CHAPTER 7

DROUGHT RESPONSE INFORMATION, ACTIVITIES, AND RECOMMENDATIONS

2021 FINAL PLAN

REGION B

OCTOBER 2020

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7.1 Introduction

Drought response and management have long been important aspects of regional water planning. The extensive drought experienced in Texas during the 2010-2015 timeframe, however, served to re-focus attention on the need for comprehensive consideration of drought management measures. Requirements for improved drought planning in the State through the regional water planning process are found in Title 31 of the Texas Administrative Code (TAC), Part 10, Chapter 357, Subchapter D. Specifically §357.42 of Subchapter D includes requirements related to drought response information, activities, and recommendations. This chapter of the regional plan addresses the requirements found in §357.42.

This chapter also addresses the recommendations of the Drought Preparedness Council (DPC) in a letter dated August 1st, 2019. This Chapter of the Regional Plan generally follows the outline template provided by the TWDB for Chapter 7, satisfying the first recommendation of the DPC. The DPC also recommended that region specific model drought contingency plans be developed for all water use categories in the region that account for more than 10 percent of water demands in any decade. For Region B the water use categories that satisfy this requirement include municipal use and irrigation use. Region B specific model drought contingency plans were developed for municipal use and irrigation use and are discussed in Section 7.7.2.

Region B was significantly impacted by drought during 2010-2015, and although the drought subsided during the late spring and summer of 2015 as major water supply reservoirs were filled, the region can rapidly return to a drought status with seasonal or longer periods of drought occurring frequently.

7.2 Droughts of Record

A central principal of regional water planning is that the availability of water sources is determined for drought-of-record conditions. State-wide, the drought of the 1950's is often considered the drought of record, but on regional or sub-regional bases, other periods of time may actually be demonstrated to have been more severe. Chapter 7 includes a detailed examination of preparations for and responses to drought conditions in the region, as required by §357.42. Such examination begins with identification of significant recent droughts within the region.

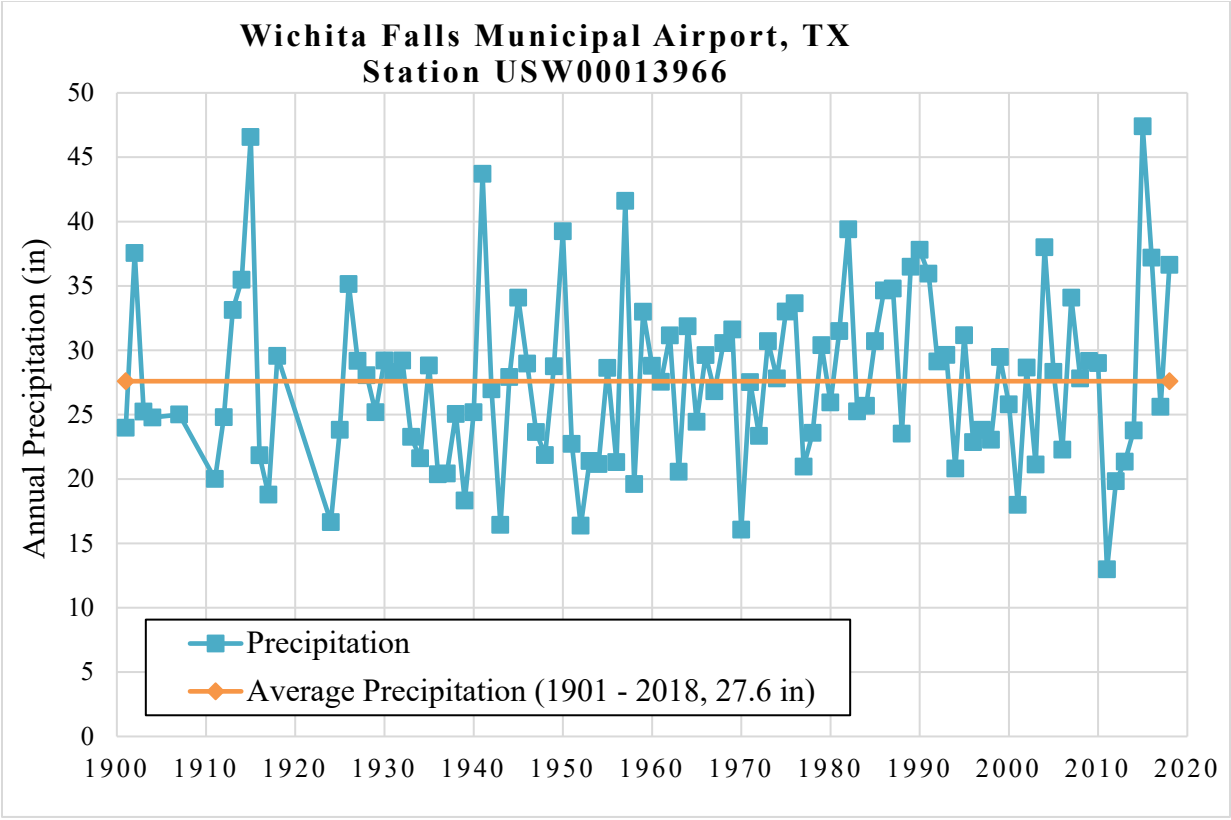
Numerous definitions of drought have been developed to describe drought conditions based on various factors and potential consequences. In the simplest of terms, drought can be defined as "a prolonged period of below-normal rainfall." However, the State Drought Preparedness Plan provides more specific and detailed definitions:

- Meteorological Drought. A period of substantially diminished precipitation duration and/or intensity that persists long enough to produce a significant hydrologic imbalance.
- Agricultural Drought. Inadequate precipitation and/or soil moisture to sustain crop or forage production systems. The water deficit results in serious damage and economic loss to plant and animal agriculture. Agricultural drought usually begins after meteorological drought but before hydrological drought and can also affect livestock and other agricultural operations.
- Hydrological Drought. Refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, and as lake, reservoir, and groundwater levels. There is usually a lack of rain or snow and less measurable water in streams, lakes, and reservoirs, making hydrological measurements not the earliest indicators of drought.
- Socioeconomic Drought. Occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

These definitions are not mutually exclusive and provide valuable insight into the complexity of droughts and their impacts. They also help to identify factors to be considered in the development of appropriate and effective drought preparation and contingency measures.

Regional water planning primarily addresses meteorological, agricultural, and hydrological drought and response to these conditions to avoid socioeconomic drought. Figure 7-1 shows the long-term precipitation for Wichita Falls. This data set shows that the average precipitation in the area is 27.6 inches. The minimum annual rainfall documented during this period was 13.0 inches in 2011. The maximum annual rainfall recorded was 47.4 inches during 2015, which allowed the area to recover from the drought of record (2011) for this sub-region of the state.

Figure 7-1 Precipitation Record for Wichita Falls



Source: https://www.ncdc.noaa.gov/cdo-web/datasets#GSOY, Accessed July 3, 2019.

It can be noted that there were significant periods of low and high rainfall from 1905 to 1930, but this was prior to development of many of the current water supply sources. The minimal rainfall that occurred in 2011 is also less than any annual rainfall total since 1901.

7.2.1 Current Droughts of Record

As described in Chapter 3, the surface water supplies for the regional water plans were determined using the TCEQ-approved Water Availability Models (WAM).[1] For example, the firm yield of a reservoir is the greatest amount of water a reservoir can supply on an annual basis without shortage during a repeat of historical hydrologic conditions, particularly the drought of record. The WAMs incorporate historical hydrologic conditions that occurred between 1940 and 1996; however, data for hydrologic conditions through December 2015 were also used. The droughts of record that were used to evaluate currently available water supplies (Chapter 3) are provided in Table 7-1.

