRIGATION, SHERMAN	1.1	1.1	1.2	1.3	1.4	1.4
IRRIGATION, WHEELER	1.1	1.1	1.2	1.2	1.2	1.3
LAKE TANGLEWOOD	1.4	1.4	1.3	1.3	1.3	1.3
LIVESTOCK, ARMSTRONG	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, CARSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, CHILDRESS	1.2	1.1	1.0	1.0	1.0	1.0
LIVESTOCK, COLLINGSWORTH	1.1	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, DONLEY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HALL	1.2	1.1	1.1	1.0	1.0	1.0
LIVESTOCK, HANSFORD	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, MOORE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, OCHILTREE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, OLDHAM	1.5	1.3	1.3	1.3	1.2	1.2
LIVESTOCK, POTTER	1.2	1.1	1.1	1.1	1.0	1.0
LIVESTOCK, RANDALL	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, ROBERTS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, WHEELER	1.4	1.3	1.2	1.2	1.2	1.1
MANUFACTURING, CARSON	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, GRAY	1.1	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HANSFORD	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HEMPHILL	1.2	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, MOORE	1.0	1.0	1.0	1.2	1.0	1.0
MANUFACTURING, OCHILTREE	1.0	1.0	1.0	1.0	1.0	1.0

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region A Water User Group (WUG) Management Supply Factor

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	2020	2030	2040	2050	2060	2070
MANUFACTURING, POTTER	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, RANDALL	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
MCLEAN MUNICIPAL WATER SUPPLY	1.5	2.0	1.7	1.4	1.2	1.1
MEMPHIS	1.0	1.3	1.3	1.2	1.0	1.0
MIAMI	1.3	1.3	1.3	1.3	1.3	1.3
MINING, CARSON	1.0	1.0	1.0	1.0	1.0	1.0
MINING, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HANSFORD	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
MINING, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
MINING, MOORE	1.0	1.0	1.0	1.0	1.0	1.0
MINING, OCHILTREE	1.0	1.0	1.0	1.0	1.0	1.0
MINING, OLDHAM	1.0	1.0	1.0	1.0	1.0	1.0
MINING, POTTER	1.0	1.0	1.0	1.0	1.0	1.0
MINING, ROBERTS	1.0	1.0	1.0	1.0	1.0	1.0
MINING, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
MINING, WHEELER	1.0	1.0	1.0	1.0	1.0	1.0
PAMPA MUNICIPAL WATER SYSTEM	1.1	1.1	1.3	1.2	1.2	1.1
PANHANDLE MUNICIPAL WATER SYSTEM	1.3	1.3	1.0	1.0	1.0	1.0
PERRYTON MUNICIPAL WATER SYSTEM	1.3	1.2	1.0	1.2	1.1	1.0
RED RIVER AUTHORITY OF TEXAS*	1.2	1.3	1.4	1.3	1.3	1.3
SHAMROCK MUNICIPAL WATER SYSTEM	2.4	2.4	2.4	2.3	2.2	2.1
SPEARMAN MUNICIPAL WATER SYSTEM	1.2	1.2	1.0	1.4	1.1	1.0
STEAM ELECTRIC POWER, POTTER	1.0	1.0	1.0	1.0	1.0	1.0
STINNETT	1.3	1.2	1.1	1.1	1.1	1.1
STRATFORD	1.7	1.6	1.5	1.5	1.1	1.1
SUNRAY	1.4	1.9	1.4	1.2	1.1	1.0
TCW SUPPLY	1.0	1.4	1.2	1.1	1.0	1.0
TEXHOMA	1.1	1.1	1.1	1.1	1.1	1.1
TEXLINE	1.3	1.2	1.1	1.4	1.3	1.2
TURKEY MUNICIPAL WATER SYSTEM	1.0	1.9	1.9	1.9	1.9	1.9
VEGA	1.0	1.0	1.0	1.1	1.1	1.1
WELLINGTON MUNICIPAL WATER SYSTEM	1.1	1.2	1.2	1.2	1.1	1.1
WHEELER	1.4	1.3	1.1	1.2	1.1	1.0
WHITE DEER	1.2	1.2	1.2	1.2	1.2	1.2

*A single asterisk next to a WUG's name denotes that the WUG is split by more than one planning region.

