Chapter 11 Implementation and Comparison to Previous Regional Water Plan

11.1 Introduction

One of the new requirements for the 2016 Regional Water Plan is the inclusion of a chapter providing a comparison of the current Regional Water Plan to the previous Plan, and a discussion of the differences between the two. This chapter includes a discussion on the major differences between the two Plans and a description of strategies that have been implemented since the publication of the 2011 Plan.

11.2 Differences Between Previous and Current Regional Water Plan

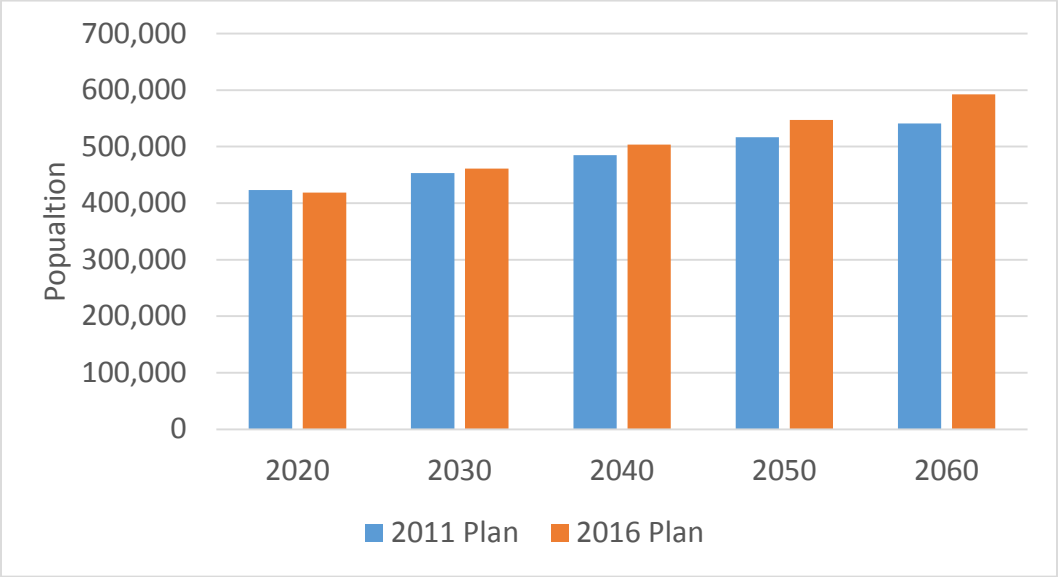
The following sections specifically address changes between the 2011 and 2016 Plan in:

- Population projections
- Water demand projections,
- Drought of record and hydrologic modeling and assumptions,
- Groundwater and surface water availability,
- Existing water supplies for water users,
- Identified water needs for WUGs and WWPs, and
- Recommended and alternative water management strategies.

11.2.1 Population Projections

Population projections for the 2016 Plan are based on the 2010 Census and expected growth associated with major metropolitan areas and future oil and gas activities. The 2011 population projections were based on the 2000 Census and were not reflective of recent oil and gas activities. As a result, population projections in the 2016 plan are about the same in 2020 with slightly higher population in the latter decades (Figure 11-1). One of the impacts of changes in population included the change in Water User Groups (WUGS) in the PWPA. Two WUGs in the 2011 Plan are no longer WUGs in the 2016 Plan, Lefors (population < 500) and Hi-Texas Water Company (incorporated into county other). One Wholesale Water Provider (WWP), Mesa Water Inc. is no longer a WWP since their water rights were purchased by the Canadian River Municipal Water Authority (CRMWA).

Figure 11-1: Comparison of PWPA Population



11.2.2 Water Demand Projections

Water demands in the PWPA for the 2016 Plan increased in comparison to the 2011 Plan (Figure 11-2) by approximately 8 to 14 percent. However, a pattern of overall decline continues to be projected throughout the 50 year analysis. Irrigation, manufacturing and municipal water demands are driving these increases (Table 11-1). The 2016 Plan shows lower water demands for mining, livestock and steam electric power.