The drought of record can be different for different geographic locations. Based on the current data it appears there have been two primary droughts of record in Region B:

- The drought of the 1950s in the southeastern portion of the region.
- The more recent drought with initiation dates varying from 1993 to 2010 depending upon the location within the remainder of the region.

Table 7-1 Current Droughts of Record for Water Supply Reservoirs

Reservoir Name	Date Last Full (1)	Date of Minimum Content	Drought of Record
Amon Carter (2)	June 1951	March 1957	1951 - 1957
Arrowhead	May 2010	February 2015	2010 - 2015
Kemp	November 2010	March 2015	2010 - 2016
Kickapoo	May 2010	June 2014	2010 - 2015
Olney/Cooper	June 1993	April 2015	1993 - 2015
Nocona	March 2001	February 2015	2001 - 2015

(1) The Date Last Full is based on the safe yield analyses. (Note: Safe yield analyses assume the reservoir is full at the beginning of the simulation.)

(2) Hydrology for Amon Carter is based on the Trinity WAM period of record and was not extended.

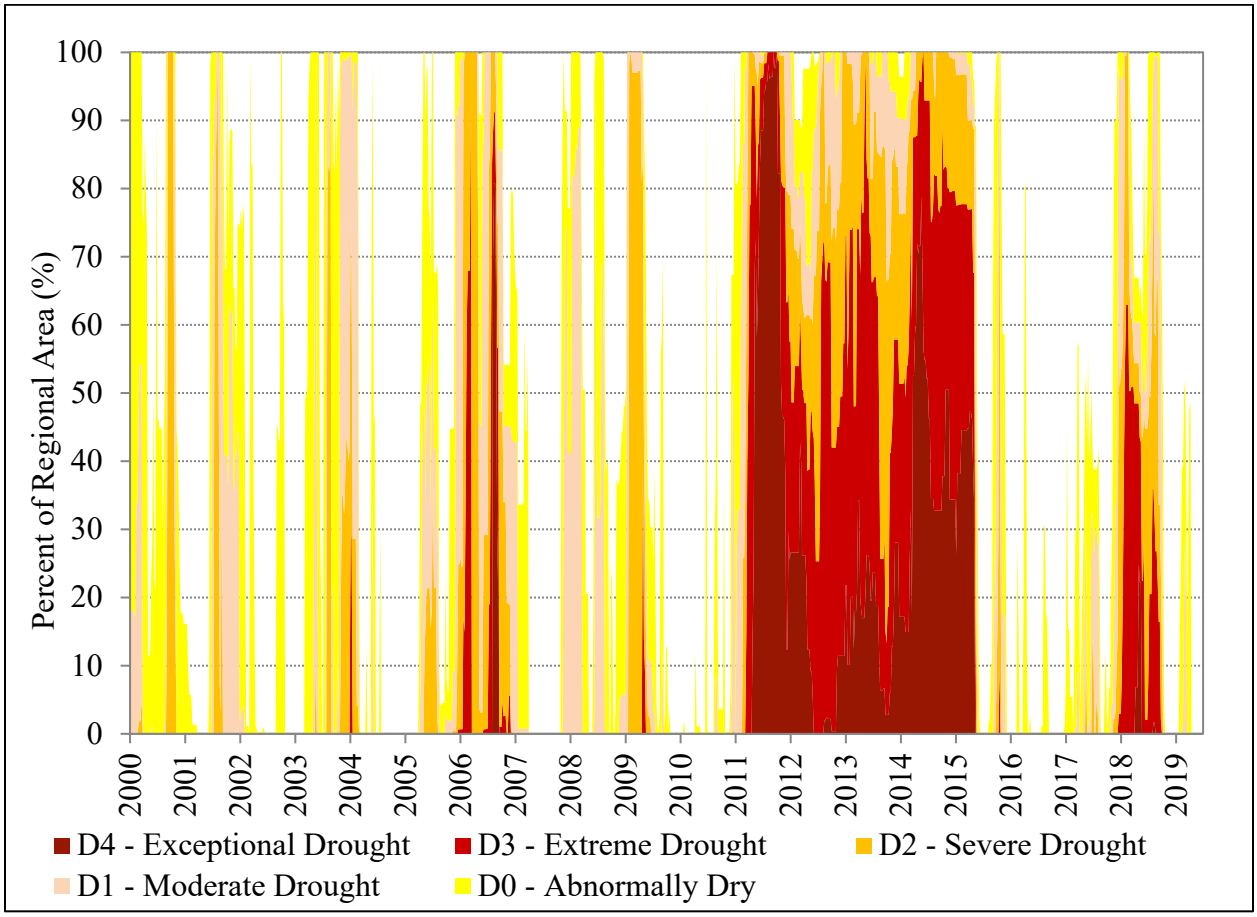
7.2.2 Recent Droughts in the Region

There are many ways to measure drought, including the U.S. Drought Monitor index, the Palmer Hydrological Drought Index, and reservoir water levels. These three indicators were reviewed to identify significant droughts in Region B since the mid-1990's.

The Drought Monitor is a composite index that is calculated weekly based on measurements of climatic, hydrologic, and soil conditions, as well as reported impacts and observations from more than 350 contributors around the country.[2] The Drought Monitor was initiated in 2000, and data can be obtained for each county in the United States. Figure 7-2 shows a composite Drought Monitor index calculated for the counties in Region B over the period of record. This composite index shows the percentage of the land area in the affected counties that experienced different levels of drought. The Drought Monitor index indicates that about 50 percent of region has continued with Extreme Drought or Exceptional Drought conditions from early 2011 through the start of 2015. Over 95 percent of the region experienced Exceptional Drought conditions from late July through early October 2011 with about 25 percent of the region being in extreme or exceptional drought continuously from July 2011 through May 2015.