Region A Recommended Water Management Strategy (WMS) Supply Associated with a New or Amended Inter-Basin Transfer (IBT) Permit

IBT WMS supply is the portion of the total WMS benefitting WUGs that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085.

			IBT WMS SUPPLY (ACRE-FEET PER YEAR)					
WMS NAME	SOURCE BASIN	RECIPIENT WUG BASIN	2020	2030	2040	2050	2060	2070

Region A Water User Groups (WUGs)
Recommended Water Management Strategy (WMS) Supply Associated with a
New or Amended Inter-Basin Transfer (IBT) Permit and Total Recommended Conservation WMS Supply

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

BENEFITTING WUG NAME | BASIN	WMS SOURCE ORIGIN BASIN | WMS NAME	WMS SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070

Region A Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

WMS NAME	WMS SPONSOR	SOURCE NAME	UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
BRUSH CONTROL - CRMWA	CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A | MEREDITH LAKE/RESERVOIR	2,500	2,500	2,500	2,500	2,500	2,500
CRMWA ASR	CANADIAN RIVER MUNICIPAL WATER AUTHORITY	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	0	11,500	10,200	10,200	10,200	10,200
DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	A | OGALLALA AQUIFER | DONLEY COUNTY	0	2,000	2,000	1,999	1,307	555
EXPAND CAPACITY CRMWA II	CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	31,411	26,438	19,323	14,832	12,568
REPLACE WELL CAPACITY	CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	0	2,437	4,327	8,043	10,133
		TOTAL UNALLOCATED STRATEGY SUPPLIES	**2,500**	**47,411**	**43,575**	**38,349**	**36,882**	**35,956**

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an ‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

Region A Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

WMS TYPE *	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	5,000	7,000	7,000	7,000	7,000
DIRECT POTABLE REUSE	0	2,000	2,000	2,000	2,000	2,000
GROUNDWATER WELLS & OTHER	8,700	35,449	39,513	58,953	64,040	75,594
IRRIGATION CONSERVATION	141,398	246,799	474,520	541,226	536,855	565,397
MUNICIPAL CONSERVATION	5,274	5,841	6,435	7,062	7,711	8,394
DROUGHT MANAGEMENT	0	0	0	0	0	0
OTHER SURFACE WATER	0	0	0	0	0	0
NEW MAJOR RESERVOIR	0	0	0	0	0	0
OTHER CONSERVATION	0	0	0	0	0	0
CONJUNCTIVE USE	0	0	0	0	0	0
INDIRECT REUSE	0	0	0	0	0	0
OTHER STRATEGIES	0	0	0	0	0	0
SEAWATER DESALINATION	0	0	0	0	0	0
GROUNDWATER DESALINATION	0	0	0	0	0	0
OTHER DIRECT REUSE	0	0	0	0	0	0
TOTAL STRATEGY SUPPLIES	**155,372**	**295,089**	**529,468**	**616,241**	**617,606**	**658,385**

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region A Water User Group (WUG)
Recommended Water Management Strategy (WMS) Supplies by Source Type

SOURCE SUBTYPE*	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	5,000	7,000	7,000	7,000	7,000
GROUNDWATER	8,700	35,449	39,513	58,953	64,040	75,594
GROUNDWATER TOTAL STRATEGY SUPPLIES	**8,700**	**40,449**	**46,513**	**65,953**	**71,040**	**82,594**
DIRECT NON-POTABLE REUSE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	2,000	2,000	2,000	2,000	2,000
INDIRECT NON-POTABLE REUSE	0	0	0	0	0	0
INDIRECT POTABLE REUSE	0	0	0	0	0	0
REUSE TOTAL STRATEGY SUPPLIES	**0**	**2,000**	**2,000**	**2,000**	**2,000**	**2,000**
ATMOSPHERE	0	0	0	0	0	0
GULF OF MEXICO	0	0	0	0	0	0
LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
OTHER LOCAL SUPPLY	0	0	0	0	0	0
RAINWATER HARVESTING	0	0	0	0	0	0
RESERVOIR	0	0	0	0	0	0
RESERVOIR SYSTEM	0	0	0	0	0	0
RUN-OF-RIVER	0	0	0	0	0	0
SURFACE WATER TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
REGION A TOTAL STRATEGY SUPPLIES	**8,700**	**42,449**	**48,513**	**67,953**	**73,040**	**84,594**

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region A Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