Figure 11-2: Comparison of PWPA Water Demand

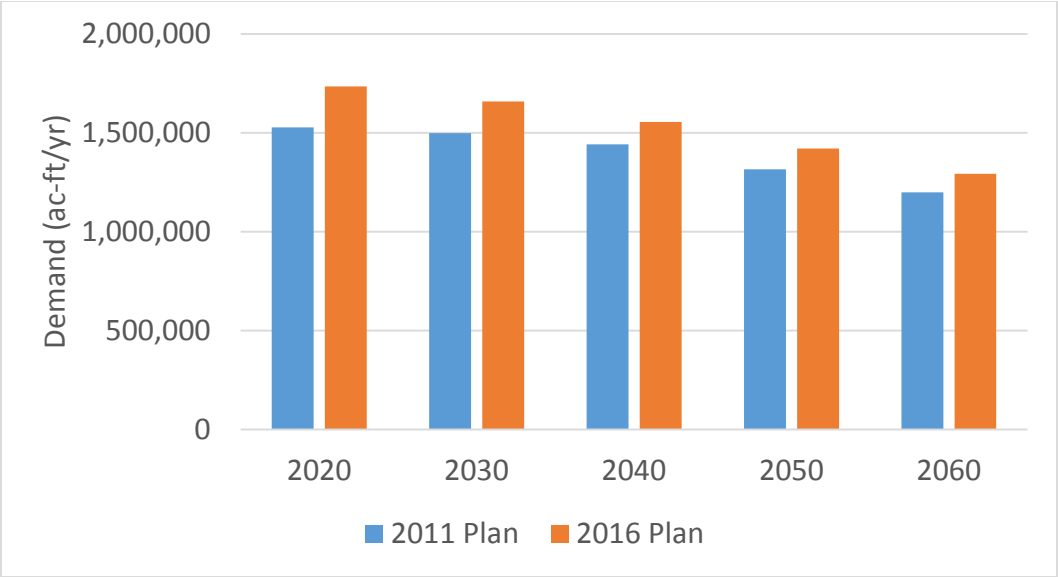


Table 11-1: Changes in Projected Demands from the 2011 Plan to the 2016 Plan by Use Type

Use Type	Changes in Projected Water Demands (ac-ft/yr)				
	2020	2030	2040	2050	2060
Irrigation	202,097	154,866	109,052	99,825	83,814
Livestock	-2,813	-4,062	-4,833	-5,718	-6,718
Manufacturing	2,420	2,591	2,757	2,903	3,112
Mining	-2,735	-3,309	-4,473	-6,030	-6,546
Municipal	7,747	9,603	11,600	14,511	19,620
Steam Electric Power	0	-200	-200	-200	-213
Total	**206,716**	**159,489**	**113,903**	**105,291**	**93,069**

Note: Negative numbers indicate lower demand in the 2016 Plan and positive numbers show higher demand in the 2016 Plan.

Projected demands for irrigation increased the most of all water use types. Table 11-2 identifies changes in irrigation demand by county. The counties with the greatest increases in irrigation demand are Dallam, Hansford, Hartley, and Sherman counties. These counties accounted for greater than 90 percent of the increase in irrigation demand in the 2016 Plan. These four counties are significant agricultural centers accounting for 45 percent of the harvested cropland in the region based on the 2012 Census of Agriculture. Counties in the southwest part of the region show lower irrigation demands than projected in the 2011 Plan.

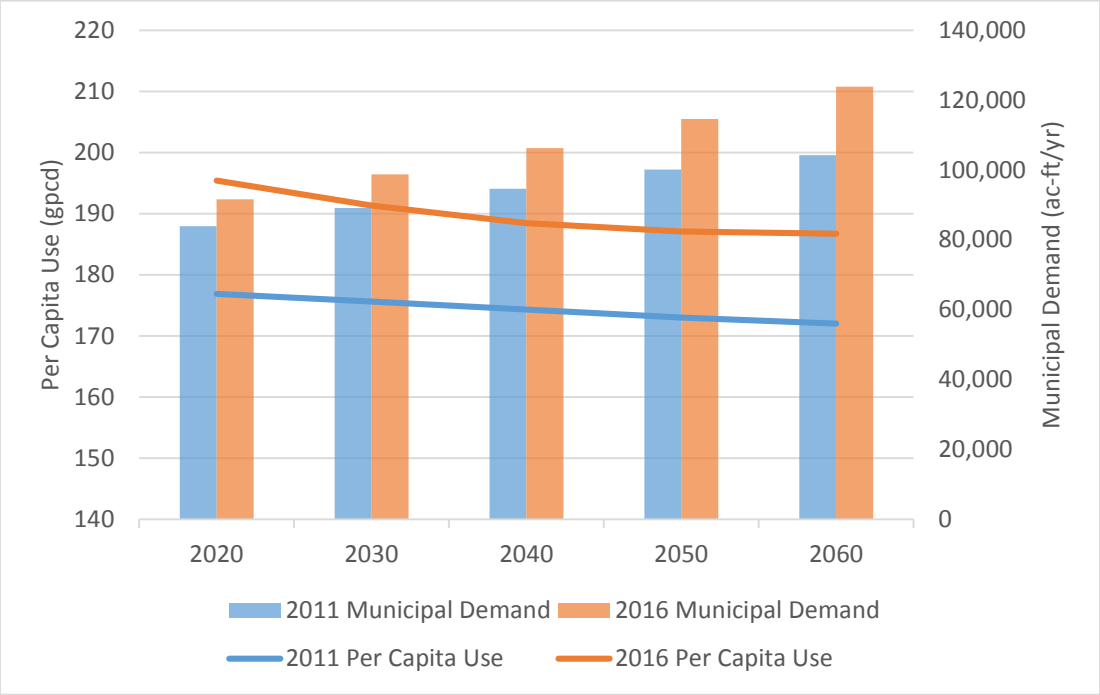
Table 11-2: Changes in Projected Irrigation Demands from the 2011 Plan to the 2016 Plan