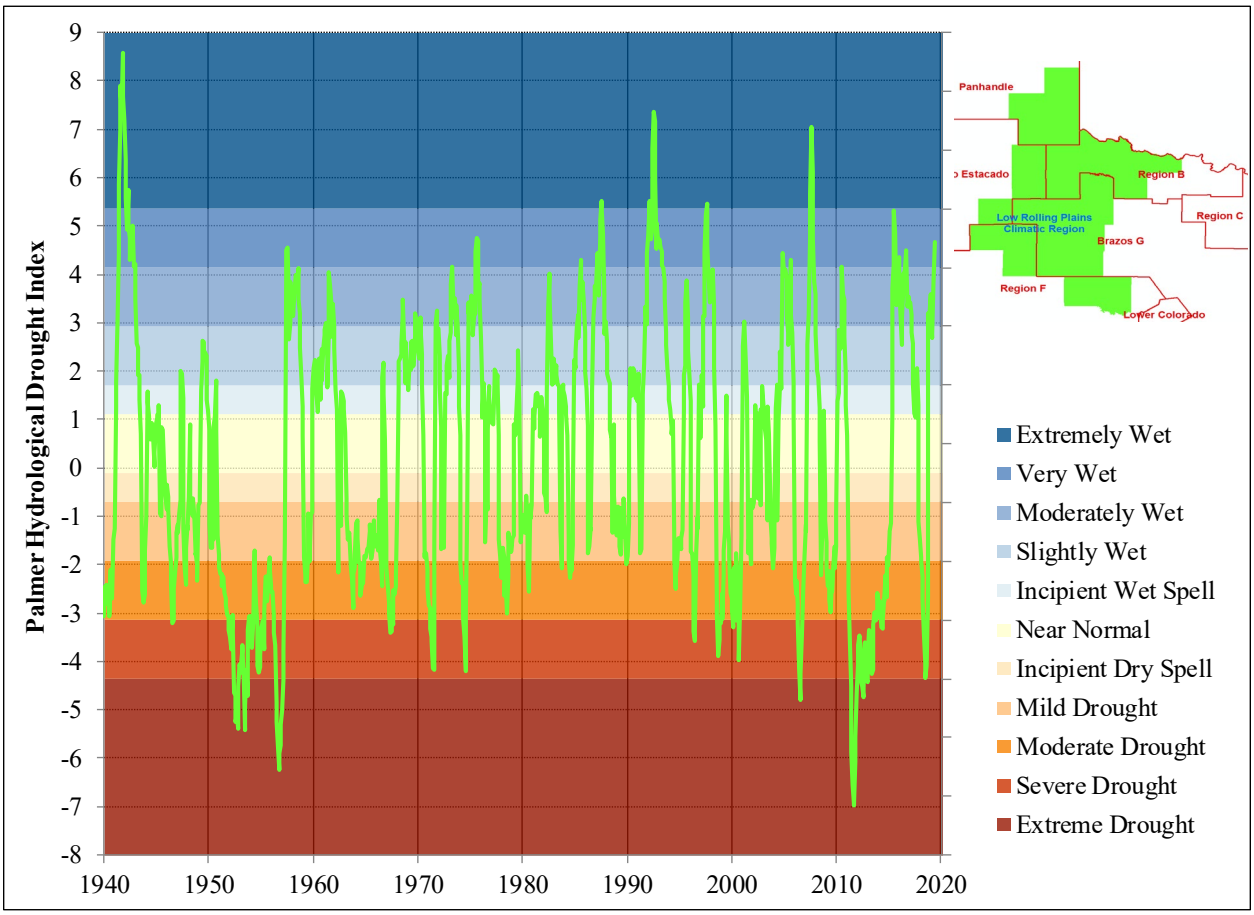
Compared to climatic effects of drought, the hydrological effects, such as lower reservoir and groundwater levels, may take longer to develop and longer still for recovery. The Palmer Hydrological Drought Index (PHDI) was developed as an indicator of the long-term cumulative moisture supply. The PHDI is available on a monthly basis for each year since 1900 for ten climatic regions in each state.[3] The Low Rolling Plains climatic region includes the western half of Region B and the North Central climatic region includes the eastern half of Region B. Figure 7-3 shows the PHDI for the Low Rolling Plains and Figure 7-4 shows the PHDI for the North Central climatic region.

Figure 7-2 Composite Drought Monitor Index for Counties in Region B



Source: https://droughtmonitor.unl.edu/Data/DataDownload/ComprehensiveStatistics.aspx, July 2019.

Figure 7-3 Palmer Hydrological Drought Index for the Low Rolling Plains Climatic Region

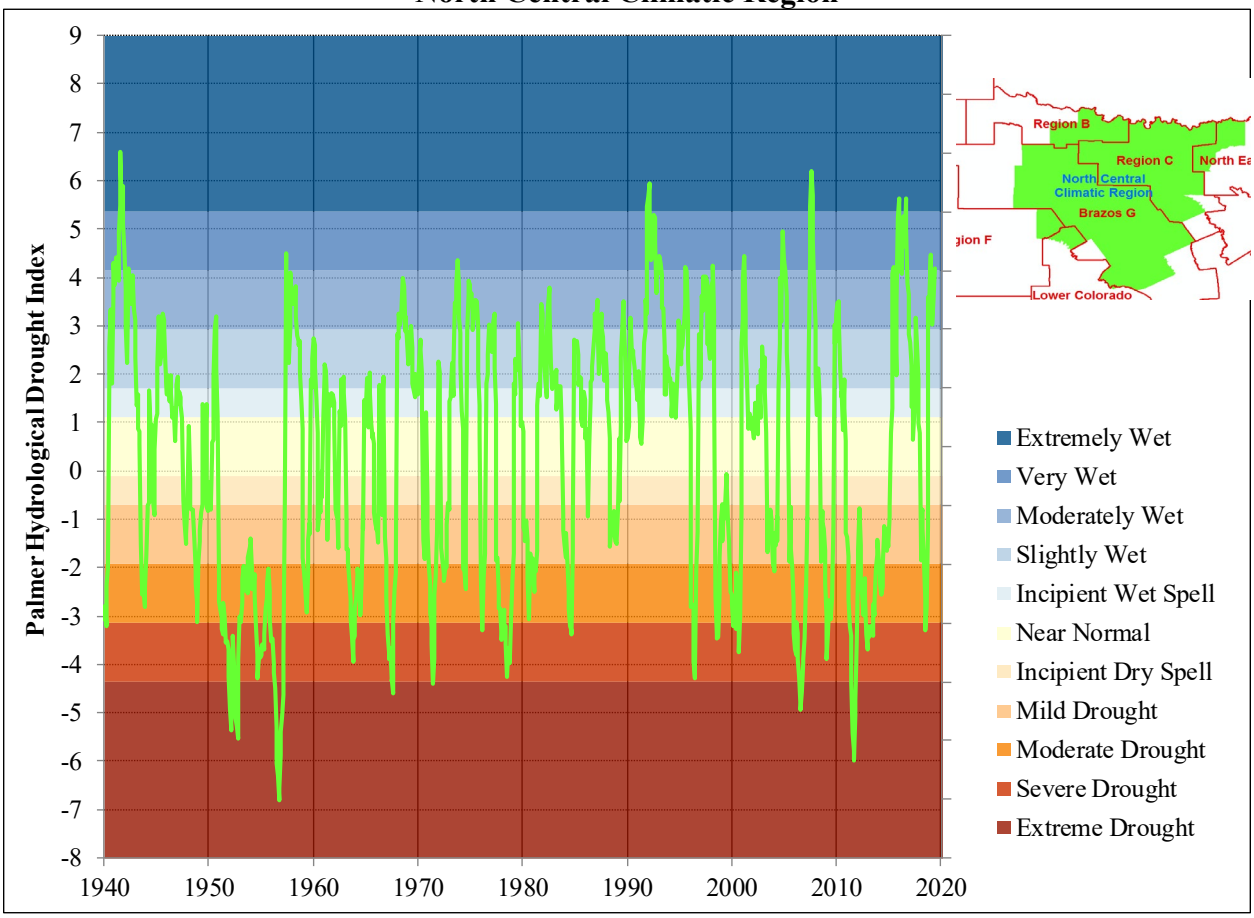


Source**:** Source: National Climatic Data Center: PHDI Divisional Data,

URL: Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, July 2019.

The PHDI reflects extended droughts during the 1950s and 2010-2015 with many shorter-term droughts occurring during the period of record. According to the PHDI, the peak (lowest downward spike) of the 2010-2015 drought was slightly more severe in the Low Rolling Plains region and slightly less severe in the North Central region. The peak of the drought in the 1950s was slightly more significant in the North Central region as compared with the Low Rolling Plains.

Figure 7-4 Palmer Hydrological Drought Index for the North Central Climatic Region



Source**:** Source: National Climatic Data Center: PHDI Divisional Data,

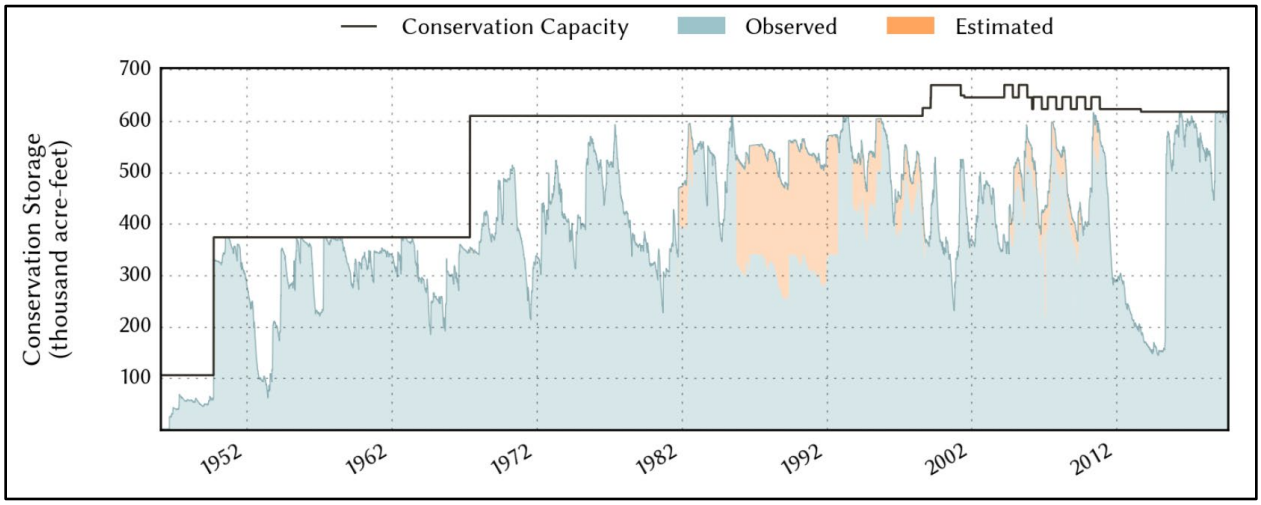
URL: Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, July 2019.

Another means of considering the drought is the impact on specific water sources. The total reservoir storage in Region B over the period of record is presented in Figure 7-5.[4] This figure indicates that the total conservation storage available within the region has increased as the result of constructing additional reservoirs. However, the available water supply dropped to about 150,000 acre-feet during the recent drought (2010-2015). During the drought of the 1950s, less than 100,000 acre-feet remained in storage, but with much less total available reservoir storage capacity.

Figure 7-6 provides the reservoir storage volume for Lake Kemp, which is one of the oldest and largest reservoirs serving Region B. Since about 1970, the reservoir has seldom been filled above

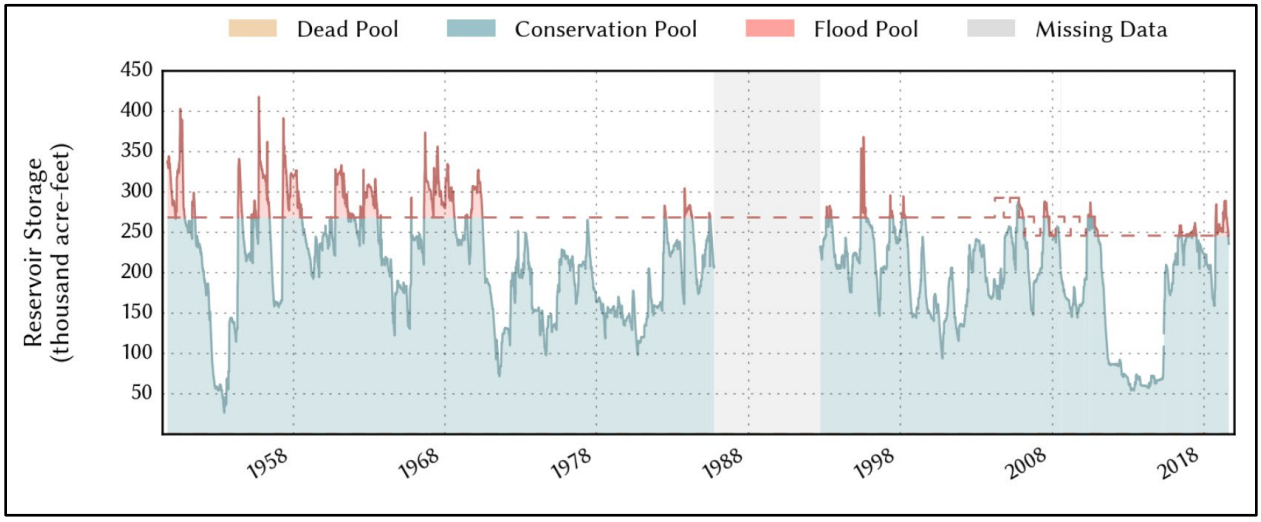
the conservation pool level. The recent drought (2010-2015) caused a significant prolonged reduction in available water supply stored in Lake Kemp.

Figure 7-5 Composite Reservoir Storage in Region B



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/region/region-b, accessed July 2019.

Figure 7-6: Reservoir Storage in Lake Kemp



Source: Texas Water Development Board: Region B Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/individual/kemp, accessed January 2015.

All drought indicators discussed in this section support a determination that the 2010-2015 period is the most significant drought, and establishes the new drought of record for Region B.

7.3 Summary of Current Drought Triggers.

The majority of the drought contingency plans in Region B use trigger conditions based on the state of water supply sources. For surface water sources the drought triggers are specific reservoir levels or volumes. For groundwater sources, the drought triggers are based on groundwater production capacity. Drought triggers for each of the surface water sources and information regarding the managing entity for each source follows. Where appropriate, the RWPG recommended retaining the triggers by stage currently in place in drought contingency plans adopted by entities responsible for managing the water source.

7.3.1 Lake Kickapoo and Lake Arrowhead

The City of Wichita Falls operates Lake Kickapoo and Lake Arrowhead. The following describes the existing drought stages triggers in these lakes under the City's DCP:

- Stage 1 – "Drought Watch" combined storage reaches 65% of conservation capacity.
- Stage 2 – "Drought Warning" combined storage reaches 50% of conservation capacity.
- Stage 3 – Drought Emergency" combined storage reaches 40% of conservation capacity.
- Stage 4 – "Drought Disaster" combined storage reaches 30% of conservation capacity.
- Stage 5 – "Drought Catastrophe" combined storage reaches 25% of conservation capacity.

7.3.2 Lake Kemp

The Wichita County Water Improvement District No. 2 operates Lake Kemp. The following describes the existing drought stages triggers for this lake under the District's DCP:

- Stage 1 – Voluntary Water Conservation - Lake elevation above 1,138 ft msl (70%)
- Stage 2 – Severe – Lake elevation between 1137.5 ft and 1131.55 ft (50%)
- Stage 3 – Critical – Lake elevation between 1131 ft and 1123.5 ft (31%)

- Stage 4 – Emergency – Lake elevation between 1123 ft and 1109.55 ft (10%)
- Stage 5 – City of Wichita Falls – Lake elevation drops below 1109 ft (9.5%)

7.3.3 Petrolia City Lake

The City of Petrolia operates Petrolia City Lake. The following describes the existing drought stages triggers for this lake under the City's DCP:

- Stage 1 – Lake storage drops below 60% capacity
- Stage 2 – Lake storage drops below 50% capacity
- Stage 3 – Lake storage drops below 35% capacity

7.3.4 Lakes Olney and Cooper

The City of Olney operates Lakes Olney and Cooper which are adjoining reservoirs. The following describes the existing drought stages triggers for Lake Cooper under the City's DCP:

- Stage 1 – Lake elevation drops below 1,135 ft msl
- Stage 2 – Lake elevation drops below 1,133 ft msl
- Stage 3 – Lake elevation drops below 1,130 ft msl
- Stage 4 – Lake elevation drops below 1,127 ft msl

7.3.6 North Fork Buffalo Creek Lake

The City of Iowa Park operates North Fork Buffalo Creek Lake. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Iowa Park has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.7 Lake Electra

The City of Electra operates Lake Electra. The lake is no longer used for municipal water supply and there are no longer trigger conditions identified for this reservoir. The City of Electra has adopted a DCP that follows the DCP triggers for Wichita Falls.