AMARILLO - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	49,454	53,992	58,861	64,093	70,074	76,402
PROJECTED WHOLESALE CONTRACT DEMANDS	25,682	26,273	26,273	26,273	25,273	25,273
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**75,136**	**80,265**	**85,134**	**90,366**	**95,347**	**101,675**
GROUNDWATER SALES TO RETAIL CUSTOMERS	41,597	38,487	35,691	31,597	28,729	28,873
SURFACE WATER SALES TO RETAIL CUSTOMERS	9,850	9,835	9,414	9,081	9,217	9,259
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	5,708	5,501	4,680	3,805	2,755	2,539
REUSE SALES TO WHOLESALE CUSTOMERS	18,554	18,554	18,554	18,554	18,554	18,554
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	1,420	1,406	1,234	1,095	883	814
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**77,129**	**73,783**	**69,573**	**64,132**	**60,138**	**60,039**

BORGER - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	3,163	3,201	3,182	3,177	3,172	3,172
PROJECTED WHOLESALE CONTRACT DEMANDS	7,919	8,307	8,241	8,187	8,143	8,098
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**11,082**	**11,508**	**11,423**	**11,364**	**11,315**	**11,270**
GROUNDWATER SALES TO RETAIL CUSTOMERS	6,599	5,233	4,598	3,719	3,138	3,136
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	4,529	5,156	5,244	5,312	5,252	5,251
REUSE SALES TO WHOLESALE CUSTOMERS	1,100	1,100	1,100	1,100	1,100	1,100
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	1,729	1,594	1,506	1,438	1,427	1,423
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**13,957**	**13,083**	**12,448**	**11,569**	**10,917**	**10,910**

CACTUS MUNICIPAL WATER SYSTEM - WUG/WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED RETAIL WUG DEMANDS	985	1,107	1,242	1,382	1,532	1,685
PROJECTED WHOLESALE CONTRACT DEMANDS	3,247	3,370	3,370	3,370	3,370	3,370
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**4,232**	**4,477**	**4,612**	**4,752**	**4,902**	**5,055**
GROUNDWATER SALES TO RETAIL CUSTOMERS	679	525	423	311	240	256
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	2,239	1,597	1,149	760	529	513
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**2,918**	**2,122**	**1,572**	**1,071**	**769**	**769**

CANADIAN RIVER MUNICIPAL WATER AUTHORITY - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	101,071	109,865	115,523	120,717	121,460	121,598
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**101,071**	**109,865**	**115,523**	**120,717**	**121,460**	**121,598**
GROUNDWATER SALES TO WHOLESALE CUSTOMERS	63,003	63,289	60,674	55,476	49,833	49,833
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	24,669	24,635	24,602	24,568	24,534	24,501
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**87,672**	**87,924**	**85,276**	**80,044**	**74,367**	**74,334**

GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY - WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	3,865	3,881	3,896	3,713	3,767	3,822
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**3,865**	**3,881**	**3,896**	**3,713**	**3,767**	**3,822**

Region A Major Water Provider (MWP) Existing Sales and Transfers

GROUNDWATER SALES TO WHOLESALE CUSTOMERS	1,465	1,376	1,291	1,149	992	843
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	2,400	2,505	2,605	2,563	2,428	2,256
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**3,865**	**3,881**	**3,896**	**3,712**	**3,420**	**3,099**

Region A Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale o water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

AMARILLO | ADVANCED METERING INFRASTRUCTURE - AMARILLO

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	1,485	1,655	1,831	2,008	2,198	2,398

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
ADVANCED METERING INFRASTRUCTURE - AMARILLO	DATA GATHERING/MONITORING TECHNOLOGY

AMARILLO | DEVELOP POTTER/CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	10,000	10,000	20,000	20,000	20,000

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE I (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD
DEVELOP POTTER/CARSON COUNTY WELL FIELD PHASE II (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD

AMARILLO | DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	0	0	0	11,210

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	MULTIPLE WELLS/WELL FIELD
AMARILLO WELLFIELD TO CRMWAII TRANSMISSION PIPELINE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE

AMARILLO | DIRECT POTABLE REUSE - AMARILLO

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	2,000	2,000	2,000	2,000	2,000

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
DIRECT POTABLE REUSE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; WATER TREATMENT PLANT EXPANSION
AQUIFER STORAGE AND RECOVERY - AMARILLO	MULTIPLE WELLS/WELL FIELD; INJECTION WELL