County	Change in Projected Irrigation Demand (ac-ft/yr)				
	2020	2030	2040	2050	2060
Armstrong	-494	-554	-597	-531	-465
Carson	6,472	4,856	3,319	6,988	2,582
Childress	1,789	1,676	1,533	1,363	1,192
Collingsworth	-3,964	-3,960	-3,863	-3,434	-3,005
Dallam	86,549	72,882	58,608	52,095	45,584
Donley	-5,596	-5,568	-5,410	-4,809	-4,208
Gray	881	319	-205	-182	-159
Hall	-597	-597	-581	-517	-452
Hansford	19,875	14,975	10,122	8,998	7,873
Hartley	63,717	52,856	41,633	37,007	32,382
Hemphill	202	161	119	106	93
Hutchinson	37	-1,077	-2,073	-1,844	-1,613
Lipscomb	4,463	3,944	3,373	2,999	2,624
Moore	8,027	3,526	-691	-614	-538
Ochiltree	5,404	3,573	1,807	1,606	1,405
Oldham	23	-26	-70	-62	-54
Potter	-2,270	-2,233	-2,143	-1,904	-1,667
Randall	-1,900	-2,135	-2,299	-2,044	-1,788
Roberts	319	143	-24	-21	-19
Sherman	20,445	13,320	7,774	5,763	5,043
Wheeler	-1,285	-1,215	-1,280	-1,138	-996
Total	**202,097**	**154,866**	**109,052**	**99,825**	**83,814**

Note: Negative numbers indicate lower demand in the 2016 Plan and positive numbers show higher demand in the 2016 Plan.

Projected municipal water demand continues to increase with each plan. The 2016 Plan shows additional growth over time with over 19,000 acre-feet per year higher demand in 2060 (Table 11-1). Some of this higher demand is associated with higher per capita water use. Due to the drought in 2011, the starting per capita water use in the PWPA was higher for most municipal water users. As a result the regional average per capita water use in 2020 for the 2016 Water Plan was 195 gallons per person per day. For the 2011 Plan, the regional average was 177 gallons per person per day. The rate of decline over time in per capita water use was about the same (Figure 11-3).

Figure 11-3: Comparison of Projected Per Capita Use and Municipal Demand



11.2.3 Drought of Record and Hydrologic Modeling Assumptions

In general the drought of record is defined as the worst drought to occur in a region during the entire period of meteorological record keeping. For most of Texas, the drought of record occurred from 1950-1957. Surface water sources in the PWPA were in drought of record conditions for the 2011 Plan and continue to be in drought of record conditions. Since the 2011 Plan, the region has experienced record low inflows into area lakes and streams. This has continued to impact the water supplies from these sources. It also impacted the ability to accurately assess the reliable supply from these sources. As a result, alternative approaches to yield analyses were conducted for Lake Meredith and Greenbelt Reservoir. These analyses used extend hydrology and a conditional reliability model approach. This approach provides an estimate of how the reservoir will respond to continuing drought conditions. A similar conditional reliability analysis was conducted for Lake Meredith in the 2006 Water Plan and retained for the 2011 Plan. However, the earlier analysis did not capture the low flows experienced since 2004.

Groundwater modeling assumptions are very different for some aquifers with the development of Desired Future Conditions (DFCs) for use in the 2016 Plans. For the Ogallala aquifer, the DFCs for the 2011 Plan and 2016 Plan are basically the same. The resulting availability differs due to the use of the more recent Northern Ogallala Groundwater Availability Model (GAM) for the development of the Modeled Available Groundwater (MAGs), and the methodology developed by the TWDB to develop the MAG. In the 2011 Plan, water availability in the Ogallala was constrained by the DFC in both time (year) and space (per square mile grid cell). The modeling employed the 2004 Ogallala GAM (Dutton) which had different red

bed data. For the 2016 Plan, the time constraint was the 50-year simulation and the spatial constraint was either at a county or multi-county level. This results in different availabilities for the Ogallala both in time and location. In the 2011 plan, the availability for the Seymour and minor aquifers were consistent with the DFCs set for the Ogallala: have 50 percent storage remaining in 50 years. As part of the joint planning process, different DFCs were adopted for these resources.

For the Dockum aquifer the DFC was set as the average decline in water levels to be no more than 30 feet over the next 50 years. As a result, the availability of supplies were drastically reduced from the 2011 Plan estimates.

For the Seymour aquifer the DFC was set as 50 percent of current volume in storage reaming in 50 years for Pods 1,2 and 3 (Mesquite GCD) in Childress, Collingsworth and Hall Counties. The DFC was set for total decline in water levels to be no more than 1 foot over 50 years for Pods 3 and 4 (Gateway GCD) in Childress County. The impact of these DFCs led to small increases in availability in the 2016 Plan.

For the Blaine aquifer the DFC was set at 50 percent of the volume in storage remaining in 50 years in Wheeler County, and 80 percent of current volume of storage remaining in 50 years in Childress, Collingsworth and Hall Counties. The impact of these DFCs have led to increases in availability of over 80,000 acre-feet per decade for the Blaine in the 2016 Plan.

11.2.4 Groundwater Availability

Overall groundwater availability is about the same for both the 2011 and 2016 Plans (Figure 11-4). This results primarily from increases of availability in the Ogallala and Blaine aquifers, and reductions in availability from the Dockum aquifer (Table 11-3). Table 11-4 shows the change in availability in the Dockum aquifer between the 2011 Plan and the 2016 Plan.

While the overall availability across the PWPA has increased slightly in the 2016 Plan, the distribution of supplies across the region differ (Figure 11-5). Declines in availability in the counties in the southern portion of the PWPA are mostly attributed to declines in the Dockum aquifer and reduced thickness along the fringes of the Ogallala aquifer. Generally, increases in supplies in the northern portion of the PWPA are a results of increased Ogallala aquifer availability.

Figure 11-4: Comparison of Groundwater Availability from the 2011 and 2016 Plans

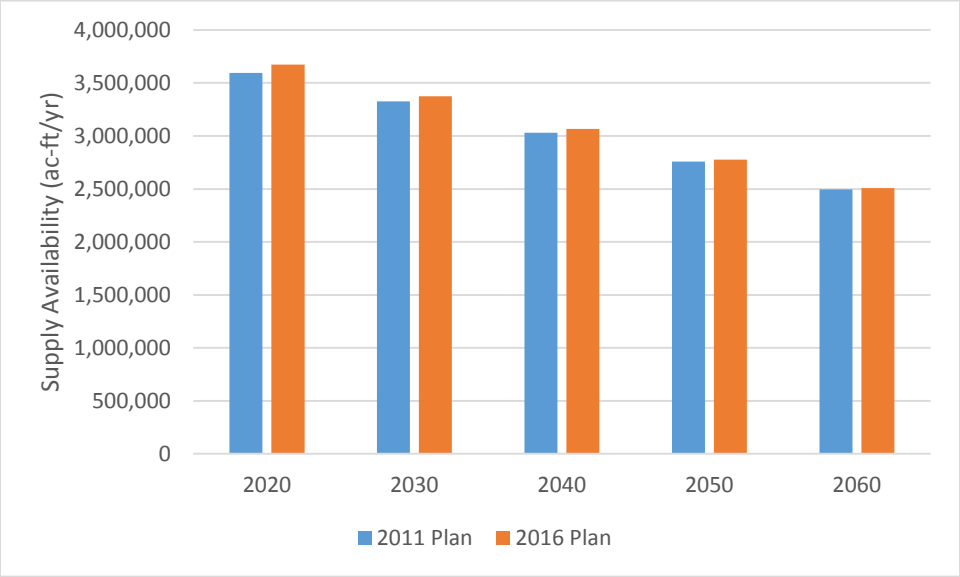
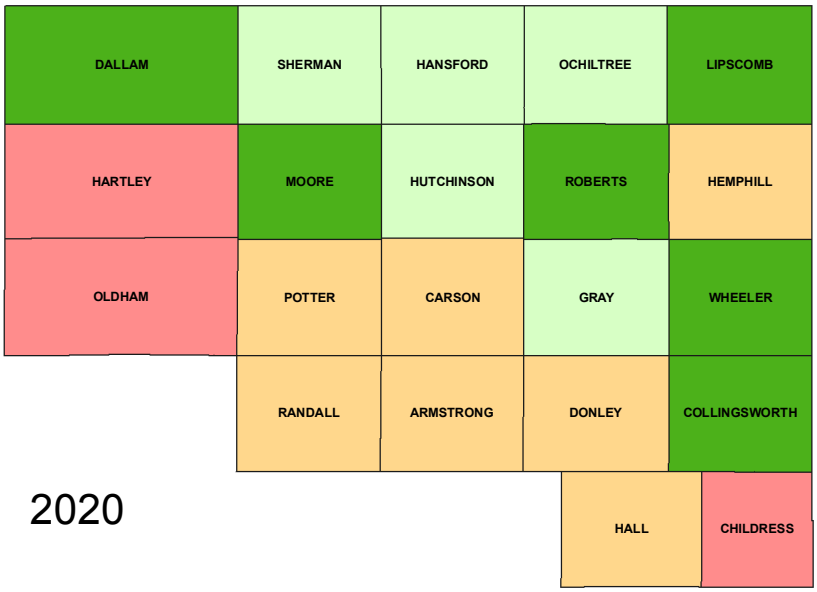


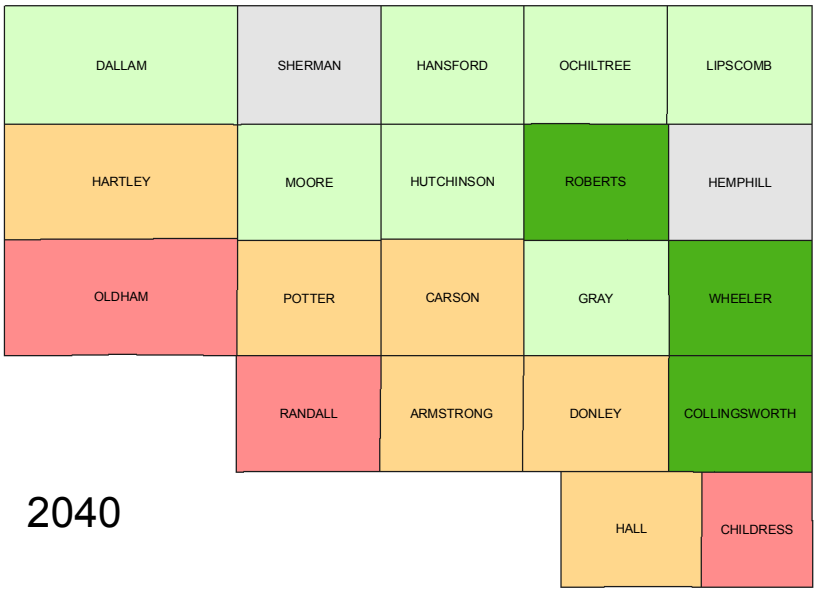
Table 11-3: Change in Groundwater Availability from the 2011 Plan to 2016 Plan

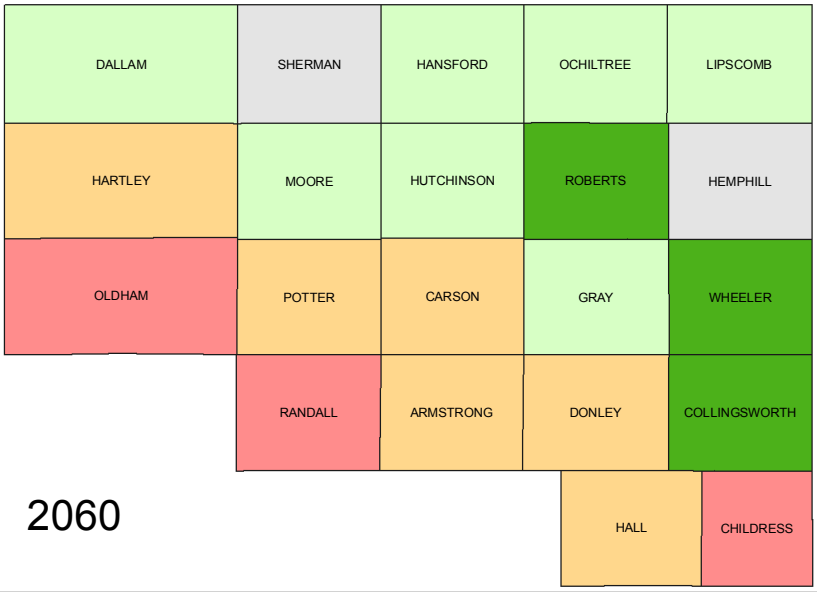
Source	Changes in Groundwater Availability (ac-ft/yr)				
	2020	2030	2040	2050	2060
Blaine Aquifer	82,338	82,338	82,338	82,338	81,036
Dockum Aquifer	-250,297	-238,177	-206,277	-178,277	-153,577
Ogallala/Rita Blanca Aquifer	258,094	214,518	173,578	129,299	98,143
Other Aquifer	-11,763	-12,221	-13,724	-15,524	-16,525
Seymour Aquifer	2,115	2,118	2,121	2,121	2,121
Total	**80,487**	**48,576**	**38,036**	**19,957**	**11,198**

Table 11-4: Changes in Dockum Aquifer Supply by County from the 2011 Plan to 2016 Plan

County	Changes in Dockum Aquifer Availability (ac-ft/yr)				
	2020	2030	2040	2050	2060
Armstrong	-18,018	-15,718	-15,718	-11,918	-10,318
Carson	-5,117	-4,417	-4,417	-3,317	-2,917
Dallam	-58,766	-50,866	-50,866	-38,066	-32,766
Hartley	-57,433	-49,833	-49,833	-37,333	-32,233
Moore	-9,805	-7,905	-7,905	-4,805	-3,505
Oldham	-61,428	-54,628	-54,628	-41,828	-36,528
Potter	-4,440	-24,220	-24,220	-18,220	-15,720
Randall	-35,881	-31,181	-31,181	-23,381	-20,181
Sherman	591	591	591	591	591







Total Groundwater Difference (Acre-feet per year)

- -25,000 <
- -25,000 - -1,000
- -1,000 - 1,000
- 1,000 - 25,000
- >25,000

0 12.5 25 50 Miles

DATE: APRIL 2015

SCALE: 1:3,168,000

DATUM & COORDINATE SYSTEM: GCS NORTH AMERICAN 1983

PREPARED BY: JJR

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N W E S

PANHANDLE WATER PLANNING AREA

TOTAL GROUNDWATER DIFFERENCE IN AVAILABILITY

Location Map

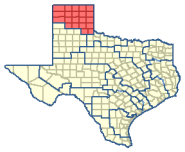


FIGURE 11-5

11.2.5 Surface Water Availability

Surface water availability decreased by approximately 68 percent from the 2011 Plan to the 2016 Plan as shown in Figure 11-6. As of October 2014, the three major reservoirs (Lake Meredith, Greenbelt Reservoir and Palo Duro Reservoir) are in the critical drought period and at less than 13 percent full. Lake Meredith is no longer considered a reliable supply of surface water in the 2016 Plan because of drought and continued low inflows. The available supply from Greenbelt Reservoir is projected to decline by 42 percent in 2060 from the previous plan (Table 11-5).

Figure 11-6: Comparison of Surface Water Availability in the 2011 and 2016 Plans

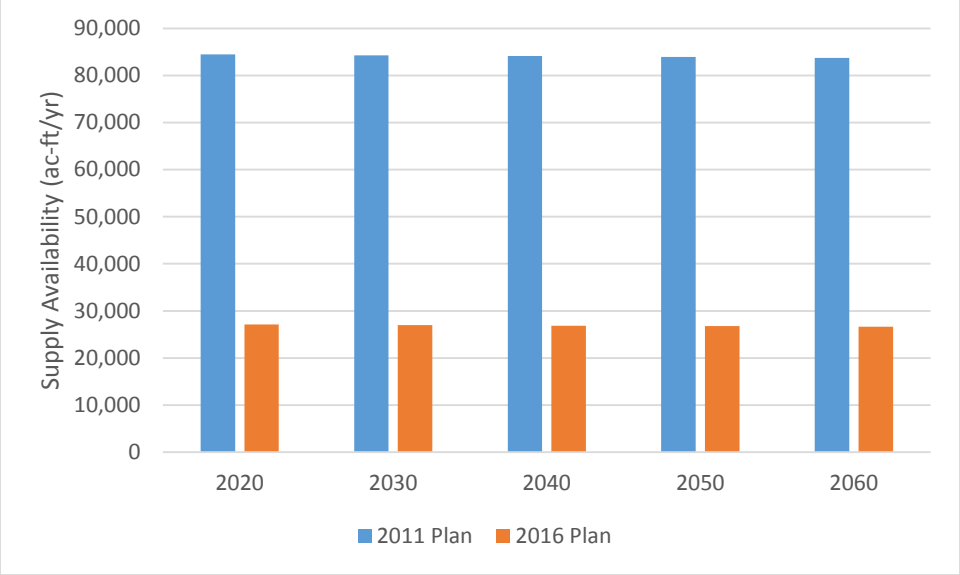


Table 11-5: Projected Change in Surface Water Supply from the 2011 to 2016 Plan in 2060

Supply	2011 Plan	2016 Plan	Percent Change
	(ac-ft/yr)		
Lake Meredith	50,000	0	-100%
Greenbelt Reservoir	6,181	3,578	-42%
Palo Duro Reservoir	3,750	3,750	0%
Local Supplies	21,217	16,783	-21%
Run-of-River	2,598	2,538	-2%

Note: Negative numbers indicate lower supply in the 2016 Plan and positive numbers show higher supply in the 2016 Plan.

11.2.6 Existing Water Supplies of Water Users

Existing supplies to users are based on the source availability and infrastructure developed to provide the water. Due to changes in source availability, some sources are no longer used or reduced supplies were available from existing sources. Those sources no longer used include Lake Meredith and Ogallala

Aquifer in Collingsworth County (considered non-relevant and not included in GAM Model). Sources with significant reductions in supply include the Dockum aquifer and the Ogallala aquifer in several counties. On the contrary, increasing water demands and drought have caused water users to adopt new supplies, including several that were implemented as strategies from the 2011 Plan. These include the City of Amarillo's Potter County well field (Phase 1), new wells in the Ogallala aquifer for Greenbelt MIWA, additional wells for Borger, Dockum aquifer wells for Canyon and several small direct non-potable reuse projects. Also the allocation of Ogallala aquifer supplies to irrigation and municipalities for the 2016 Plan considered the geographic constraints with a 1-mile buffer. In the 2011 Plan, there was no buffer area used in evaluating the supply allocation. As a result, several large irrigation counties and some municipalities have greater supplies in the 2016 Plan than the 2011 Plan. Table 11-6 shows entities with significant (less than or greater than 50 percent and/or 100 acre-feet) change in supply for the 2016 Plan by the year 2060.

Table 11-6: Entities with Significant Change in Supply (2060) for the 2016 Plan

Higher	Lower
Canadian	Colorado River Municipal Water Authority (CRMWA)
Hutchinson County-Other	Amarillo (CRMWA)
Groom	Armstrong County-Other
Gruver	Hansford County-Other
Dallam County Irrigation	Moore County-Other
Hartley County Irrigation	Ochiltree County-Other
Sherman County Irrigation	Dalhart
Potter County Mining	Potter County Irrigation
Spearman	Lake Tanglewood
	Manufacturing Moore County
	Manufacturing Potter County
	Manufacturing Randall County
	Mclean
	Perryton
	Shamrock
	Stinnett
	Sunray
	TCW Supply Inc
	Vega
	Wheeler

11.2.7 Identified Water Needs

Water Use Type

Relative consumption of water by use type has remained fairly constant between the two plans with irrigation being the largest consumer followed by municipal, manufacturing, livestock, steam electric power and mining use. There were some absolute differences in demands by use type, with higher demands for irrigation and municipal use and lower demands for livestock and mining.

Needs

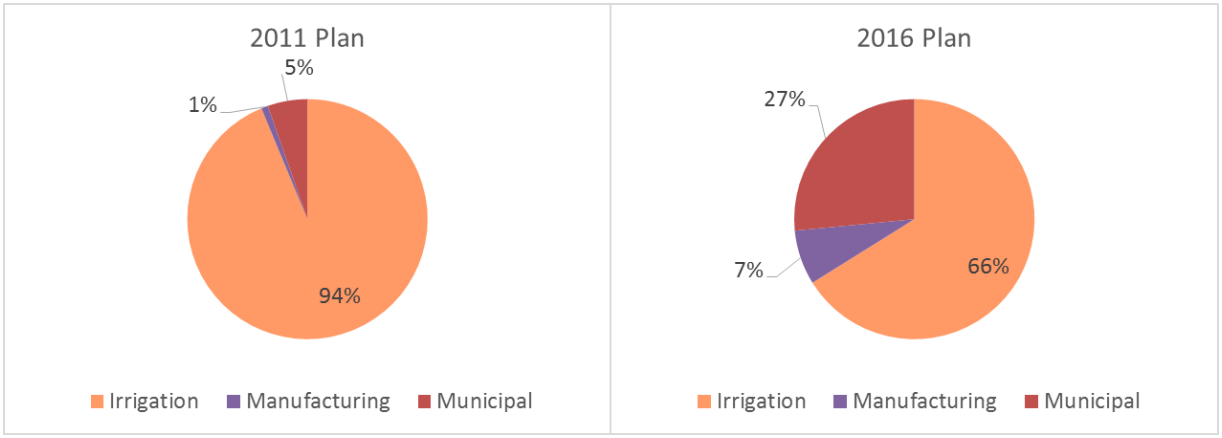
The total needs for the 2016 Plan are considerably less than the 2011 Plan. This is mostly due to the additional supplies for irrigation that were developed in the 2016 Plan. As a result, the distribution of water needs by use type are different with municipal water use having greater needs in the 2016 Plan and irrigation having lower water needs (Figure 11-7).

There are 14 water users shown to have a need in the 2016 Plan, but did not have a need in the 2011 Plan These users include Booker, Claude, Dalhart, Happy, McLean, Pampa, Panhandle, Perryton, Stinnett, TCW Supply, Texline, Wheeler, and Manufacturing in Lipscomb and Randall Counties. Several users were found to no longer have a need in the 2016 Plan. These are shown in Table 11-7.

Table 11-7: Entities with New Needs or No Need for the 2016 Plan

New Need	No Need
Booker	Irrigation Hansford County
Claude	Irrigation Hutchinson
Dalhart	Irrigation Sherman
Happy	Moore Steam Electric Power
Manufacturing Lipscomb	
Manufacturing Randall	
Mclean	
Pampa	
Panhandle	
Perryton	
Stinnett	
TCW Supply	
Texline	
Wheeler	

Figure 11-7: 2060 Need by Use Type in the 2011 and 2016 Plans



New Water Management Strategies

Due to changes in water needs, new strategies were developed for the 2016 Water Plan. Also for the 2016 Plan, municipal conservation is a recommended strategy for all cities whether the municipality has a need or not. In the previous plan, conservation was only considered for cities with a need. Table 11-8 lists the 2016 new recommended strategies for water user groups.

Table 11-8: New Recommended Water Management Strategies in the 2016 Plan

Water User Group	New Recommended Water Management Strategy
Claude	Municipal Conservation
Claude	New Groundwater Wells in Ogallala Aquifer
Wellington	Municipal Conservation
Wellington	New Groundwater Wells in Seymour Aquifer
Wellington	Expanded Use (RO Treatment)
Dalhart	Municipal Conservation
Dalhart	New Groundwater Wells in Ogallala Aquifer
McLean	Municipal Conservation
McLean	New Groundwater Wells in Ogallala Aquifer
Hall County-Other	New Groundwater Wells in Seymour Aquifer
Hall County-Other	Expanded Use (RO Treatment)
Stinnett	Municipal Conservation
Stinnett	New Groundwater Wells in Ogallala Aquifer
TCW Supply	Municipal Conservation
TCW Supply	New Groundwater Wells in Ogallala Aquifer
Booker	Municipal Conservation
Booker	New Groundwater Wells in Ogallala Aquifer
Lake Tanglewood	Municipal Conservation
Lake Tanglewood	New Groundwater Wells in Ogallala Aquifer
Moore County-Other	New Groundwater Wells in Ogallala Aquifer
Canyon	New Groundwater Wells in Ogallala Aquifer

Water User Group	New Recommended Water Management Strategy
Potter County Manufacturing	New Groundwater Wells in Ogallala Aquifer
Potter County-Other	New Groundwater Wells in Dockum Aquifer
Randall County Manufacturing	New Groundwater Wells in Ogallala Aquifer
Lipscomb County Manufacturing	Purchase from Booker
Potter County Manufacturing	Purchase Reuse from Amarillo

Table 11-9 lists previous and new recommended water management strategies for the PWPA wholesale water providers. CRMWA and Amarillo have at least one new strategy from the previous plan. There are no changes to the basic recommended strategies for Borger, Cactus and Greenbelt MIWA; however, each of these entities have developed additional groundwater but the WWP is still planning to develop additional supplies. For PDRA the recommended strategy to develop infrastructure to its members is an alternative strategy in the 2016 Plan.

Table 11-9: Wholesale Water Provider Strategies in the 2011 and 2016 Plan

Wholesale Water Providers	2011 Plan	2016 Plan
CRMWA	Acquisition of Water Rights[1]	CRMWA II Transmission from Roberts County
	Replacement Wells in Roberts County Well Field	Replacement Wells in Roberts County Well Field
		Conjunctive Use with Lake Meredith
		Brush Control in Lake Meredith Watershed
Amarillo	Potter County Well Field (Phase I)[1]	Potter County Well Field (Phase II)
	Roberts County Well Field	Roberts County Well Field
		Carson County Well Field
Borger	New Groundwater (Ogallala)	New Groundwater (Ogallala)
Cactus	New Groundwater (Ogallala)	New Groundwater (Ogallala)
Greenbelt MIWA	Donley County Well Field	Donley County Well Field
Palo Duro River Authority	Develop PDRA Transmission System	Develop PDRA Transmission System[2]

1. Implemented strategy since the 2011 Plan
2. Alternative strategy

New alternative strategies were developed for Amarillo and TCW Supply to potentially meet their projected water needs (Table 11-10). The alternative strategy for Randall County-Other to obtain water from Amarillo in the 2011 Plan was removed.

Table 11-10: New Alternate Water Management Strategies

Entity	New Alternate Strategy
Amarillo	Develop Direct Potable Reuse Supply
TCW Supply	Purchase Water from Borger

11.2.8 Altered Water Management Strategies

Several strategies in the current plan were listed in the previous plan but have been altered in some way. This section focuses on strategies that were significantly changed from the last plan either due to major conceptual changes, better available data, or considerable changes in assumptions used to calculate the water available from the strategy. This section is meant to highlight the differences, not give a full description of the strategy. More information on these strategies can be found in Chapter 5.

Municipal Conservation

In the previous plan, only entities with projected needs were considered for municipal conservation. The 2016 Plan recommends conservation measures for all municipalities, regardless if there is a need. Municipal conservation was also considered for County-Other entities with needs. The current plan includes specific conservation Best Management Practices (BMPs) dependent on the population of the city to better identify appropriate conservation measures based on water need and available resources. In the 2011 Plan, conservation savings were estimated on a percent of demand reduction. The 2016 Plan provided more specific BMP savings. Additional information on municipal conservation measures can be found in subchapter 5B.1.

Irrigation Conservation

For the 2016 Plan, a suite of conservation irrigation conservation strategies were identified and the combined savings determined. The recommended irrigation conservation strategies reflect a specific suite of strategies for each county. In the 2011 Plan, all irrigation conservation strategies were evaluated individually and the savings were summed together. This resulted in an over-estimation of conservation savings. This was corrected in the 2016 Plan. Additional information on agricultural water conservation can be found in subchapter 5B.2.

11.2.9 No Longer Considered Water Management Strategies

In addition to new and altered strategies, some strategies included in the 2011 Plan are no longer being considered for the entity for various reasons. These are outlined in Table 11-11.

Table 11-11: Strategies No Longer Considered in the 2016 Plan

Entity	Strategies No Longer Considered in the 2016 Plan
Fritch	New Groundwater Wells in Ogallala Aquifer
Memphis	Purchase from Greenbelt MIWA
Moore County Steam Electric Power	New Groundwater Wells in Ogallala Aquifer

11.3 Implementation of Previously Recommended Water Management Strategies

The following sections discuss the strategies that were recommended in the 2011 Plan, and have been partially or completely implemented since that plan was published. These strategies are included in the 2016 Plan as currently available supply.

11.3.1 Amarillo

Potter County Well Field

In 2011, Amarillo complete the first phase of its Potter County Well Field. The well field included 21 wells and 15 miles of 48" pipeline. This project can supply up to 10 MGD. For planning purposes the estimated supply is over 9,000 acre-feet in 2020, decreasing to 5,600 acre-feet by 2070.

11.3.4 Borger

Ogallala Aquifer

The City of Borger has purchased water rights for the Ogallala aquifer in Hutchinson County. This strategy includes drilling 13 groundwater wells to a depth of 500 feet with a capacity of 600 gpm. The infrastructure includes 10 miles of 20-inch pipeline to transport the water to the City of Borger. The city currently has sufficient treatment capacity to treat the annual supply of 2,000 acre-feet. Production wells, pipelines, pumps, and storage facilities have been constructed and the project should be on-line in 2015.

11.3.3 CRMWA

Acquisition of Water Rights

In the 2011 Plan, CRMWA held 263,000 acres of water rights in Roberts County. Since then it has acquired additional rights for a total of 444,833 acres of water rights in Roberts and adjacent counties.

11.4 Conclusion

While there were several significant changes to supplies and demands in the PWPA for the 2016 Plan, the overall recommended strategies remain fairly consistent. Conservation remains a major strategy to meet irrigation and municipal water needs. Groundwater is still the preferred source for new supply development. The region continues to show some unmet water needs for irrigation.