7.3.8 Lake Amon G. Carter

The City of Bowie operates Lake Amon G. Carter. The following describes the existing drought stages triggers in this lake under the City's DCP:

- Stage 1 – Lake elevation drops below 917 feet msl
- Stage 2 – Lake elevation drops below 913 feet msl
- Stage 3 – Lake elevation drops below 909 feet msl
- Stage 4 – Lake elevation drops below 905 feet msl.
- Stage 5 – Emergency, major water production or distribution limitations.

7.3.9 Greenbelt Reservoir

The Greenbelt Municipal and Industrial Water Authority (GMIWA) operates Greenbelt Reservoir, which is located in Region A. Several of the water suppliers in Region B obtain water from Greenbelt Reservoir and have adopted DCPs based on the GMIWA DCP. The following describes the existing drought stages triggers under the GMIWA's DCP:

- Stage 1 – Mild water shortage, lake elevation reaches 2,634.0 ft msl
- Stage 2 – Moderate water shortage, lake elevation drops below 2,631.0 ft msl
- Stage 3 – Severe water shortage, lake elevation drops below 2,628.0 ft msl
- Stage 4 – Emergency water shortage, lake elevation drops below 2,625.0 ft msl

7.3.10 Groundwater Sources

Drought contingency plans are addressed for the following groundwater conservation districts:

- Gateway Groundwater Conservation District
- Rolling Plains Groundwater Conservation District
- Upper Trinity Groundwater Conservation District

Gateway Groundwater Conservation District

The Gateway Groundwater Conservation District has adopted rules that indicate the district will provide drought severity information to all groundwater users in the district. The Palmer Drought severity index value will updated on the District's web site on a bi-monthly basis.

Rolling Plains Groundwater Conservation District

The Rolling Plains Groundwater conservation District primarily serves an agricultural area and has adopted a philosophy that water conservation is a continuous operating principle, and that all agricultural producers are to make every effort to conserve groundwater. Due to the significant impact that drought can have on agricultural producers, the district has adopted an operating policy that it will not limit groundwater use during drought periods beyond the limits provided by district rules.

Upper Trinity Groundwater Conservation District

The Upper Trinity Groundwater Conservation District has adopted the objective of performing a monthly review of drought conditions as posted by the TWDB on the Board's web site. In addition, the District will complete an annual review of drought conditions within the district and include this information in the Annual Report to the Board of Directors and will post the information on the District's web site.

7.4 Current Drought Preparations and Response

In 1997, the Texas Legislature directed the TCEQ to adopt rules establishing common drought plan requirements for water suppliers in response to drought conditions throughout the state. Since 1997, the TCEQ has required all wholesale public water suppliers (TAC §288.30.6), retail public water suppliers serving 3,300 connections or more (TAC §288.30.5.A), and irrigation districts (TAC §288.30.7) to submit drought contingency plans.[5] All drought contingency plans should be updated every five years and be available for inspection upon request. The most recent updates were to be submitted to the TCEQ by May 1, 2019.

All wholesale water providers and larger retail municipalities in Region B have taken steps to prepare for and respond to drought through the preparation of individual Drought Contingency Plans and by taking the necessary steps to implement the Drought Contingency Plans. The plans are required to specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement.

7.4.1 Entities Required to Have DCPs.

Table 7-2 is a list of all entities required to have DCPs, indicates which water suppliers are required to submit the DCP to Region B, and which suppliers have voluntarily provided a copy of the DCP to the Region B.

Table 7-2 Region B Water Suppliers Required to Maintain Drought Contingency Plans

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
Amon G Carter Lake WSC	Montague		
Archer County MUD 1	Archer		
Baylor SUD	Baylor		
Bluegrove WSC	Clay		
Charlie WSC	Clay		
City of Archer City	Archer	Yes	Yes
City of Bellevue	Clay		
City of Bowie	Montague	Yes	Yes
City of Burkburnett	Wichita	Yes	Yes
City of Byers	Clay	Yes	Yes
City of Chillicothe	Hardeman		
City of Crowell	Foard		
City of Electra	Wichita	Yes	Yes
City of Henrietta	Clay	No	Yes
City of Holliday	Archer		
City of Iowa Park	Wichita	Yes	Yes
City of Lakeside City	Archer		
City of Megargel	Archer		
City of Nocona	Montague	No	Yes
City of Olney	Young		
City of Paducah	Cottle		
City of Petrolia	Clay		
City of Quanah	Hardeman		
City of Saint Jo	Montague		
City of Scotland	Archer		
City of Seymour	Baylor	Yes	Yes
City of Vernon	Wilbarger	Yes	Yes
City of Wichita Falls	Wichita	Yes	Yes
Dean Dale SUD	Clay	Yes	Yes
Forestburg WSC	Montague		
Friberg-Cooper WSC	Wichita		
Gateway GWCD	Hardeman		
Greenbelt Municipal & Industrial Water Authority	Montague	Yes	Yes
Harrold WSC	Wilbarger		
Horseshoe Bend Estates	Wichita		
King Cottle WSC	Cottle		
Montague Water System	Montague		
Nocona Hills WSC	Montague		
North Montague County WSD[1]	Montague	Yes	Yes

Regulated Entity	County	Required to Submit DCP to Region B	DCP Submitted to Region B
Northside WSC	Wilbarger		
Oak Shores Water System	Montague		
Oklaunion WSC	Wilbarger		
Red River Authority of Texas	Multiple	Yes	Yes
RRA Arrowhead Lake Lots	Clay		
RRA Box Community Water System	Wilbarger		
RRA Farmers Valley Water System	Wilbarger		
RRA Foard County Water System	Foard		
RRA Goodlett Water System	Hardeman		
RRA Guthrie Dumont Water System	King		
RRA Hinds Wildcat Water System	Wilbarger		
RRA Lockett Water System	Wilbarger		
RRA Medicine Mound Water System	Hardeman		
RRA New Goodlett Water System	Hardeman		
RRA Northeast Quanah Water System	Hardeman		
RRA Ringgold	Montague		
RRA Southwest Quanah Water System	Hardeman		
Rolling Plains GCD	Baylor		
Sheppard Air Force Base	Wichita		
Sunset Water System	Montague		
Thalia WSC	Foard		
Town Of Pleasant Valley	Wichita		
Upper Trinity GCD	Montague		
Wichita County WID#2	Wichita	Yes	Yes
Waterco	Montague		
Wichita Valley WSC	Wichita		
Windthorst WSC	Archer		

1. The State Legislature is dissolving this district by the end of 2019. The City of Nacona will take over their responsibilities in 2020.

7.4.2 Water Use Reduction Targets

Stage 1 water use reduction targets range from 5 to 20 percent of total water use. Water use reduction targets in the final stage range from 30 to 60 percent of total water use. In some cases the final stage includes water rationing or reduction to a specific water production limit, which results in even greater water savings. Some WUGs do not list a reduction target for the final stage, but these plans indicate that water use limits will be based on the available supply. Table 7-3 includes a summary of the basis for drought triggers, the drought triggers for each stage and the conservation goals for each stage included in the DCPs for entities in Region B that have provided copies to the RWPG. This table also indicates the first stage where mandatory measures are required.

Table 7-3: Drought Trigger Conditions and Goals Documented in Drought Contingency Plans

Entity	Trigger Based On:		First Stage with Mandatory Measures	Drought Stage Triggers by Stage (S. = Supply; D. = Demand)					
				Percent Reduction Goal					
	Supply	**Demand**		**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**
City of Archer City	Arrowhead & Kickapoo	Demand	1	S. <= 60% D. >= 105%	S <= 50% D. >= 110%	S. <= 40% D. >= 115%	S. <= 30% D. >= 120%	S. <= 25% D. >= 120%	-
				N/A	*Surcharge*	*Surcharge*	*Surcharge*	*Surcharge*	-
City of Bowie	Lake Amon G. Carter	Demand	2	S. <= 917 ft D. >= 85%	S. <= 913 ft D. >= 90%	S. <= 909 ft D. >= 100%	S. <= 905 ft D. >= 110%	Source Contamination	-
				5%	*15%*	*25%*	*35%*	*As Needed*	-
City of Burkburnett	Notice from Wichita Falls	Total Demand	2	May 1-Sept 30 Annually	D. >= 21 MG for 10 days	D. >= 24 MG for 10 days	D. >= 27 MG for 10 days	D. >= 30 MG for 10 days	Public Health Threat
				5%	*15%*	*35%*	*45%*	*50%*	*Rationing*
City of Crowell		Water Distribu-tion Capacity	2	D. >= 85% for 2 days	D. >= 95% for 2 days	D. = 100% of capacity	-	-	-
				5%	*25%*	*25%*			
City of Electra	Arrowhead & Kickapoo	Demand	1	S. <= 65% D. >= 90%	S. <= 50% D. >= 90%	S. <= 40% D. >= 90%	S. <= 30% D. >= 100%	S. <= 25%	-
				5%	*15%*	*35%*	*45%*	*55%*	
City of Henrietta	Arrowhead Volume	Demand	2	S. <= 60% D. >=1.2 MGD	S. <= 50% D. >=1.3 MGD	S. <= 40% D.>=1.35MGD	S. <= 30% and D.>=1.38MGD	S. <= 25%	-
				-	-	-	-	-	
City of Iowa Park	Notice from Wichita Falls (WF)	Demand	2	WF @ Stg 1 or D.>= 90% for 3 days	WF @ Stg 2 or D.>= 90% for 3 days	WF @ Stg 3 or D.>= 90% for 3 days	WF @ Stg 4 or D.>= 100%	WF @ Stg 5	-
				5%	*15%*	*35%*	*45%*	*55%*	
City of Nocona	Lake Nocona Levels	Treatment Capacity	2	May1 to Sep30 Annually	Lake 824 ft or D: >=85%	Lake 822 ft or D: >=70%	Lake 819 ft or D: >=50%	Lake 817 ft or D: >=40%	As Needed
				30%	*15%*	*30%*	*50%*	*60%*	*As Needed*
City of Olney	Lake Cooper	-	1	S. <= 1135 ft	S. <= 1133 ft	S. <= 1130 ft	S. <= 1127 ft	-	-
				Use Limits	*Use Limits*	*Use Limits*	*Use Limits*	-	-
City of Seymour	Seymour Water Storage Tank	-	2	S. <= 80%	Water Table <= 9 feet	Water Table <= 6 feet	Failures or Contamination	-	-
				10%	*10%*	*20%*	*Cease Wtr Sys.*		

Entity	Trigger Based On:		First Stage with Mandatory Measures	Drought Stage Triggers by Stage (S. = Supply; D. = Demand)					
				Percent Reduction Goal					
	Supply	**Demand**		**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**
City of Vernon	Seymour Aquifer	-	3	S. <= 41ft or 15% loss of prod. capacity	S. <= 38.5ft or 20% loss of prod. capacity	S. <= 37.5ft or 25% loss of prod. capacity	S. <= 36ft or 30% loss of prod. capacity	S. <= 34ft or 50% loss of prod. capacity	-
				15%	*20%*	*25%*	*30%*	*50%*	-
City of Wichita Falls	Arrowhead & Kickapoo	-	1	S: <= 65%	S: <= 50%	S: <= 40%	S: <= 30%	S: <= 25%	-
				5%	*15%*	*35%*	*45%*	*14 MGD limit*	-
Dean Dale SUD	Arrowhead & Kickapoo	-	2	S: <= 60%	S: <= 50%	S: <= 40%	S: <= 30%	-	-
				5%	*15%*	*20%*	*30%*	-	
North Montague County Water Supply District	Lake Nocona	Total Demand	3	May1 to Sep30 Annually	S. <= 824 ft. D. >= 0.66 mgd	S. <= 822 ft. D. >= 0.88 mgd	S. <= 819 ft. D. >= 1.1 mgd	S. <= 817 ft. Major Interrupt	S. <= 815 ft. Major Interrupt
				30% of Peak	*15%*	*30%*	*50%*	*Alt. Wtr. Src.*	*Ration*
RRA Dodson Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Farmers Valley Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Guthrie Dumont Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Howardwick Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Preston and Lake Arrowhead Water Systems	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Ringgold WSC	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Samnorwood Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-
RRA Truscott-Gilliland Water System	GW Capacity	-	3	20% loss in prod. capacity	36% loss in prod. capacity	49% loss in prod. capacity	59% loss in prod. capacity	-	-
				20%	*30%*	*40%*	*As Needed*	-	-

Drought response measures vary somewhat across drought contingency plans. In general, retail water suppliers have a wider range of drought response measures available to them compared to wholesale water suppliers. One of the main drought response measures for retail water suppliers is restricting irrigation. Many plans include the following progression of irrigation limits:

- Stage 1: Voluntary limits on irrigation days (maximum of twice per week, odd/even schedule, etc.) and hours (no irrigation in the middle of the day).
- Stage 2: Mandatory limits on irrigation days and hours with irrigation limited to two days per week
- Stage 3: Irrigation limited to one day per week. Hand-held hoses may be used.
- Stage 4: Hand-held hoses or watering cans only may be used on the designated day and within the allowable hours.
- Stage 5: No outdoor water use.

The majority of Region B was in some stage of drought status from late 2010 until May of 2015. Wichita Falls and most of the other water suppliers in Region B moved to Stage 5 or the highest stage of the DCPs in May 2014. The utilities and customers operated in Stage 5 for approximately one full year with no outdoor watering from the public water supplies allowed. The region experienced relief from the drought in May 2015, lasting through the end of 2017. Drought conditions reappeared for a short term in the first half of 2018.

7.4.3 Unnecessary or Counterproductive Variation in Drought Response Strategies

In reviewing the drought response strategies presented in Table 7-3 there are some inconsistencies between drought triggers and the number of stages in drought contingency plans. There are generally drought contingency plans that have adopted five stages of drought that are consistent with the City of Wichita Falls drought trigger conditions and drought reduction goals for each drought stage. This allows for consistency in providing information to the public within the vicinity of Wichita Falls. The groundwater systems have generally adopted 4-stages of drought conditions consistent with the goals in the Red River Authority Drought Contingency Plans for groundwater supplies. There are a limited number of plans that depart from these two general types of drought

contingency plans, having a different number of drought stages, drought triggers, and reduction targets.

Region B has identified that having variation between the number of drought stages, trigger conditions, and water use reduction targets can create some uncertainty for users in the event of a drought if the messages communicated in the region do not match the local drought contingency plan requirements. All WUGs in Region B should consider the "Region-Specific Drought Response Recommendations and Model Drought Contingency Plans" identified in Section 7.7 of this Chapter.

7.5 Existing and Potential Emergency Interconnects

According to Texas Statute §357.42(d),(e) regional water planning groups are to collect information on existing major water infrastructure facilities that may be used in the event of an emergency shortage of water. Pertinent information includes identifying the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided, and a general description of the facility. Texas Water Code §16.053(c) requires information regarding facility locations to remain confidential.

This section provides general information regarding existing and potential emergency interconnects among water user groups within Region B.

7.5.1 Existing Emergency Interconnects

Much of Region B has dealt with drought conditions repeatedly over the last 20 years. As a result many of the local supplies derived from smaller reservoirs or from groundwater systems have been limited. In addition water quality has limited use of some supplies. Therefore, interconnects between water systems have become routine with many of the systems now relying on supplies from neighboring systems. In fact, the drought between 2011 and 2015 required implementation of almost all feasible interconnects. The existing interconnects are shown in Table 7-4.

Table 7-4 Existing Interconnects Between Region B WUGs

Receiver Public Water System	Provider WUG
Amon G Carter Lake WSC	City of Bowie
Archer County MUD 1	City of Wichita Falls
Baylor WSC	City of Seymour
Charlie WSC	City of Byers, Dean Dale WSC, City of Wichita Falls
City Of Burkburnett	City of Wichita Falls
City Of Byers	Dean Dale WSC City of Wichita Falls
City Of Chillicothe	Greenbelt MIWA
City Of Crowell	Greenbelt MIWA
City Of Electra	City of Iowa Park City of Wichita Falls
City Of Holliday	City of Wichita Falls
City Of Iowa Park	City of Wichita Falls
City Of Lakeside City	City of Wichita Falls
City of Megargel	Baylor WSC City of Seymour
City Of Quanah	Greenbelt MIWA
City Of Scotland	City of Wichita Falls
City Of Seymour	Baylor WSC
Dean Dale SUD	City of Wichita Falls
Friberg Cooper WSC	City of Wichita Falls
Harrold WSC	City of Electra City of Iowa Park City of Wichita Falls
Horseshoe Bend Estates	City of Wichita Falls
Northside WSC	City of Vernon
Oklaunion WSC	City of Vernon
RRA Lockett Water System	City of Vernon
RRA Box Community Water System	City of Vernon
RRA Farmers Valley Water System	Greenbelt MIWA
RRA Foard County Water System	Greenbelt MIWA
RRA Goodlett Water System	Greenbelt MIWA
RRA Hinds Wildcat Water System	City of Vernon
RRA Medicine Mound Water System	Greenbelt MIWA
RRA New Goodlett Water System	Greenbelt MIWA
RRA Northeast Quanah Water System	Greenbelt MIWA
RRA Southwest Quanah Water System	Greenbelt MIWA
Sheppard Air Force Base	City of Wichita Falls
Thalia WSC	City of Crowell Greenbelt MIWA

Receiver Public Water System	Provider WUG
Town Of Pleasant Valley	City of Wichita Falls
TPWD Copper Breaks State Park	Greenbelt MIWA
Wichita Valley WSC	City of Archer City City of Iowa Park City of Wichita Falls

Source: Texas Commission on Environmental Quality: Water Utility Database, URL: https://dww2.tceq.texas.gov/DWW/, accessed July 2019.

7.5.2 Potential Emergency Interconnects

The existing water systems within the region were evaluated for potential to implement additional emergency interconnects. Due to the number of interconnects that have already been implemented, limited opportunity for additional interconnects are feasible.

7.6 Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

Texas Statute §357.42(g) requires regional water planning groups to evaluate potential temporary emergency water supplies for all County-Other WUGs and municipalities with 2010 populations less than 7,500 that rely on a sole source of water. The purpose of this evaluation is to identify potential alternative water sources that may be considered for temporary emergency use in the event that the existing water supply sources become temporarily unavailable due to extreme hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts.

This section provides potential solutions that should act as a guide for municipal water users that are most vulnerable in the event of a loss of supply. This review was limited and did not require technical analyses or evaluations following in accordance with 31 TAC §357.34.

7.6.1 Emergency Responses to Local Drought Conditions

Table 7-5 presents temporary responses that may or may not require permanent infrastructure. It was assumed in the analysis that the entities listed would have approximately 180 days or less of remaining water supply. Table 7-5 is followed by a discussion of the alternative drought water supply strategies.

Table 7-5: Emergency Responses to Local Drought Conditions in Region B

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Archer City	Archer	2,022	263	*	*		*		*			Wichita Falls	*
Holliday	Archer	1,786	231	*	*		*		*			Wichita Falls	*
Lakeside City	Archer	1,077	125	*	*		*		*			Wichita Falls	*
Scotland	Archer	501	194	*	*		*		*			Wichita Falls	*
Wichita Valley WSC	Archer	2,994	221	*	*		*		*			Wichita Falls	*
Windthorst WSC	Archer	1,266	294	*	*		*		*			Bowie	*
Seymour	Baylor	2,692	490	*	*		*		*			Baylor WSC	*
Dean Dale WSC	Clay	2,151	163	*	*		*		*			Wichita Falls	*
Henrietta	Clay	3,374	664	*	*		*		*				
Windthorst WSC	Clay	227	140	*	*		*		*			Bowie	*
Paducah	Cottle	1,458	290	*	*		*		*				
Crowell	Foard	1,137	138	*	*		*		*			Greenbelt	*
Quanah	Hardeman	2,981	396	*	*		*		*			Greenbelt	*
Bowie	Montague	5,305	995	*	*		*		*				
Nocona	Montague	3,321	740	*	*		*		*				

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
Saint Jo	Montague	898	155	*	*		*		*				
Dean Dale WSC	Wichita	1,248	81	*	*		*		*			Wichita Falls	*
Electra	Wichita	3,206	884		*		*		*			Wichita Falls	*
Iowa Park	Wichita	6,678	884		*		*		*			Wichita Falls	*
Wichita Valley WSC	Wichita	3,159	370	*	*		*		*			Wichita Falls	*
Olney	Young	3,429	556	*	*		*		*				*
County Other													
Windthorst	Archer	409		*	*				*				
Byers	Clay	534		*	*		*		*			Dean Dale WSC	*
Petrolia	Clay	808		*	*		*		*				
Chillicothe	Hardeman	796		*	*		*		*			Greenbelt	*
RRA Goodlett Water System	Hardeman	58		*	*				*			Greenbelt	*
RRA New Goodlett Water System	Hardeman	50		*	*				*			Greenbelt	*
RRA Northeast Quanah Water System	Hardeman	199		*	*				*			Greenbelt	*
RRA Southwest Quanah Water System	Hardeman	51		*	*				*			Greenbelt	*
RRA Foard County Water System	Foard	225		*	*				*			Crowell/ Greenbelt	*

Entity											Implementation Requirements		
Water User Group Name	County	2010 Population	2020 Demand (AF/year)	Drill additional groundwater wells	Brackish groundwater limit treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked - in water	Voluntary transfer from irrigation	Type of infrastructure required	Entity providing supply	Emergency agreements already in place
City Of Lakeside City	Wichita			*	*				*			Wichita Falls	*
RRA Lockett Water System	Wilbarger	638		*	*				*			Vernon	*
RRA Box Community Water System	Wilbarger	127		*	*				*			Vernon	*
RRA Hinds-Wildcat	Wilbarger	160		*	*				*		Pipeline and pump station	Vernon	

7.6.2 Voluntary Transfer of Irrigation Rights

An additional evaluation was conducted which considered voluntary transfer of irrigation rights as an emergency response to local drought conditions. Voluntary transfer of irrigation rights is the payment for temporary transfer of local irrigation supplies for other uses. Voluntary transfer or "irrigation suspension" programs have been implemented successfully in Edwards Aquifer near San Antonio. Similar strategies are not considered viable in Region B, as during drought the WCWID No. 2 has already curtailed water use, conserving the remaining surface water quantities for municipal use. In addition there are not groundwater systems that would allow for such a water transfer because the groundwater sources are not as regionally connected as the Edwards Aquifer.

7.6.3 Brackish Groundwater

Brackish groundwater was evaluated as a temporary source during an emergency water shortage. Some brackish groundwater is found in various locations throughout the region. Due to water quality concerns many system have abandoned or limited use of existing brackish groundwater sources. In some cases these could be utilized during severe drought and blended with other sources. Required infrastructure would include some additional wells, potential treatment facilities, and conveyance facilities.

7.6.4 Drill Additional Local Groundwater Wells and Trucking in Water

In the event that the existing water supply sources become temporarily unavailable, drilling additional groundwater wells and trucking in water are optimal solutions. Table 7-5 presents this option as viable for all entities listed.

7.7 Region-Specific Drought Response Recommendations and Model Drought Contingency Plans

As required by the TWDB, Region B shall develop drought recommendations regarding the management of existing groundwater and surface water sources. These recommendations must include factors specific to each source as to when to initiate drought response and actions to be taken as part of the drought response. These actions should be specified for the manager of a water source and entities relying on the water source. Region B has defined the manager of water sources

as the entity that controls the water production and distribution of the water supply from the source. For purposes of this assessment, a manager must also meet the TCEQ requirements for development of Drought Contingency Plan. Entities that rely on the water sources include customers of the water source manager and direct users of the water sources. A list of each surface water source in Region B and the associated drought triggers was provided in Section 7.3.

7.7.1 Drought Trigger Conditions for Groundwater Supplies

In general, groundwater supplies are somewhat localized to the users of these sources. As noted in Section 7.4, some public water providers utilize groundwater and have developed DCPs that are specific to their water supplies. However, there are many individual groundwater users not connected to a public water system or located within a groundwater conservation district. To convey drought conditions to all users of these resources in Region B, the RWPG proposes to use the Drought Monitor. This information is easily accessible and updated regularly. It does not require a specific entity to monitor well water levels or stream gages. It is also geographically specific so that drought triggers can be identified on a sub-county level that is consistent with the location of use. Region B adopted the nomenclature from the Drought Monitor for corresponding drought triggers. Table 7-6 shows the drought stages adopted by the U.S. Drought Monitor and the associated Palmer Drought Index.

Table 7-6 Drought Severity Classification

Category	Description or Stage	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

U.S. Drought Monitor: https://droughtmonitor.unl.edu/About/WhatistheUSDM.aspx

For groundwater supplies, Region B recognizes that the initiation of drought response is the decision of the manager of the source and/or user of the source. Region B recommends the following actions based on each of the drought stages listed in Table 7-6:

- Abnormally Dry – Entities should begin to review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Moderate Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Severe Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should begin considering alternative supplies.
- Extreme Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should consider alternative supplies.
- Exceptional Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies are not sufficient to meet reduced demands the entity should implement alternative supplies.

7.7.2 Model Drought Contingency Plans

Model drought contingency plans were developed for municipal and irrigation entities in Region B and are available online through the Region B website under the Misc Documents tab within Publications (http://regionbwater.org/). Each plan identifies four drought stages: mild, moderate, severe and emergency. Some plans also include a critical drought stage. The recommended responses range from notification of drought conditions and voluntary reductions in the "mild" stage to mandatory restrictions during an "emergency" stage. Each entity will select the trigger

conditions for the different stages and the appropriate response. Entities should use the TAC 228 rules mandated by the TCEQ as the guideline in development of these plans.

7.8 Drought Management Water Management Strategies

Drought management is a temporary strategy to conserve available water supplies during times of drought or emergencies. This strategy is not recommended to meet long-term growth in demands, but rather acts as means to minimize the adverse impacts of water supply shortages during drought. The TCEQ requires drought contingency plans for wholesale and retail public water suppliers and irrigation districts. A drought contingency plan may also be required for entities seeking State funding for water projects. Region B does not recommend specific drought management strategies. Region B recommends the implementation of DCPs by suppliers when appropriate to reduce demand during drought and prolong current supplies. Region B also recommends the implementation of conservation measures for all users to conserve water resources for the future.

7.9 Other Drought Recommendations

One of the challenges with drought in Region B is that the response to drought and associated impacts can vary depending upon the timing of the drought. Droughts that occur during the growing season can have a greater impact than drought occurring at other times. Since irrigated agriculture accounts for a large percent of the water use in the region, the impacts of agricultural droughts on water supplies can be significant.

To be better prepared for future droughts, Region B has the following recommendations:

- Municipal water users that rely on groundwater should consider protecting water supplies from competition through the acquisition of additional water rights and/or expansion of current well fields.
- To minimize potential catastrophic failure of an entity's water system, the entity should provide sufficient resources to maintain its infrastructure in good condition. Region B recognizes that water main breaks and system failures do occur, but with proper maintenance these may be able to be reduced.
- Water users should continue to use water efficiently to conserve limited resources on a year round basis, so that conservation becomes standard practice.

Region B provides the following recommendations to the DPC and regarding the State Drought Preparedness Plan:

- The DPC information should be maintained in the Texas Division of Emergency Management (TDEM). As such, information on drought status should be provided at https://tdem.texas.gov/. In reviewing the information provided on this site there is no mention of drought as an emergency condition. This is an oversight that should be addressed. At a minimum, this internet site should provide a link to https://www.drought.gov/drought/states/texas, which provides access to current drought status information. A link to the TWDB Drought Dashboard (https://waterdatafortexas.org/drought) should also be provided.
- The quarterly DPC reports are housed on the site of the State Climatologist (https://climatexas.tamu.edu/drought/index.html). However, there is no link between the TDEM site and the State Climatologist site that would provide quick access to these reports. In addition, the State Climatologist site does not provide DPC reports after the Fall, 2018, or two years before the date of this plan. It is not known whether these reports were not produced or if they have not been provided with links added to the site. The DPC should produce quarterly reports, as required.
- A comprehensive State Drought Preparedness Plan was not found at the TDEM web site, the State Climatologist web site, or the TWDB web site. The DPC shall develop and implement a comprehensive State Drought Preparedness Plan as required by the Texas Water Code, Section 16.0551 and it should be accessible through the TDEM web site.

References

[1] Drought Dashboard, Water Data for Texas, Texas Water Development Board, https://waterdatafortexas.org/drought .

[2] Drought page, Office of the Texas State Climatologist, https://climatexas.tamu.edu/drought/index.html .

[3] National Climatic Data Center: PHDI Divisional Data, URL: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv/climdiv-phdidv-v1.0.0-20190604, accessed July 2019.

[4] National Drought Mitigation Center: U.S. Drought Monitor, URL: http://droughtmonitor.unl.edu/, accessed July 2019.

[5] Texas Administrative Code, Title 30, Chapter 288.

[6] Texas Commission on Environmental Quality: Water Availability Models, URL: http://www.tceq.texas.gov/permitting/water_rights/wam.html, accessed May 2014.

[7] Texas Department of Emergency Management, https://tdem.texas.gov/ .

[8] Texas Water Code, Section 16.0551.

[9] Texas Water Development Board: Region-B Planning Region Reservoirs, URL: https://www.waterdatafortexas.org/reservoirs/region/region-b, accessed July 2019.