AMARILLO | EXPAND CAPACITY CRMWA II

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	4,921	5,472	6,874	6,592	5,083
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	812	1,805	2,819	3,080	3,366
TOTAL MWP RELATED WMS SUPPLY	0	5,733	7,277	9,693	9,672	8,449

AMARILLO | MUNICIPAL CONSERVATION - AMARILLO

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070

Region A Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWP RETAIL CUSTOMERS	976	1,087	1,202	1,319	1,444	1,575

AMARILLO | PWPA ASR						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	5,000	6,500	6,500	6,500	6,500
WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION					
DIRECT POTABLE REUSE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; WATER TREATMENT PLANT EXPANSION					
AQUIFER STORAGE AND RECOVERY - AMARILLO	MULTIPLE WELLS/WELL FIELD; INJECTION WELL					

AMARILLO | REPLACE WELL CAPACITY						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	817	2,153	4,714	5,986

AMARILLO | WATER AUDIT AND LEAK REPAIR - AMARILLO						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	2,077	2,268	2,472	2,692	2,943	3,209
WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION					
WATER AUDIT AND LEAK REPAIR - AMARILLO	WATER LOSS CONTROL					

BORGER | EXPAND CAPACITY CRMWA II						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	1,636	1,678	1,999	1,906	1,728
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	32	58	79	167	172
TOTAL MWP RELATED WMS SUPPLY	0	1,668	1,736	2,078	2,073	1,900

BORGER | MUNICIPAL CONSERVATION - BORGER						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	41	43	43	43	43	43

BORGER | REPLACE WELL CAPACITY						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	0	0	116	304	666	846

CACTUS MUNICIPAL WATER SYSTEM | DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	3,992	3,227	2,779	2,390	2,159	2,143
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	1,008	1,773	2,221	2,610	2,841	2,857
TOTAL MWP RELATED WMS SUPPLY	5,000	5,000	5,000	5,000	5,000	5,000
WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION					
DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD					

CACTUS MUNICIPAL WATER SYSTEM | MUNICIPAL CONSERVATION - CACTUS

Region A Major Water Provider (MWP) Water Management Strategy (WMS) Summary

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MWP RETAIL CUSTOMERS	13	15	17	19	21	23

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | BRUSH CONTROL - CRMWA

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
RELATED UNALLOCATED WMS WATER VOLUMES	2,500	2,500	2,500	2,500	2,500	2,500

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | EXPAND CAPACITY CRMWA II

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	15,746	19,884	26,048	25,838	22,573
RELATED UNALLOCATED WMS WATER VOLUMES	0	31,411	26,438	19,323	14,832	12,568
TOTAL MWP RELATED WMS SUPPLY	0	47,157	46,322	45,371	40,670	35,141

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	MULTIPLE WELLS/WELL FIELD
CRMWA II SHARED PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE
CRMWA II CRMWA PIPELINE	CONVEYANCE/TRANSMISSION PIPELINE

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | PWPA ASR

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	500	1,800	1,800	1,800	1,800
RELATED UNALLOCATED WMS WATER VOLUMES	0	11,500	10,200	10,200	10,200	10,200
TOTAL MWP RELATED WMS SUPPLY	0	12,000	12,000	12,000	12,000	12,000

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
AQUIFER STORAGE AND RECOVERY - CRMWA	MULTIPLE WELLS/WELL FIELD; INJECTION WELL

CANADIAN RIVER MUNICIPAL WATER AUTHORITY | REPLACE WELL CAPACITY

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	0	1,889	5,197	11,450	14,558
RELATED UNALLOCATED WMS WATER VOLUMES	0	0	2,437	4,327	8,043	10,133
TOTAL MWP RELATED WMS SUPPLY	0	0	4,326	9,524	19,493	24,691

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	MULTIPLE WELLS/WELL FIELD

GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY | DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA

DATA DESCRIPTION	WATER VOLUMES (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
TRANSFERS RELATED TO WHOLESALE CUSTOMERS	0	0	0	10	366	753
RELATED UNALLOCATED WMS WATER VOLUMES	0	2,000	2,000	1,999	1,307	555
TOTAL MWP RELATED WMS SUPPLY	0	2,000	2,000	2,009	1,673	1,308

WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION
DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD