Chapter 7

Drought Response Information, Activities, and Recommendations

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Drought response and management have long been important aspects of regional water planning. The extensive drought experienced in Texas during the 2010-2012 time-frame, however, served to re-focus attention on the need for comprehensive consideration of drought management measures. Requirements for improved drought planning in the State through the regional water planning process are found in Title 31 of the Texas Administrative Code, Part 10, Chapter 357, Subchapter D. Specifically §357.42 of Subchapter D includes requirements related to drought response information, activities, and recommendations. This chapter addresses the requirements found in §357.42.

While the ETRWPA is generally less prone to extreme drought, there have been significant historical droughts identified throughout the region. These have tended to be sub-regional in nature, meaning a significant or extreme drought is more likely to be localized than in other, drier regions of the State. This limited geographic extent affects how the region prepares for and responds to drought when it does occur.

7.1 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, droughts during 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.

7.1.1 Historical 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 (WAMs).[1] The WAMs can be used to simulate the response of existing and proposed water supply reservoirs to historical hydrologic conditions. The firm yield of a reservoir is the greatest amount of water the reservoir can supply on an annual basis without shortage during a repeat of historical drought of record conditions. The WAMs incorporate historical hydrologic conditions that occurred between 1940 and 1996. The historical droughts of record that were used to evaluate currently available water supplies occurred during this time period. Table 7.1 shows the historical drought of record for each major reservoir in the ETRWPA.

Table 7.1 Historical Droughts of Record for Major Water Supply Reservoirs

Reservoir Name	Counties	Drought of Record[a]	
		Start Date	End Date
Trinity River Basin			
Houston County	Houston	Jul 1950	Apr 1957
Neches River Basin			
Lake Athens	Henderson	Jun 1947	Mar 1957
Lake Jacksonville	Cherokee	Jul 1950	Mar 1957
Lake Palestine	Anderson, Cherokee, Henderson, Smith	Jul 1950	Feb 1957
Sam Rayburn	Angelina, Jasper, Nacogdoches, Sabine, San Augustine	Jun 1954	Feb 1957
B. A. Steinhagen	Jasper, Tyler		
Lake Columbia[b]	Cherokee, Smith	Jul 1962	Mar 1966
Lake Naconiche	Nacogdoches	Jan 1962	Oct 1973
Striker Creek Reservoir	Cherokee, Rusk	May 1963	Mar 1965
Lake Nacogdoches	Nacogdoches	Jun 1969	Oct 1972
Lake Pinkston	Shelby	Jun 1969	Oct 1972
Lake Tyler/Tyler East	Smith	Jun 1980	Oct 1985
Sabine River Basin			
Lake Cherokee	Gregg, Rusk	Jun 1962	Dec 1964
Lake Murvaul	Panola	Jun 1962	Jan 1965
Toledo Bend Reservoir	Newton, Panola, Sabine, Shelby	Jun 1962	Jan 1968

a For each location, the drought of record refers to a set of hydrologic conditions that is used to evaluate the firm yield of an existing or proposed reservoir.
b Lake Columbia is permitted but not yet constructed, and is in the process of U.S. Army Corps of Engineers permitting.

The drought of record can be different for different geographic locations. There have been four primary droughts of record in the East Texas Region:

- The drought of the 1950s in the western and central portions of the region.
- With exceptions described below, the drought beginning in about 1962 and spanning the mid-1960s for the north central and eastern portions of the region.
- The June 1969-October 1972 drought in the north central portion of the region.
- The June 1980-October 1985 drought for the northern portion of the region.

7.1.2 Recent Droughts in the Region. There are a number of ways to measure drought, including the U.S. Drought Monitor index, the Palmer Hydrological Drought Index, and reservoir water levels. These indicators were used in an attempt to identify significant new droughts in the ETRWPA 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 7.1 shows a composite Drought Monitor index calculated for the 20 counties in the ETRWPA 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. Approximately 15 to 30 percent of the region experienced extreme drought in 2006, 2007, and for a brief period in 2013. The Drought Monitor index indicates that the region experienced extreme/exceptional drought conditions from late 2010 through early 2012. In October 2011, the entire region experienced exceptional drought conditions.

Compared to climatic effects of drought, the hydrological effects, such as lower reservoir and groundwater levels, may take longer to develop and take longer to recover

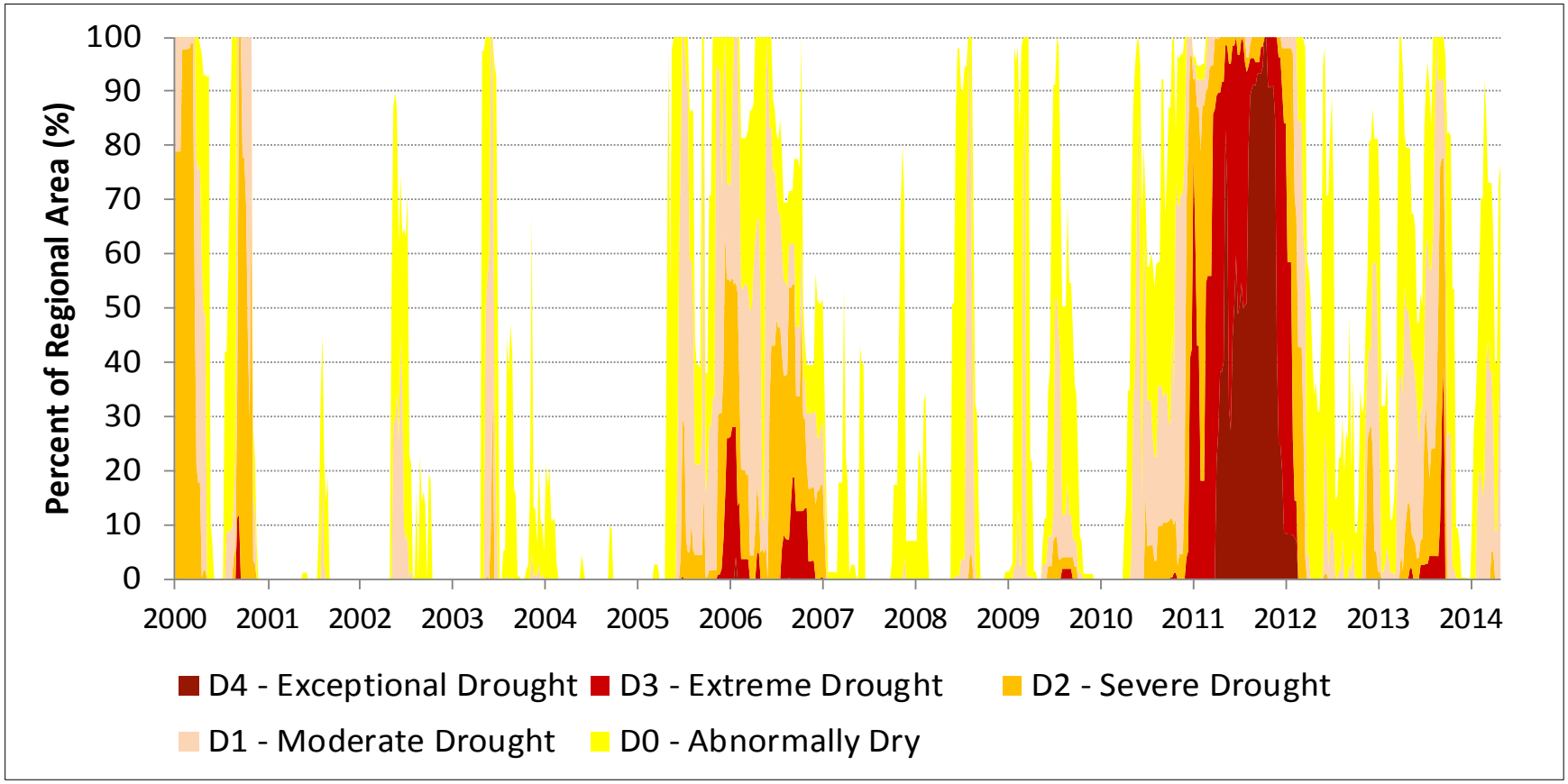
from. The Palmer Hydrological Drought Index (PHDI) was developed as an indicator of the long-term cumulative moisture supply. The PHDI is available on a monthly basis for each year since 1900 for ten climatic zones in each state.[3] The East Texas climatic zone includes most of the ETRWPA, as well as parts of Regions C, G, and H and the North East Texas RWPA. Figure 7.2 shows the PHDI for the East Texas climatic zone. The PHDI reflects extreme droughts in this area during the 1950s, as well as in 1981, 2005-06, and 2010-12.[1] According to the PHDI, the 2010-2012 drought was more severe than any of the individual droughts in the 1950s.

Since construction of the Sam Rayburn and Toledo Bend Reservoirs in the late 1960s, reservoirs in the ETRWPA reached minimum conservation storage during the droughts of 1995-1996 and 2010-2012, with several smaller droughts occurring during the period (Figure 7.3).[4]

Each of the three drought indicators suggests that the 2010-2012 period was one of significant drought for the ETRWPA. However, each of these indicators applies to the ETRWPA as a whole, and more localized hydrologic information is necessary to evaluate whether accounting for recent droughts would change the estimates of available surface water supplies. For a full evaluation of the impact of a potential new drought of record on surface water supply availability, the WAMs should be updated to incorporate the hydrologic conditions that have occurred since 1996.

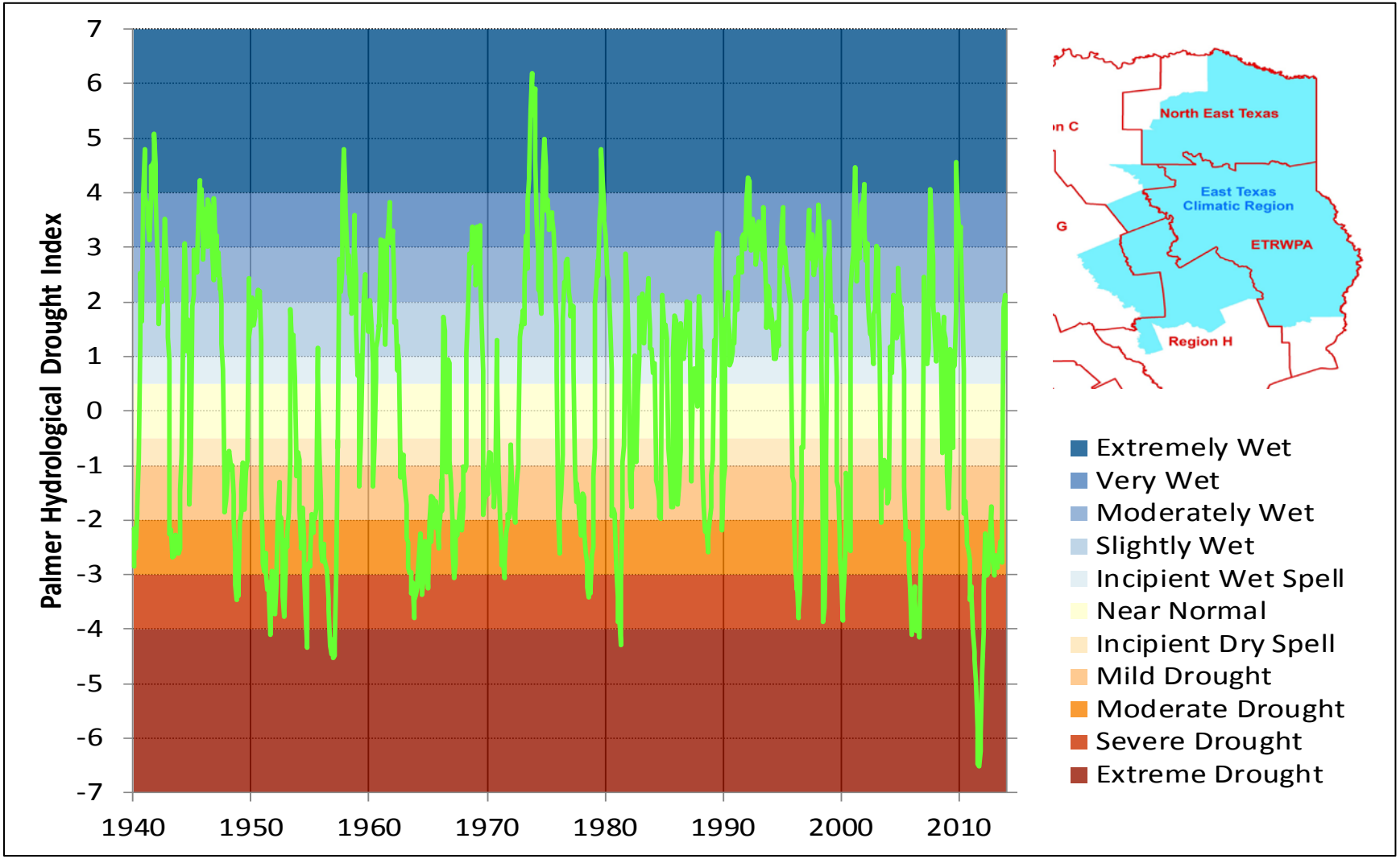
[1] Note that, while "extreme drought" is the second most severe category of drought for the Drought Monitor index, it is the most severe category of drought for the PHDI.

Figure 7.1 Composite Drought Monitor Index for Counties in the ETRWPA



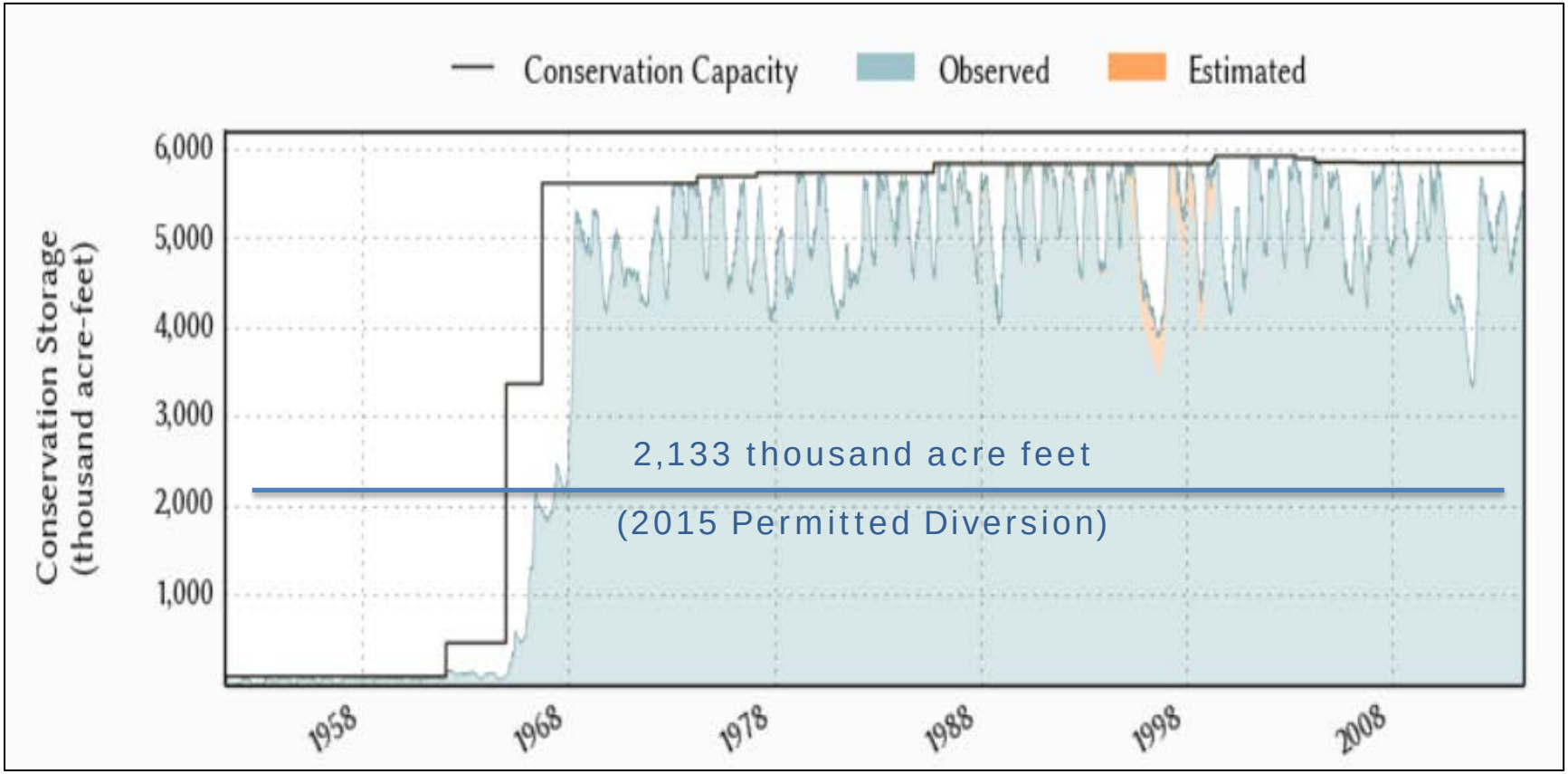
Source: Data provided by the National Drought Mitigation Center, May 2014.

Figure 7.2 Palmer Hydrological Drought Index for the East Texas Climatic Zone



Source: National Climatic Data Center: PHDI Divisional Data, URL: http://www1.ncdc.noaa.gov/pub/data/cirs/drd/drd964x.phdi.txt, accessed May 2014.

Figure 7.3 Composite Reservoir Storage in the ETRWPA



Source: Texas Water Development Board: East Texas Planning Region Reservoirs, URL: http://waterdatafortexas.org/reservoirs/region/east-texas, accessed May 2014.

7.2 Current Drought Preparations and Responses in Drought Contingency Plans

The Texas Commission on Environmental Quality (TCEQ) requires the following types of water providers to submit drought contingency plans to the agency:

- Retail public water suppliers serving 3,300 connections or more
- Wholesale public water suppliers
- Irrigation districts
- Applicants for new or amended water rights

In addition, the TCEQ requires retail public water suppliers serving fewer than 3,300 connections to prepare and adopt a drought contingency plan and make the plan available upon request. A list of water users that are required by Texas Water Code Section 11.1272 to submit a drought contingency plan is included in Table 7.2. For retail public water suppliers, the current number of connections was obtained from the TCEQ Water Utility Database. Drought contingency plans were to be updated and submitted to the TCEQ and ETRWPG by May 1, 2014. Failure to submit a drought contingency plan is a violation of the Texas Water Code, Section 11.272 and the Texas Administrative Code, Section 288.30, and is subject to enforcement by the TCEQ.

7.2.1 Summary of Current Drought Triggers, Goals, and Response Measures.

The majority of the drought contingency plans (DCPs) in the ETRWPA use trigger conditions based on a combination of water supply and demands placed on the water distribution system.

Utilities use water supply-based triggers to identify the onset of drought and to reduce water usage accordingly. Typical supply based triggers depend on water levels in wells, water levels in reservoirs, and/or water system storage capacity.

Demand-based triggers are based on limitations in a utility's ability to treat and/or convey water to its customers. Demand-based triggers are typically expressed as a percentage of water production capacity.

Drought contingency plans typically identify different stages of drought and specific triggers and responses for each stage. In addition, the plan must specify quantifiable targets for water use reductions for each stage, and a means and method for enforcement. Table 7.3 summarizes 36 DCPs for entities who submitted their plans to the ETRWPG by February 20, 2015 or who have published drought contingency plans on their web sites. The plans include 3 to 6 stages, typically with voluntary measures beginning in Stage 1 and mandatory measures beginning in Stage 2. Some DCPs include an emergency stage not directly related to drought but based on system rupture or failure. Other DCPs have a water rationing section, apparently for situations that are more severe than the final drought contingency stage. In these instances, water rationing is listed in Table 7.3 as the final stage.

Many plans that list water savings goals in terms of percentages of total water use. For these plans, Figure 7.4 shows the following by drought response stage:

- Range of water savings goals and
- Number of plans that include percentage water savings goals.

Table 7.2 ETRWPA Water Suppliers Required to Submit Drought Contingency Plans

Angelina & Neches River Authority	City of Palestine
Angelina-Nacogdoches WCID	City of Pineland
Athens Municipal Water Authority	City of Port Arthur
City of Athens	City of Port Neches
City of Beaumont	City of Rusk
City of Bridge City	City of San Augustine
City of Carthage	City of Tyler
City of Center	G M WSC
City of Crockett	Houston County WCID No. 1
City of Grapeland	Lake Livingston Water Supply & Sewer Service Company
City of Groves	Lindale Rural WSC
City of Hemphill	Lower Neches Valley Authority
City of Henderson	Lumberton MUD
City of Jacksonville	North Cherokee WSC
City of Jasper	Orange County WCID 1
City of Joaquin	Panola County Fresh Water Supply District No. 1
City of Kilgore	Rusk Rural WSC
City of Lindale	Sabine River Authority
City of Lufkin	Southern Utilities Company
City of Nacogdoches	South Sabine WSC
City of Nederland	The Consolidated WSC
City of Orange	Upper Neches River Municipal Water Authority

Table 7.3 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans

Entity	Plan Date	Trigger Based On:		No. of Stages	First Stage with Manda-tory Measures	Retail Water Sales	Wholesale Water Sales	Water Use Reduction Goals by Stage: (Reduction in Total Use Unless Otherwise Specified)					
		Supply	Demand					1	2	3	4	5	6
Angelina and Neches River Authority	2014	•	•	5	2	•	•	5%	10%	10%	10%	10%	
Angelina-Nacogdoches WCID 1	2009	•		4	2		•	n/a 290'[b]	10% 288'[b]	25% 286'[b]	50% 284'[b]		
Athens Municipal Water Authority	2011	•	•	6	2		•	10%	4 MGD[c]	4 MGD[c]	4 MGD[c]	4 MGD[c]	n/a
City of Athens	2011	•	•	6	2	•		10%	4 MGD[c]	4 MGD[c]	4 MGD[c]	4 MGD[c]	n/a
City of Beaumont	2008	•	•	5	2	•	•	8%	10%	12.5%	15%	30%	
City of Bridge City	2010	•		6	2	•	•	5%	10%	15%	25%	40%	n/a
City of Carthage	2014	•	•	5	2	•	•	5%	10%	15%	20%	25%	
City of Center	2014	•	•	3	1	•	•	5%	10%	15%			
City of Crockett	2014	•	•	4	2	•	•	10%	20%	30%	n/a		
City of Grapeland	2014	•	•	4	2	•	•	10%	20%	30%	n/a		
City of Groves	2014	•	•	5	2	•	•	5%	10%	12.5%	15%	15%	
City of Henderson	2014	•	•	3	2	•		10%	10%	10%[d]			
City of Jacksonville	2014	•	•	3	2	•	•	n/a	n/a	n/a			
City of Jasper	2014	•	•	3	2	•		10%	20%	30%			
City of Kilgore	2009	•		6	2	•	•	5%	10%	15%	20%	30%	n/a
City of Lindale	2009[a]	•	•	3	2	•	•	n/a	n/a	n/a			
City of Lufkin	2000	•	•	3	2	•	•	n/a	n/a	n/a			
City of Nacogdoches	2011	•	•	5	2	•	•	10%[e]	30%[e]	50%[e]	90%[e]	75%	
City of Orange	2014	•		4	2	•	•	10%	15%	25%	n/a		
City of Palestine	2014	•	•	4	2	•	•	n/a	n/a	n/a	n/a		
City of Pineland	2014	•	•	4	2	•	•	5%	10%	20%	n/a		

Table 7.3 Drought Trigger Conditions and Strategies Documented in Drought Contingency Plans (Cont.)

Entity	Plan Date	Trigger Based On:		No. of Stages	First Stage with Manda-tory Measures	Retail Water Sales	Wholesale Water Sales	Water Use Reduction Goals by Stage: (Reduction in Total Use Unless Otherwise Specified)					
		Supply	Demand					1	2	3	4	5	6
City of Port Arthur	2014	•	•	3	2	•	•	n/a	n/a	n/a			
City of Rusk	2014	•	•	4	2	•	•	10%	15%	20%	n/a		
City of Tyler	2014	•	•	3	2	•	•	5%	10%	25%			
Four Pines WSC	2014	•	•	3	1	•	•	20%	30%	40%			
G M WSC	2009	•	•	5	2	•	•	5%	10%	20%	30%	40%	
Houston County WCID No. 1	2014	•	•	4	2	•		10%	20%	30%	n/a		
Lake Livingston Water Supply & Sewer Service Company	2011	•	•	3	2	•		n/a	n/a	n/a			
Lower Neches Valley Authority	2012	•		6	2		•	30%[f]	10%	20%	30%	n/a	n/a
Lumberton MUD	2014	•	•	6	2	•	•	25%	30%	50%	60%	70%	n/a
North Cherokee WSC	2000	•		6	2	•	•	n/a	n/a	n/a	n/a	n/a	n/a
Orange County WCID 1	2014	•	•	6	2	•		10%	15%	20%	25%	30%	n/a
Sabine River Authority	2014	•		5	2		•	n/a	10%	20%	n/a	n/a	
South Sabine WSC	2000	•		6	2	•	•	10%	15%	20%	30%	35%	n/a
Southern Utilities Company	2014	•	•	3	2	•		5%	10%	25%			
Upper Neches River Municipal Water Authority	2014	•		4	2		•	5%	10%	15%	n/a		

[a] Dated 1999 but updated with water use statistics through 2008.
[b] Water surface elevation in Lake Striker.
[c] Total usage.
[d] Cushion between demand and capacity.
[e] Reduction in landscape irrigation usage.
[f] Reduction in non-essential water use.

Figure 7.4 Range of Percentage Water Savings Goals ETRWPA Drought Contingency Plans

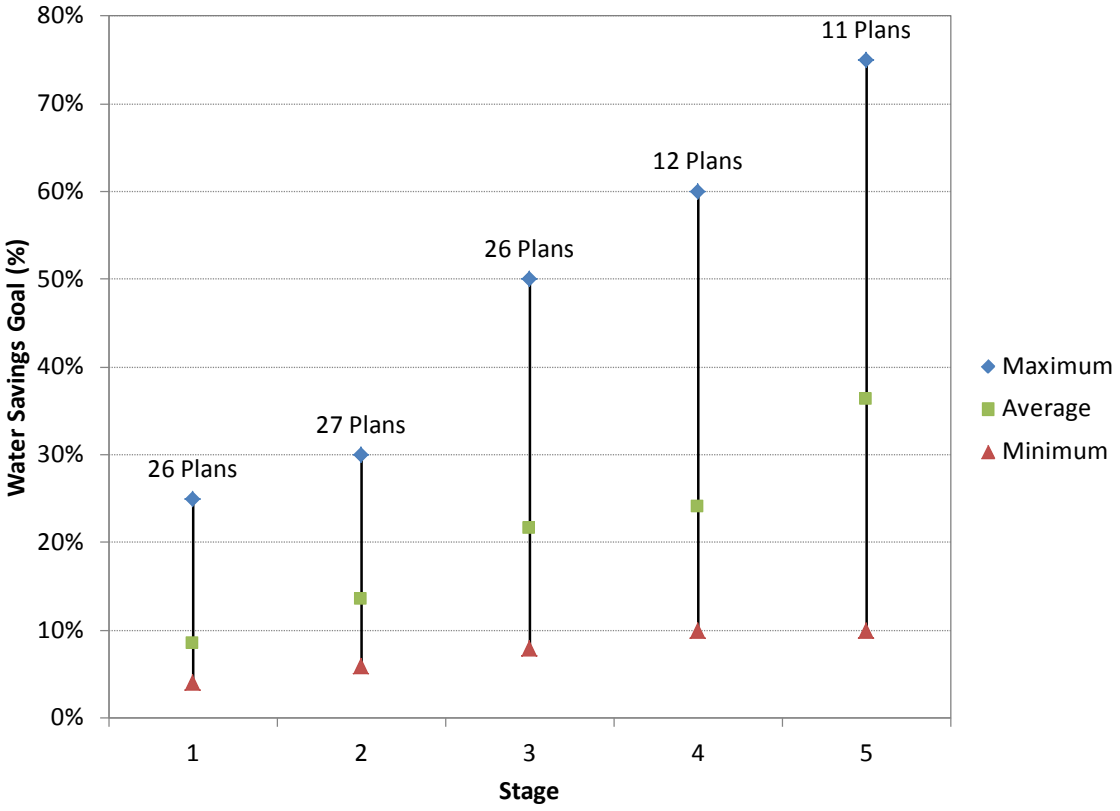


Table 7.4 summarizes drought response measures in the DCPs, showing measures that are present in at least 10 percent of the plans reviewed. In general, retail water suppliers have a wider range of drought response measures available to them compared to wholesale water suppliers.

Table 7.4 Summary of Drought Response Measures

Strategy Type 1	Strategy Type 2	Percentage of Plans Specifying Strategy	Stage Index (0-1)	Strategy
General		80%	0.24	Voluntary usage reductions
Waste	Ban	72%	0.49	Prohibit non-essential water uses (washdown, dust control, uncontrolled leaks)
Irrigation	Ban	72%	0.89	No irrigation
Rationing		64%	0.88	Water rationing
Education		63%	0.30	Public awareness/ customer awareness measures
Irrigation	Ban	63%	0.45	No irrigation during certain hours
Irrigation	Timing	54%	0.21	Voluntary irrigation hours
Waste	Ban	51%	0.70	No adding water to pools, spas
Waste	Ban	49%	0.41	No operation of ornamental fountains, ponds
Irrigation	Timing	47%	0.41	Mandatory twice-weekly irrigation limits
Irrigation	Ban	46%	0.61	No irrigation with hose-end sprinklers
Waste	Reduce	43%	0.37	Add water to pools, spas only during certain days/hours
Comm/Ind		43%	0.39	Restaurants serve water only on request
Vehicle		43%	0.46	Residential vehicle watering, window washing, pavement washing limited to hose with positive shutoff and/or bucket
Irrigation	Timing	42%	0.21	Voluntary twice-weekly irrigation limits
Comm/Ind		40%	0.75	Mandatory (or additional mandatory) reductions by wholesale, industrial, and commercial customers
Vehicle		37%	0.42	Vehicle washing only during certain days/hours (outside of commercial facilities)
Vehicle		37%	0.62	No vehicle washing outside commercial facilities
Vehicle		37%	0.62	Commercial vehicle washing only during certain hours
Irrigation	Ban	37%	0.64	No irrigation of golf course tees
Irrigation	Ban	37%	0.71	No irrigation with automatic sprinkler systems
Utility	Hydrant	34%	0.38	Limit use of water from hydrants to firefighting, activities necessary to maintain public health, safety, and welfare, and specially permitted uses.
Vehicle		34%	0.93	No vehicle washing
Rationing		33%	0.65	Initiate pro rata curtailment for wholesale customers (focus on temporary & short-term contracts first)
Utility	Similar	31%	0.30	Discuss conservation/ rationing with wholesale customers; request voluntary measures
Utility	Rates	31%	0.75	Implement rate surcharges
Utility	Admin	31%	0.80	If appropriate, notify city, county, and/or state emergency response officials for assistance
Utility	Hydrant	29%	0.25	Reduce flushing of water mains
Utility	Similar	29%	0.47	Request wholesale customers implement mandatory conservation/ rationing measures
Utility	Hydrant	29%	0.64	No construction water use from hydrants

Table 7.4 Summary of Drought Response Measures (Cont.)

Strategy Type 1	Strategy Type 2	Percentage of Plans Specifying Strategy	Stage Index (0-1)	Strategy
Utility	Admin	29%	0.65	Inform the utility director or other responsible official of each wholesale water customer by telephone or in person and suggest actions, as appropriate, to alleviate problems
Utility	Admin	29%	0.65	Undertake necessary actions, including repairs and/or clean-up as needed
Utility	Admin	29%	0.88	Assess the severity of the problem and identify the actions needed and time required to solve the problem
Utility	System	26%	0.72	No new or increased connections
Alternative		26%	0.74	Use alternative supply sources, including interconnects
Utility	Admin	26%	0.87	Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions
Utility	Similar	23%	0.19	Utility water use follows Stage 2
Irrigation	Timing	23%	0.43	Mandatory odd-even irrigation limits
Waste	Ban	23%	0.80	No outdoor water use
Waste	Ban	23%	0.97	All water usage except to protect public health, safety, and welfare is prohibited
Utility	System	20%	0.32	Inspect infrastructure, equipment; system oversight
Rationing		20%	0.46	Prepare monthly water usage allocations for wholesale customers in advance of pro rata curtailment
Utility	Hydrant	20%	0.53	No hydrant flushing/ no flushing of water mains
Irrigation		20%	0.54	Reduce or discontinue irrigation of public areas
Waste	Enforce	19%	0.67	Increased enforcement; add personnel
Alternative		17%	0.57	Investigate alternative water sources, including interconnects
Waste	Ban	17%	0.78	Discontinue non-essential water use by utility personnel
Irrigation	Timing	14%	0.25	Voluntary odd-even irrigation limits
Comm/Ind		14%	0.29	Discuss conservation with industrial and commercial customers
Utility	System	14%	0.35	Take steps toward increasing system capacity (e.g., repair wells, etc.)
Irrigation	Ban	14%	0.53	Discontinue irrigation of public areas
Irrigation	Ban	14%	0.64	No irrigation of golf course fairways
Rationing		11%	0.33	Eliminate reservoir releases to supply interruptible supplies
Utility	Leaks	11%	0.42	Aggressively locate and repair major water main leaks and breaks; move personnel to leak repair
Waste	Reduce	11%	0.42	Request customers insulate pipes to prevent freezing
Irrigation	Timing	11%	0.60	Mandatory irrigation schedule (unspecified)
Irrigation	Timing	11%	0.63	Mandatory every fourth day irrigation limits
Irrigation	Ban	11%	0.65	No irrigation of athletic fields
Rationing		11%	0.68	Establish water allocations for residential customers

Stage index is the average over all plans of the stage in which a strategy is specified divided by the number of stages. It indicates of how far into the drought response stages a strategy is specified: The higher the value, the later the stage.

One of the primary 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.
- Stage 3: No use of hose-end sprinklers.
- Stage 4: No use of automatic irrigation systems.
- Stage 5: No irrigation.

7.2.2 Drought Contingency Plan Recommendations.

During the review of submitted DCPs, eight common water sources were identified. In the following sections, DCPs are compared for entities that sell or receive water from these common water sources. The comparison focuses on the number of response stages, the triggers that initiate the stages, the water savings goals, and the response measures.

Lake Athens

The Athens Municipal Water Authority (AMWA) supplies treated water from Lake Athens to the City of Athens. The DCPs for AMWA and Athens are identical.

Houston County Lake

The Houston County Water Control and Improvement District No. 1 (HCWCID #1) supplies treated water from Houston County Lake to the Cities of Crockett and Grapeland. In the DCPs for HCWCID #1 and Crockett, the triggers, stages, and goals are aligned, and the response measures are complementary. In the DCPs for HCWCID #1 and Grapeland, the triggers, stages, and goals are aligned, and the response measures are the same. However, response measures for the HCWCID #1 are general in nature and not necessarily appropriate for a retail water provider. Grapeland should consider adding detail about the specific response measures that will be used to achieve its goals for each response stage.

Lake Jacksonville

The City of Jacksonville supplies treated water from Lake Jacksonville to the North Cherokee WSC. Jacksonville's DCP has three stages, while the North Cherokee WSC DCP has six stages. Neither plan specifies water savings goals for any of the stages. Response measures are not well-aligned, probably due to the different numbers of stages. For example, the third stage in each plan is labeled "Severe Conditions," but Jacksonville's plan bans all outdoor water use, while North Cherokee WSC's plan appears to allow twice-weekly irrigation by hand or drip irrigation system.

Both Jacksonville and North Cherokee WSC should specify water savings goals by response stage. In addition, North Cherokee WSC and Jacksonville should consider revising their plans to have the same number of response stages and commensurate response measures.

Sam Rayburn Reservoir-Steinhagen Lake System

The Lower Neches Valley Authority (LNVA) supplies raw water from the Sam Rayburn Reservoir-Steinhagen Lake System to Beaumont, Bolivar Peninsula SUD, Groves, Jefferson County WCID #10, Nederland, Nome, Port Arthur, Port Neches, West Jefferson County MWD, and Woodville. The triggers in the LNVA and Groves DCPs are aligned, but the Groves water savings goals for Stages 3 through 5 are significantly lower than LNVA's goals (12.5% vs. 20% for Stage 3, 15% vs. 30% for Stage 4, and 15% vs. "maximum" for Stage 5). Groves should consider revising response measures for Stages 3 through 5 to achieve water savings goals similar to LNVA's goals.

The Port Arthur DCP has three stages, while the LNVA DCP has five stages. Some of the Port Arthur triggers depend on LNVA declarations of "mild", "moderate", or "severe" conditions, but LNVA's stages are labeled "moderate", "severe", "extreme", "exceptional", and "emergency". Port Arthur does not specify water savings goals for any of the response stages. Due to the different stage names, different numbers of stages, and uncertain savings goals, it is not clear whether response measures are well-aligned between the two plans. Port Arthur and LNVA should consider revising plans to have the

same number of response stages and commensurate response measures, and Port Arthur should specify water savings goals by response stage.

Lake Fork Reservoir

The Sabine River Authority (SRA) Iron Bridge/Lake Fork Division supplies raw water from Lake Fork Reservoir to the Cities of Henderson and Kilgore. The Henderson DCP has three stages, while the SRA Iron Bridge/Lake Fork DCP has five stages (not counting the emergency stage). Henderson's water savings goals appear to be commensurate with or more stringent than SRA's, so the response measures appear to be complementary. Henderson's triggers are based on its treatment/distribution capacity and not on raw water supply conditions. Henderson and SRA should consider revising the plans to have the same number of response stages, and Henderson should consider adding triggers based on raw water supply conditions.

The Kilgore DCP has six stages, while the SRA Iron Bridge/Lake Fork DCP has five stages (not counting the emergency stage). Kilgore's triggers take into account the SRA response stages. However, there is no mention of SRA Stage 5 or SRA "Emergency Water Shortage Conditions", partly due to different numbers of stages between the plans. Kilgore's water savings goals appear to be commensurate with or more stringent than SRA's, so the response measures appear to be complementary. Kilgore and SRA should consider revising the plans to have the same number of response stages, and Kilgore should consider amending triggers to acknowledge SRA Stage 5 and SRA "Emergency Water Shortage Conditions".

Toledo Bend Reservoir

The Sabine River Authority (SRA) Toledo Bend/Gulf Coast Division supplies raw water from Toledo Bend Reservoir to the City of Hemphill, which in turn provides treated water to the G M WSC. No drought contingency plan was available for the City of Hemphill.

The G M WSC DCP has five stages, while the SRA Toledo Bend/Gulf Coast DCP has three stages (not counting the emergency stage). G M WSC's water savings goals are commensurate with or more stringent than SRA's, so the response measures appear to be complementary. For each response stage, the SRA DCP contains triggers that are based on the water surface elevation in Toledo Bend Reservoir (165.1 feet in Stage 1, 162.2 feet in Stage 2, and 156 feet in Stage 3). The G M WSC DCP only contains trigger based on the Toledo Bend Reservoir elevation in Stage 1 (168 feet). The other stages are triggered based only on demands.

In coordination with the City of Hemphill, G M WSC and SRA should consider revising the plans to have the same number of response stages. In addition, G M WSC should consider adding Stage 2 and Stage 3 triggers based on raw water supply conditions (similar or complementary to SRA's and/or Hemphill's triggers).

Lake Palestine

The Upper Neches River Municipal Water Authority (UNRMWA) supplies raw water from Lake Palestine to the City of Tyler, which in turn provides treated water to the Southern Utilities Company. Tyler's triggers are based on its treatment/distribution/ storage capacity and other factors but not on raw water supply conditions. Tyler's water savings goals are commensurate with or more stringent than UNRMWA's, so the response measures appear to be complementary. Tyler should consider adding triggers based on raw water supply conditions (similar or complementary to UNRMWA's triggers).

The Tyler and Southern Utilities Company DCPs have the same number of response stages, with the complementary triggers, identical water savings goals, and substantially similar response measures. Like Tyler, Southern Utilities Company should consider adding triggers based on raw water supply conditions (similar or complementary to UNRMWA's and/or Tyler’s triggers).

The UNRMWA also supplies raw water from Lake Palestine to the City of Palestine via the Neches River. The UNRMWA and Palestine DCPs have the same

number of response stages. Palestine's triggers are based on demand volume, water levels in storage tanks, and UNRMWA drought stage. Although Palestine has not listed water savings goals for its drought stages, the response measures for each stage appear to be commensurate with UNRMWA's goals. Therefore, the triggers, stages, and goals in the UNRMWA and Palestine DCPs are aligned.

Yegua-Jackson Aquifer

The City of Pineland supplies treated water from the Yegua-Jackson Aquifer to the G M WSC. The G M WSC triggers are based on its Toledo Bend Reservoir and Carrizo-Wilcox Aquifer supplies but not on Pineland water supply conditions. The G M WSC DCP has five stages, while the Pineland DCP has four stages. G M WSC's water savings goals in the latter stages (30-40%) are also greater than Pineland's (unspecified). In addition, the response measures are not particularly well-aligned. Examples include:

- In Stage 2, Pineland allows even/odd irrigation days, while G M WSC allows twice-weekly watering.
- In Stage 3, Pineland prohibits outdoor water use, while G M WSC bans hose-end sprinklers but allow twice-weekly irrigation by other methods.

However, the water purchased from Pineland comprises only a small amount of the G M WSC water supply (5.5% in 2012). For this reason, major changes to the GM-WSC plan do not appear to be necessary.

7.2.3 Drought Preparedness Council.

Title 31 of the Texas Administrative Code, §357.42(h), requires each regional water planning group to consider recommendations from the Drought Preparedness Council. On November 10, 2014, the Drought Preparedness Council provided the ETRWPG with a letter with the following two recommendations:

- Follow the outline template for Chapter 7 provided to the regions by Texas Water Development Board staff in February of 2013, making an effort to fully

address the assessment of current drought preparations and planned responses, as well as planned responses to local drought conditions or loss of municipal supply.

- Evaluate the drought preparedness impacts of unanticipated population growth or industrial growth within the region over the planning horizon.

These recommendations were considered in the development of this chapter. The sections of this chapter were developed to correspond to the sections of the Chapter 7 outline provided by the TWDB. In addition, Safety factors were used in the development of recommended WMSs, where possible, and extensive coordination with local water providers account for unanticipated population growth or industrial growth within the ETRWPA.

7.3 Existing and Potential Emergency Interconnects

Regional water planning requirements include collection of information on existing major water infrastructure facilities that could be used for interconnections with WUGs in the event of an emergency shortage of water (§357.42(d)). However, Texas Water Code §16.053(c) requires such information to be confidential and may not be released to the public. Texas Water Development Board (TWDB) guidance on the subject states that the regional water planning group will collect such information confidentially and separately from the 2016 Plan. However, a general description in the plan that does not divulge details such as interconnect locations is acceptable. This section of Chapter 7 provides the required general information regarding the use of interconnections in the region and how they are or may be used as potential drought management measures.

For example, there are a number of existing and proposed emergency interconnects between WUGs in the ETRWPA. In a region where drought may be more geographically limited, emergency interconnects become an effective tool to mitigate its effects. As emergency interconnects become more common in the region, it may be necessary to encourage the connected communities to coordinate closely on their

individual drought planning processes to that when emergency interconnections are utilized, all affected communities are aware of the need and can help facilitate water transfers with a minimum of adverse impact on all parties.

Interconnecting with another water system is a potential drought response measure. The drought contingency plans reviewed in Section 7.2 establish the following interconnection drought response measures.

- Evaluate the potential for interconnecting with other neighboring systems (Stage 1, one utility)
- Implement protocols to establish interconnections with other neighboring systems, if appropriate (Stage 2, one utility)
- Interconnect with other neighboring systems/implement agreements with adjacent water providers (Stage 3, three utilities)

Many WUGs have existing emergency interconnects with other utilities. Existing interconnects have not been listed in this plan for security reasons.

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

For all County-Other WUGs and for municipal WUGs with 2010 population less than 7,500 that rely on a sole water source, regional water planning rules require an evaluation of potential emergency response to local drought conditions or temporary loss of existing water supplies.

Of the 142 municipal WUGs, 82 had a 2010 Census population of less than 7,500 people and rely on a single water source. Of these municipal WUGs:

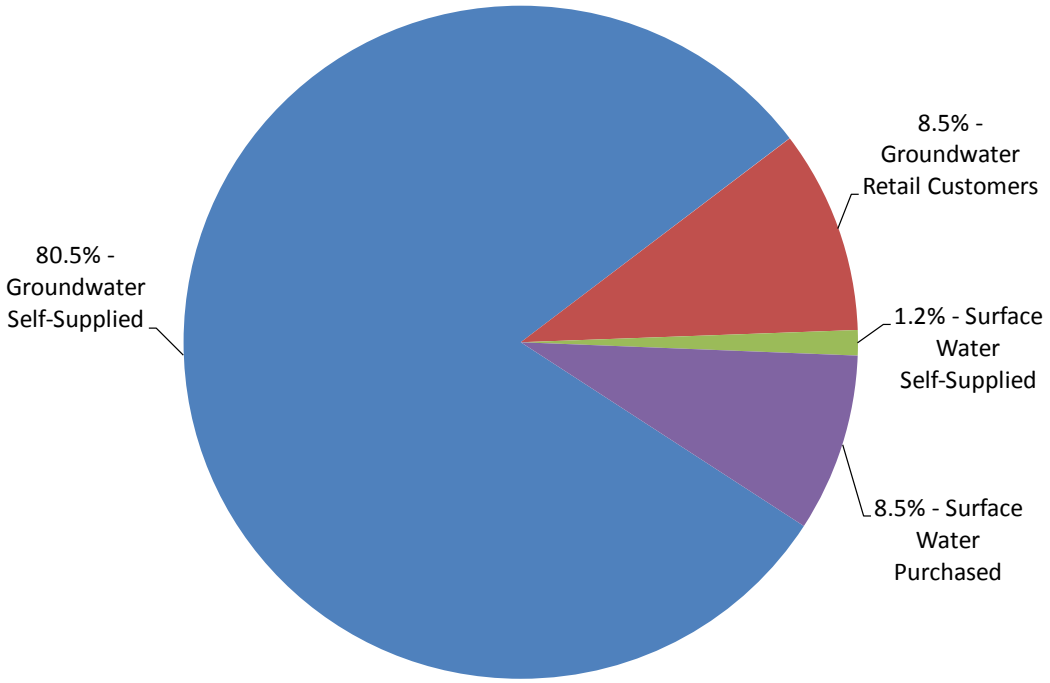
- Most (66) rely on their own groundwater wells;
- Eight also rely on groundwater but the water users are retail customers of other entities;
- Seven purchase surface water from other entities; and

- One relies on its own surface water source.

Figure 7.5 shows the relative distribution of sole water supplies for these municipal WUGs.

The ETRWPG conducted a limited, screening-level review of emergency response options available to the WUGs described in the previous section. The results are to serve as a general indicator of the potential options that might be considered in the event of a local emergency and should be investigated in greater detail by the subject WUG(s) before implementation. For the purposes of this analysis, it is assumed that the emergency response option must provide additional water within 180 days.

Figure 7.5 Summary of Sole-Source Water Supplies for Municipal WUGs with Population Less Than 7,500



Emergency response options considered include:

- Additional local groundwater well(s),

- Use of brackish groundwater,
- Voluntary Redistribution,
- Emergency interconnect(s), and
- Trucked-in water.

7.4.1 Additional Local Groundwater Wells. Depending on the emergency, drilling one or more wells may be a potential option for obtaining an emergency water supply. Since virtually the entire region is underlain by water supply aquifers, this is a potential option that each of the subject WUGs should evaluate in more detail.

Required infrastructure would include a new well and additional conveyance facilities. If the subject WUG is located within a Groundwater Conservation District, additional rules may apply.

7.4.2 Brackish Groundwater. Brackish water has total dissolved solids (TDS) concentrations between 1,000 and 10,000 milligrams per liter (mg/L). Brackish groundwater can be obtained from two locations in the ETRWPA: (1) relatively narrow bands of the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers that cross the middle of the ETRWPA in an east-west orientation and (2) a narrow band of the Gulf Coast aquifer that crosses Jefferson and Orange Counties near the coast in an east-west orientation.[5] Subject WUGs that are located in these bands should evaluate the emergency use of brackish groundwater in more detail (Table 7.5).

Required infrastructure would include a new well into the brackish part of the formation and additional conveyance facilities. Treatment to remove dissolved salts might also be included. However, such treatment is very expensive and disposal of treatment residuals is often difficult. Therefore, treatment is considered to be a viable component of using brackish groundwater only in extraordinary circumstances.

For brackish groundwater that is at the lower end of elevated TDS concentrations, the brackish water could be blended with existing non-brackish supplies to create an

emergency potable supply. As the TDS of a brackish source increases or as fresh water supplies diminish, blending may become less practical. For reasons noted above, brackish groundwater at the higher end of TDS concentrations would likely not be a viable alternative, even for emergency situations.

Table 7.5 Potential Brackish Groundwater Sources for Subject WUGs

Subject WUG	Aquifer			
	Carrizo-Wilcox	Gulf Coast	Queen City/ Sparta	Yegua-Jackson
Angelina WSC	x		x	
Burke	x		x	
Colmesneil				x
Diboll	x		x	
Four Way SUD	x		x	
Groveton	x			
Hemphill	x		x	
Hudson	x		x	
Hudson WSC	x		x	
Pineland	x		x	
Tyler County WSC				x
Woodville				x
Angelina County-Other	x		x	
Houston County-Other	x		x	
Jasper County-Other				x
Jefferson County-Other		x		
Nacogdoches County-Other	x		x	
Newton County-Other				x
Orange County-Other		x		
Polk County-Other				x
Sabine County-Other	x		x	
San Augustine County-Other	x		x	
Trinity County-Other	x		x	x
Tyler County-Other				x

Brackish groundwater availability, productivity, and production costs are summarized for each aquifer in Table 7.6. In the counties where brackish groundwater is located, availability is moderate to high. The major aquifers (Carrizo-Wilcox and Gulf Coast) have greater productivity than the minor aquifers. The production cost for the Carrizo-Wilcox aquifer is moderate to high, since the depth to the brackish groundwater may be 3,000 to 6,000 feet.

Table 7.6 Summary of ETRWPA Potential Emergency Water Supplies from Brackish Groundwater

Aquifer	Availability	Productivity	Source Water Production Cost	Primary Counties
Carrizo-Wilcox	High	Moderate	Moderate to High	Houston, Trinity, Angelina, Nacogdoches, San Augustine, Sabine
Queen City/ Sparta	High	Low	Moderate	
Gulf Coast	High	High	Low to Moderate	Jefferson, Orange
Yegua-Jackson	Moderate	Low	Moderate	Trinity, Polk, Tyler, Jasper, Newton

Source: LBG-Guyton Associates in association with NRS Consulting Engineers: Brackish Groundwater Manual for Texas Regional Water Planning Groups, prepared for Texas Water Development Board, Austin, February 2003.

7.4.3 Voluntary Redistribution. Another emergency response option for WUGs that already treat surface water is a voluntary redistribution of water from upstream water right holders. This option requires a contract with an upstream entity for water to release from an upstream reservoir for diversion by the subject WUG downstream. For purposes of this evaluation, if a watercourse downstream of a major reservoir flows through or within close proximity to the CCN of a subject WUG that treats surface water and has an existing surface water intake, then a release from an upstream reservoir is considered a potential emergency response alternative (Table 7.7). The TCEQ's Water Utilities Map Viewer was used to identify subject WUGs and potential emergency releases from upstream reservoirs.[6]

Required infrastructure may include upgrades to existing intake and conveyance facilities. It has been assumed that WUGs that would use this emergency response option already treat surface water, but improvements to treatment processes may also be necessary. This option would require an agreement with one or more water right holders or their contractees in the upstream reservoir and would require approval of the treatment facilities by the TCEQ. This option would also require a new or amended water right permit from the TCEQ that authorizes the use of stream bed and banks for conveyance of the water and a new diversion point.

Table 7.7 Potential Supplies from Releases from an Upstream Reservoir for Subject WUGs

Subject WUG	Upstream Reservoir	Water Right Holders
Jefferson County WCID #10	Sam Rayburn Reservoir; B.A. Steinhagen Reservoir	LNVA, Lufkin; LNVA
Nome	Sam Rayburn Reservoir; B.A. Steinhagen Reservoir	LNVA, Lufkin; LNVA
Cherokee County-Other	Lake Palestine; Lake Jacksonville; Striker Lake; Lake Tyler; Lake Tyler East	Upper Neches River Municipal Water Authority; Jacksonville; Angelina-Nacogdoches WCID 1; Tyler; Tyler
Houston County-Other	Lake Palestine; Lake Jacksonville; Various Region C Reservoirs	Upper Neches River Municipal Water Authority; Jacksonville; Various
Nacogdoches County-Other	Striker Lake; Lake Tyler; Lake Tyler East; Lake Naconiche	Angelina-Nacogdoches WCID 1; Tyler; Tyler; County of Nacogdoches
Panola County-Other	Lake Cherokee; Martin Lake; Lake Tawakoni/Lake Fork	Cherokee Water Company; Luminant Generation Company LLC; SRA, North Texas Municipal Water District
San Augustine County-Other	Lake Pinkston; Lake Naconiche; San Augustine City Lake	Center; County of Nacogdoches; San Augustine
Shelby County-Other	Lake Murvaul; Lake Cherokee; Martin Lake; Lake Tawakoni/Lake Fork	Panola County FWSD 1; Cherokee Water Company; Luminant Generation Company LLC; SRA, North Texas Municipal Water District
Trinity County-Other	Lake Palestine; Lake Jacksonville	Upper Neches River Municipal Water Authority; Jacksonville

7.4.4 Emergency Interconnect. An emergency interconnect is an alternative for subject WUGs that are located in close proximity to another water provider. For purposes of this evaluation, it is assumed that an emergency interconnect is a potential emergency response option if there is another Certificate of Convenience and Necessity (CCN) located contiguous to or within close proximity to the subject WUG's CCN. Potential emergency interconnects are summarized in Table 7.8. Some of these potential emergency interconnects may already be in place. Subject WUGs should investigate further the potential for obtaining potable water through emergency interconnects with neighboring water systems.

Table 7.8 Potential Emergency Interconnect Sources for Subject WUGs

Subject WUG	Potential Emergency Interconnects
Alto	Alto Rural WSC
Alto Rural WSC	Alto, Rusk Rural WSC, Rusk, Iron Hill WSC, Lilbert-Looneyville WSC, D&M WSC, Forest WSC
Angelina WSC	Lufkin, Beulah WSC, M&M WSC, Four Way SUD
Appleby WSC	Nacogdoches, Caro WSC, Swift WSC, Libby WSC, Garrison
Arp	Jackson WSC, Wright City WSC,
Beckville	Fairplay WSC, Rock Hill WSC, Hollands Quarter, Riderville WSC
Berryville	Frankston Rural WSC, Monarch Utilities I LP
Bethel-Ash WSC	Eustace, Quality Water of East Texas, Monarch Utilities I LP, Leagueville WSC, Virginia Hill WSC, Athens, Payne Springs WSC
Bevil Oaks	Water Necessities Inc., Hardin County WCID 1, Lumberton MUD, Meeker MWD
Brownsboro	Leagueville WSC, Edom WSC, Union Hill WSC, Moore Station WSC
Brushy Creek WSC	BBS WSC, Virginia Hill WSC, Poynor Community WSC, Dogwood Springs WSC, Frankston Rural WSC, Norwood WSC, Montalba WSC
Bullard	Southern Utilities Company, Walnut Grove WSC, North Cherokee WSC
Burke	Hudson WSC, Diboll,
Central WCID Of Angelina County	Woodlawn WSC, Hudson WSC, Pollok Redtown WSC, D&M WSC, Redland WSC, Angelina County FWSD 1, Lufkin
Chalk Hill SUD	New Prospect WSC, Crims Chapel WSC, Elderville WSC, Crystal Farms WSC, Tatum
Chandler	R-P-M WSC, Chandler Water Company, Three Community WSC, Dean WSC
China	Nome, Meeker MUD
Colmesneil	Tyler County WSC, Lakeside Water Supply
Corrigan	Damascus Stryker Water Supply, Moscow WSC
Cross Roads SUD	Kilgore, Elderville WSC, Kennedy Road WSC, Leveretts Chapel WSC, Jacobs WSC
Crystal Systems Inc.	Texas Water Systems Inc., Carroll WSC, Lindale Rural WSC, Lindale, Tyler, Southern Utilities Company
Cushing	Lilbert-Looneyville WSC, Sacul WSC, Caro WSC, South Rusk County WSC
Dean WSC	Southern Utilities Company, Tyler, R-P-M WSC, Chandler Water Company, Chandler
Diboll	Prairie Grove WSC, Lufkin
Easton	Elderville WSC, Chalk Hill SUD
Elkhart	Slocum WSC, Walston Springs WSC
Four Pines WSC	Palestine, BCY WSC, Tucker WSC, Pleasant Springs WSC, Lone Pine WSC
Four Way SUD	Zavalla, Angelina WSC, Huntington, M&M WSC

Table 7.8 Potential Emergency Interconnect Sources for Subject WUGs (Cont.)

Subject WUG	Potential Emergency Interconnects
Frankston	Frankston Rural WSC,
Garrison	Appleby WSC, Timpson Rural WSC, Arlam Concord WSC
Gill WSC	Marshall, Deadwood WSC, Dewberry WSC, Elysian Fields WSC, Blocker-Crossroads WSC
Groveton	Pennington WSC, Centerville WSC, Woodlake-Josserand WSC, Trinity Rural WSC, Glendale WSC
Hemphill	G M WSC
Hudson	Lufkin, Woodlawn WSC, Central WCID of Angelina County
Hudson WSC	Lufkin, Woodlawn WSC, Central WCID of Angelina County
Ivanhoe	Seneca WSC, Tyler County WSC, Warren WSC
Ivanhoe North	Seneca WSC, Tyler County WSC, Warren WSC
Jackson WSC	Wright City WSC, Lakeshore Utility Co. Inc., Southern Utilities Company, Tyler, Star Mountain WSC, Starrville WSC, West Gregg WSC
Jasper County WCID #1	South Jasper County WSC, Cougar Country Water System
Jefferson County WCID #10	Beaumont, Nederland,
Joaquin	Deadwood WSC, Paxton WSC,
Kirbyville	Upper Jasper County Water Authority, South Kirbyville Rural WSC
Kountze	West Hardin WSC, Johnson Water Service, Ranchland POA Inc.
Lilly Grove SUD	Nacogdoches, D&M WSC, Lilbert-Looneyville WSC, Caro WSC
Lindale	Tyler, Lindale Rural WSC, Crystal Systems Inc.
Meeker MUD	Beaumont, West Jefferson County MWD, China, Bevil Oaks, Lumberton MUD
Melrose WSC	Nacogdoches, Woden WSC, Swift WSC, New WSC, Denning WSC
Murchison	Bethel-Ash WSC, Leagueville WSC
New Chapel Hill	Southern Utilities Company, Jackson WSC, Lakeshore Utility Co. Inc., Wright City WSC, Walnut Grove WSC, Tyler
New London	Overton, Wright City WSC, Gaston WSC, Pleasant Hill WSC, Jacobs WSC
New Summerfield	Blackjack WSC, Stryker Lake WSC, Afton Grove WSC
Newton	East Newton WSC, Bon Wier WSC, Holly Huff WSC, Jamestown WSC
Nome	China
Noonday	Southern Utilities Company, Algonquin Water Resources, Tyler, Dean WSC
North Hardin WSC	Water Necessities Inc., Tyler County WSC, Johnson Water Service, Silsbee
Orangefield WSC	Orange County WCID 1, Orange, Bridge City
Overton	New London, Wright City WSC, Jackson WSC, Southern Utilities Company, Jacobs WSC, Leveretts Chapel WSC

Table 7.8 Potential Emergency Interconnect Sources for Subject WUGs (Cont.)

Subject WUG	Potential Emergency Interconnects
Pinehurst	Orange
Pineland	G M WSC
Rose City	Beaumont, Orange County WCID 1
R-P-M WSC	Chandler, Edom WSC, Ben Wheeler WSC, Southern Utilities Company
Rusk	Rusk Rural WSC, Alto Rural WSC, Iron Hill WSC,
San Augustine	San Augustine Rural WSC, New WSC, Bland Lake Rural WSC, Denning WSC, G M WSC
Silsbee	North Hardin WSC, Johnson Water Service, Lumberton MUD
Sour Lake	Hardin County WCID 1, Water Necessities Inc.
South Newton WSC	Orange, Mauriceville SUD
Swift WSC	Melrose WSC, Nacogdoches, Woden WSC, Appleby WSC, Libby WSC, Sand Hills WSC
Tatum	Crystal Farms WSC, Chalk Hill SUD, Rock Hill WSC
Tenaha	Tennessee WSC, Paxton WSC, Flat Fork WSC, Buena Vista WSC
Timpson	Timpson Rural WSC, Tennessee WSC, Buena Vista WSC,
Troup	Blackjack WSC, Wright City WSC,
Tyler County WSC	North Hardin WSC, Colmesneil, Ivanhoe, Ivanhoe North, Warren WSC, Monarch Utilities I LP, Seneca WSC, Woodville, Chester WSC, Upper Jasper County Water Authority
Virginia Hill WSC	Aqua Texas Inc., Brushy Creek WSC, Athens, Double Diamond Utilities Co, Leagueville WSC, Bethel-Ash WSC, Moore Station WSC, Poynor Community WSC
Walston Springs WSC	Slocum WSC, Anderson County Cedar Creek WSC, Pleasant Springs WSC, Neches WSC, Palestine
Wells	Pollok Redtown WSC, Forest WSC
West Gregg SUD	Kilgore, Jackson WSC, Starrville WSC, Liberty City WSC, Southern Utilities Company
West Hardin WSC	Hardin WSC, Lake Livingston Water Supply and Sewer Service Company, Johnson Water Service
West Orange	Orange
Woden WSC	Nacogdoches, Melrose, WSC, Swift WSC, D&M WSC
Woodville	Cypress Creek WSC, Doucette Water System, Tyler County WSC,
Wright City WSC	Southern Utilities Company, Jackson WSC, Price WSC, New Concord WSC, Blackjack WSC, Troup
Zavalla	Four Way SUD, Raylake WSC

Potential emergency interconnects were not identified for County-Other WUGs. In a given county, the County-Other WUG may represent many small utilities, and an emergency interconnect that may be a feasible emergency source for one of these utilities may not be a feasible source for another. Therefore, an extensive list of potential

emergency interconnects in each county will not be sufficiently "local" to assist an individual utility that is a component of the County-Other WUG. Utilities that are not named in Table 7.8, should consult local maps/data to identify nearby utilities that may be potential emergency interconnect supplies.

Required infrastructure would include piping and valving necessary to connect the systems. If the relative system pressures are not appropriate for the proposed connection, additional pressurization and/or conveyance facilities may be needed. This option would require an agreement with one or more neighboring utilities. Construction would require authorization from the TCEQ.

7.4.5 Trucked-In Water. Trucked-in water is considered to be an emergency response option for every subject WUG. Although this would likely require little infrastructure, it would require agreements with a treated water provider and a water transporter.

Findings for the subject WUGs and the County-Other WUGs are briefly summarized in Table 7.9.

Table 7.9 Summary of Potential Emergency Supplies for Subject WUGs

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	County	Local groundwater well	Brackish groundwater	Other named local supply	Release from upstream reservoir	Emergency interconnect	Trucked-in water
Alto	Cherokee	x				x	x
Alto Rural WSC	Cherokee	x		x	x	x	x
Angelina WSC	Angelina	x	x	x		x	x
Appleby WSC	Nacogdoches	x		x		x	x
Arp	Smith	x		x		x	x
Beckville	Panola	x				x	x
Berryville	Henderson	x		x		x	x
Bethel-Ash WSC	Henderson, Van Zandt	x		x		x	x
Bevil Oaks	Jefferson	x		x		x	x
Brownsboro	Henderson	x				x	x
Brushy Creek WSC	Anderson, Henderson	x		x		x	x
Bullard	Smith, Cherokee	x				x	x
Burke	Angelina	x	x			x	x
Central WCID Of Angelina County	Angelina	x		x		x	x
Chalk Hill SUD	Rusk	x		x		x	x
Chandler	Henderson	x		x		x	x
China	Jefferson	x		x	x	x	x
Colmesneil	Tyler	x	x	x		x	x
Corrigan	Polk	x				x	x
Cross Roads SUD	Rusk, Gregg	x		x		x	x
Crystal Systems Inc.	Smith	x		x		x	x
Cushing	Nacogdoches	x		x		x	x
Dean WSC	Smith	x		x		x	x
Diboll	Angelina	x	x	x	x	x	x
Easton	Gregg, Rusk	x		x	x	x	x
Elkhart	Anderson	x		x		x	x
Four Pines WSC	Anderson	x		x		x	x
Four Way SUD	Angelina	x	x	x		x	x
Frankston	Anderson, Henderson	x		x		x	x
Garrison	Nacogdoches	x		x		x	x
Gill WSC	Harrison, Panola	x		x	x	x	x
Groveton	Trinity	x	x	x		x	x
Hemphill	Sabine	x	x	x		x	x
Hudson	Angelina	x	x	x	x	x	x
Hudson WSC	Angelina	x	x	x	x	x	x
Ivanhoe	Tyler	x		x	x	x	x
Ivanhoe North	Tyler	x		x	x	x	x

Table 7.9 Summary of Potential Emergency Supplies for Subject WUGs (Cont.)

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	County	Local groundwater well	Brackish groundwater	Other named local supply	Release from upstream reservoir	Emergency interconnect	Trucked-in water
Jackson WSC	Smith	x		x		x	x
Jasper County WCID #1	Jasper	x				x	x
Jefferson County WCID #10	Jefferson	x		x	x	x	x
Joaquin	Shelby	x		x	x	x	x
Kirbyville	Jasper	x				x	x
Kountze	Hardin	x				x	x
Lilly Grove SUD	Nacogdoches	x				x	x
Lindale	Smith	x		x		x	x
Meeker MUD	Jefferson	x		x	x	x	x
Melrose WSC	Nacogdoches	x		x	x	x	x
Murchison	Henderson	x		x		x	x
New Chapel Hill	Smith	x		x		x	x
New London	Rusk	x		x		x	x
New Summerfield	Cherokee	x				x	x
Newton	Newton	x				x	x
Nome	Jefferson	x		x	x	x	x
Noonday	Smith	x		x		x	x
North Hardin WSC	Hardin	x		x	x	x	x
Orangefield WSC	Orange	x				x	x
Overton	Rusk, Smith	x		x		x	x
Pinehurst	Orange	x		x		x	x
Pineland	Sabine	x	x	x		x	x
Rose City	Orange	x		x		x	x
R-P-M WSC	Van Zandt, Henderson, Smith	x		x		x	x
Rusk	Cherokee	x		x		x	x
San Augustine	San Augustine	x				x	x
Silsbee	Hardin	x		x	x	x	x
Sour Lake	Hardin	x		x		x	x
South Newton WSC	Newton, Orange	x		x	x	x	x
Swift WSC	Nacogdoches	x		x	x	x	x
Tatum	Rusk, Panola	x		x	x	x	x
Tenaha	Shelby	x		x		x	x
Timpson	Shelby	x		x		x	x
Troup	Smith, Cherokee	x		x	x	x	x
Tyler County WSC	Tyler	x	x	x		x	x
Virginia Hill WSC	Henderson	x		x		x	x

Table 7.9 Summary of Potential Emergency Supplies for Subject WUGs (Cont.)

Entity		Potential Emergency Water Supply Source(s)					
Water User Group Name	County	Local groundwater well	Brackish groundwater	Other named local supply	Release from upstream reservoir	Emergency interconnect	Trucked-in water
Walston Springs WSC	Anderson	x		x	x	x	x
Wells	Cherokee	x				x	x
West Gregg SUD	Gregg, Smith, Rusk	x		x		x	x
West Hardin WSC	Hardin, Liberty	x		x		x	x
West Orange	Orange	x		x		x	x
Woden WSC	Nacogdoches	x		x		x	x
Woodville	Tyler	x		x		x	x
Wright City WSC	Smith, Cherokee, Rusk	x		x		x	x
Zavalla	Angelina	x		x		x	x
Anderson County-Other	Anderson	x		n/a[a]	x	n/a	x
Angelina County-Other	Angelina	x	x	n/a	x	n/a	x
Cherokee County-Other	Cherokee	x		n/a	x	n/a	x
Hardin County-Other	Hardin	x		n/a		n/a	x
Henderson County-Other	Henderson	x		n/a	x	n/a	x
Houston County-Other	Houston	x	x	n/a	x	n/a	x
Jasper County-Other	Jasper	x	x	n/a	x	n/a	x
Jefferson County-Other	Jefferson	x	x	n/a		n/a	x
Nacogdoches County-Other	Nacogdoches	x	x	n/a	x	n/a	x
Newton County-Other	Newton	x	x	n/a	x	n/a	x
Orange County-Other	Orange	x	x	n/a	x	n/a	x
Panola County-Other	Panola	x		n/a	x	n/a	x
Polk County-Other	Polk	x	x	n/a		n/a	x
Rusk County-Other	Rusk	x		n/a	x	n/a	x
Sabine County-Other	Sabine	x	x	n/a		n/a	x
San Augustine County-Other	San Augustine	x	x	n/a	x	n/a	x
Shelby County-Other	Shelby	x		n/a	x	n/a	x
Smith County-Other	Smith	x		n/a		n/a	x
Trinity County-Other	Trinity	x	x	n/a	x	n/a	x
Tyler County-Other	Tyler	x	x	n/a	x	n/a	x

[a] "n/a" indicates that this potential emergency water supply was not evaluated for a given WUG. Additional discussion is provided in Section 7.4.

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

Region-specific drought response recommendations regarding the management of existing surface water and groundwater sources are presented in the following sections. These recommendations include:

- 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;
- 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;
- Triggers and actions consider existing triggers and actions associated with existing drought contingency plans.

7.5.1 Drought Trigger Conditions for Reservoirs. The major recommended triggers and potential actions for reservoirs in the ETRWPA are presented in this section. Where possible, the ETRWPG has incorporated triggers and major actions from drought contingency plans that have been developed for these water sources. A summary of triggers and actions for the 16 reservoirs in the ETRWPA is provided in the following tables (Tables 7.10 through 7.21). An additional five reservoirs in the region have not submitted drought contingency plans. Therefore, generic drought triggers and actions have been developed by the consulting team for these reservoirs. (See Table 7.22). These drought contingency plans may require more actions than shown in this section and may contain exceptions to these potential actions. These additional potential actions and exceptions are also endorsed by the ETRWPA.

The potential actions are generally cumulative between stages: actions implemented in Stage 1 remain in effect in Stage 2 and so on.

Lake Athens (Athens Municipal Water Authority)

The Athens Municipal Water Authority adopted its current drought contingency plan in October 2011. The triggers and actions are related to water demand and the elevation of Lake Athens and are summarized below in Table 7.10.

Table 7.10 Lake Athens Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	• Total daily production of potable water exceeds 4.5 million gallons per day (MGD); or, • The water surface elevation of Lake Athens drops to 436.90 feet MSL (75% of net usable volume).	Request voluntary conservation measures, including odd/even watering schedule and limited irrigation hours.
Moderate	• Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 80% capacity overnight; or, • The water surface elevation of Lake Athens drops to 434.60 feet MSL (60% of net usable volume).	Implement mandatory conservation measures, including odd/even watering schedule and limited irrigation hours. Prohibit non-essential water use. Limit water use for vehicle washing and filling of pools. Limit water use from fire hydrants.
Severe	• Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 65% capacity overnight; or, • The water surface elevation of Lake Athens drops to 432.00 feet MSL (45% of net usable volume).	Implement mandatory conservation measures, including continued odd/even watering schedule and limited irrigation hours. Prohibit oil/gas/construction water use from fire hydrants. Prohibit irrigation of golf course fairways. Prohibit irrigation with private pumps that draw water from Lake Athens.
Critical	• Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 50% capacity overnight; or, • The water surface elevation of Lake Athens drops to 429.00 feet MSL (30% of net usable volume).	Implement mandatory conservation measures, including continued odd/even watering schedule and curtailed irrigation hours. Prohibit use of hose end sprinklers and permanently installed automatic sprinkler systems. No new connections.
Emergency	• Major water line breaks or pump or system failures occur, which cause an unprecedented loss of capability to provide water service; or • Natural or man-made contamination of the water supply source(s) occurs; or • Water supply sources are depleted to a level beyond those described above for Stage 4 — Critical Water Shortage Conditions.	Prohibit irrigation of landscaped areas. Prohibit vehicle washing.

Lake Center and Lake Pinkston (Center)

Center adopted its current Drought Contingency Plan in 2014. The triggers are associated with water demands and total storage in the reservoirs. The triggers and actions related to Lake Center and Lake Pinkston are outlined below in Table 7.11.

Table 7.11 Lake Center and Lake Pinkston Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	Water demand reaches ninety percent (90%) of production capacity; or Distribution limitations	Implement mandatory maximum twice-weekly watering schedule. Request that customers discontinue non-essential water uses.
Moderate	Water demand reaches ninety-five percent (95%) of production capacity; Water storage falls to fifty percent (50%) of storage capacity; or Distribution limitations	Implement mandatory maximum once-weekly watering schedule. Require that customers discontinue non-essential water uses. Expand enforcement.
Severe	Water demand reaches one hundred percent (100%) of production capacity; Water storage falls to twenty-five percent (25%) of storage capacity; or Major distribution limitations	Prohibit all landscape, non-essential, and discretionary water uses. Continue enforcement. Examine alternative sources.

Houston County Lake (Houston County WCID No. 1)

The Houston County WCID No. 1 adopted its current Drought Contingency Plan in 2014. The triggers are associated with water demands, weather conditions, and the reservoir's elevation. The triggers and actions related to Houston County Lake are outlined below in Table 7.12.

The Cities of Crockett and Grapeland purchase water from the Houston County WCID No. 1. Recommendations for aligning their DCPs with the Houston County WCID No. 1 DCP are presented in Section 7.2.2.

Table 7.12 Houston County Lake Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	1. Water demand has reached 90% of the capacity of the system for three consecutive days with the plant operating at 100% of the rated production. 2. Weather conditions that will result in reduced water supply available from the Houston County Lake for an extended period of time. 3. Water level at the Lake drops below 258 feet above mean sea level, which is 2 feet below pool. (260 feet mean sea level).	Request voluntary conservation measures.
Moderate	1. Water demand has reached 100% of the capacity of the system for three consecutive days with the plant operating at 100% of the rated production. 2. Weather conditions that result in Lake levels falling to 256 mean sea level, which is 3 feet below pool. 3. Water supply storage facilities are not maintaining a constant level with the plant operating at 100% of the rated production.	Implement mandatory conservation measures, limiting outdoor watering to hand-held hose use only. Require wholesale customers to initiate Stage 2 of their DCPs. Prepare for curtailment by preparing a monthly usage allocation for each wholesale customer.
Severe	1. The treatment plant is non-operational due to a malfunction at the site. 2. Water levels drop at the reservoir to a point where pumping equipment will not function properly.	Implement additional mandatory conservation measures, including prohibition of outdoor watering except for livestock. Initiate pro-rata curtailment of water sales to each wholesale customer.
Emergency	1. A major water line breaks which causes considerable water loss. 2. Pumps or system failures occur which causes the inability to obtain the water from the Lake, treat the water adequately, or supply the water to our customers. 3. Natural or man-made contamination of the water supply source.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Lake Jacksonville (Jacksonville)

The City of Jacksonville adopted its current Drought Contingency Plan in 2014. The triggers are associated with water demands and the status of water supply facilities such as storage tanks and pumps. The triggers and actions related to Lake Jacksonville are outlined below in Table 7.13.

The North Cherokee WSC purchases water from Jacksonville. Recommendations for aligning the DCPs for these entities are presented in Section 7.2.2.

Table 7.13 Lake Jacksonville Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	a. Water demand is approaching the safe capacity of the system on a sustained basis. Sustained water usage over 85% of safe capacity, or 7.04 MGD (five consecutive days) should be taken as a trigger condition for mild conditions. b. Mild contamination is noted in the water supply, but water can still be treated by existing facilities by means such as increasing chlorine dosage; or contamination is reported in updip portions of aquifer. c. Additional well drilling in the vicinity threatens interference with water wells. d. Water levels in tanks are consistently below% full (five days uninterrupted). e. Local power failures are imminent as a result of power station failures, storms, transmission problems, or excessive power demand in the area. f. Performance of well water pumps, high service pumps, or other equipment indicates imminent failure. g. Transmission line from surface water plant to Dorothy St. tank is in danger of failure.	Warn customers to reduce water use. Recommend a voluntary lawn watering schedule. Explore possibility of interconnection with other systems. Take steps toward increasing system capacity, including repair of wells not currently in use.

Table 7.13 Lake Jacksonville Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Moderate	a. Water demand occasionally reaches safe limit of system (two days within a 30 day period), and failure of any pump or chlorine feeder could reduce the level of service to the system. Safe limit is 8.38 MGD as discussed above. b. Contamination of supply water is approaching limit of treatability with existing facilities; or brackish water is very near the well. c. Additional wells in vicinity are drawing water at a rate which interferes with production rate of City's wells. d. Over 20% of storage tank capacity is out of service due to structural failure, leakage, maintenance, or contamination. e. Water level in tanks is consistently below half full (three days uninterrupted). f. Water emergencies in adjacent communities require diversion of so much water that the level of service to any part of the Jacksonville system is threatened. g. Severe freezing conditions have resulted in widespread damage to home plumbing or distribution lines.	Implement mandatory lawn watering schedule. Prohibit wasteful water uses. Seek reduced usage from commercial users and industries. Take steps toward interconnection with other systems. Impose system surcharge. Take steps toward increasing system capacity, including repair of wells not currently in use.
Severe	a. Water demand is exceeding safe capacity (8.38 MGD) on a regular basis (more than five consecutive days). b. Supply water is so contaminated that it cannot be treated with existing facilities or such contamination is imminent because of nearby aquifer pollution. c. Rupture of transmission lines from the raw water pumps or from the water treatment plant. d. An immediate health or safety hazard could result from actual or imminent failure of system components. e. Water levels in elevated tanks are too low to provide adequate fire protection (generally less than 1/4 full). f. Over half of storage tank capacity is out of service. h. All service pumps are out of service. i. Water emergencies in adjacent communities require so much water diversion that service to portions of the Jacksonville system is severely disrupted.	Prohibit all outdoor use and all wasteful use. Impose system surcharge. Impose rationing. Require commercial users and industries to stop using City water for processes, cooling, or recreation. Implement interconnection with other systems. Implement increased system capacity.

Lake Murvaul (Panola County FWSD No. 1)

The Panola County FWSD No. 1 did not submit a drought contingency plan. Therefore, recommendations are based on the drought contingency plan for the City of Carthage, which purchases water from the Panola County FWSD No. 1. Carthage adopted its most recent drought contingency plan in 2014. The triggers and actions are based on water demands, weather conditions, and reservoir storage. These are outlined in Table 7.14 below.

Table 7.14 Lake Murvaul Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	a. Average daily water consumption reaches 90% of the water treatment plant's production capacity for three consecutive days. b. Water level in Lake Murvaul is declining at a rate that could disrupt water supply in the future. c. Weather conditions are considered in drought classification determination. Predicted long, cold, or dry periods are to be considered in impact analysis.	Encourage voluntary reduction of water use.
Moderate	a. Average daily water consumption reaches 100% of the water treatment plant's production capacity for three consecutive days. b. Water levels in Lake Murvaul continue to decline or are declining at a rate that makes supply problems imminent. c. Weather conditions indicate mild drought will exist for five or more consecutive days.	Implement mandatory conservation measures, including odd/even watering schedule and limited watering hours. Discontinue irrigation of parks and public areas. Limit water use for vehicle washing. Prohibit water use from fire hydrants except for firefighting.
Severe	a. Average daily water consumption reaches 110% of the water treatment plant's production capacity for three consecutive days. b. Water storage levels are drained daily and recover only during overnight periods of low demand. c. Lake Murvaul water levels have declined to the point where any additional loss of water will expose an intake point to the atmosphere. d. Lake Murvaul water levels have declined to the point where water withdrawal is impeded. e. A clear well at the water treatment plant is taken out of service during a mild or moderate water shortage period.	Prohibit use of hose-end sprinklers. Prohibit use of water for street washing, filling pools, water athletic fields and courses, and dust control. Initiate development of alternative supply sources.

Table 7.14 Lake Murvaul Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Critical	a. Average daily water consumption reaches 115% of the water treatment plant's production capacity for any one day. b. Water storage levels do not fully recover even during overnight periods of low demand. c. Lake Murvaul water levels have declined to the point where water withdrawal is impeded due to exposed water inlets on the intake structure. d. System demand exceeds available high service pump capacity.	Prohibit vehicle washing.
Emergency	a. Average daily water consumption reaches 120% of the water treatment plant's production capacity for any one day. b. Lake Murvaul water levels have declined to the point where water withdrawal is impeded or equipment could be damaged by normal operation of water supply system facilities and equipment due to water supply deficiency. c. Water system is contaminated, either accidentally or intentionally. Severe condition is reached immediately upon detection. d. Water system fails-- from acts of God (tornados, hurricanes) or man. Severe condition is reached immediately upon detection.	Prohibit all non-essential water uses, including landscape watering and vehicle washing. Implement alternative supply sources. Implement pro-rate water allocation.

Lake Nacogdoches (Nacogdoches)

Nacogdoches adopted its most recent drought contingency plan in 2011. The triggers and actions are based on water demands and production capacity. These are outlined in Table 7.15 below.

Table 7.15 Lake Nacogdoches Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When total daily water demand equals or exceeds 90% of the daily water production capacity for 4 consecutive days or 92% of water capacity production on a single day.	Request voluntary conservation measures, including maximum twice-weekly watering schedule and limited irrigation hours.
Moderate	When total daily water demand equals or exceeds 92% of the daily water production capacity for 4 consecutive days or 94% of the daily production capacity on a single day.	Implement mandatory conservation measures, including maximum twice-weekly watering schedule and limited watering hours. Prohibit non-essential water use. Limit water use for vehicle washing and filling of pools. Limit water use from fire hydrants.
Severe	When total daily water production capacity equals or exceeds 94% of the daily production capacity for 4 consecutive days or 96% of the daily water production capacity on a single day.	Prohibit use of hose-end sprinklers. Prohibit watering golf course tees. Discontinue irrigation of public landscaped areas, including parks and ball fields. Prohibit use of water from fire hydrants for construction purposes.
Critical	When total daily water production capacity equals or exceeds 96% of the daily water production capacity for 4 consecutive days or 98% of the daily water production capacity on a single day.	Prohibit use of permanently installed automatic sprinklers. Prohibit filling of pools. Prohibit vehicle washing outside of commercial facilities. No new connections.
Emergency	When the City Manager, or designee, determines a water supply emergency exists based on: (1) Major water line breaks, or pump or system failures occur which cause unprecedented loss of capability to provide water service; or (2) Natural or man-made contamination of water supply source(s).	Implement alternative supply sources. Prohibit all non-essential water uses, including landscape watering and vehicle washing.

Lake Palestine (Upper Neches River Municipal Water Authority)

The UNRMWA adopted its most recent drought contingency plan in 2014. The triggers and actions are based on water elevations in the reservoir. These are outlined in Table 7.16 below.

In the ETRWPA, the Cities of Tyler and Palestine purchase water from the UNRMWA. In addition, Southern Utilities Company purchases water from Tyler. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.16 Lake Palestine Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When the stage elevation of Lake Palestine reaches or drops below 339.5 feet for three consecutive days.	Minimize unnecessary releases from Lake Palestine. Encourage wholesale customers to use alternative water sources. Request that wholesale customers implement voluntary conservation measures and Stage 1 of DCP.
Moderate	When the stage elevation of Lake Palestine reaches or drops below 336 feet for three consecutive days.	Request that wholesale customers implement mandatory conservation measures and Stage 2 of DCP. Prepare monthly water usage allocation in preparation for pro-rata curtailment.
Severe	When the stage elevation of Lake Palestine reaches or drops below 333 feet for three consecutive days.	Coordinate with authorities to reduce or eliminate releases downstream. Request that wholesale customers implement additional mandatory conservation measures and Stage 3 of DCP. Initiate pro-rata curtailment of water diversions/deliveries.
Emergency	When any of the following occur: 1. A dam, spillway, or outlet works and associated appurtenances failure occurs, which cause unprecedented loss of capability to provide water service; or 2. Natural or man-made contamination of the water supply source occurs.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Rusk City Lake (Rusk)

Rusk adopted its most recent drought contingency plan in 2014. The triggers and actions are based on water demands. These are outlined in Table 7.17 below.

Table 7.17 Rusk City Lake Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When total daily water demand equals or exceeds 800,000 gallons for five consecutive days or 1,600,000 gallons on a single day.	Request that wholesale customers implement voluntary conservation measures and Stage 1 of DCP.
Moderate	When total daily water demand equals or exceeds 1,600,000 gallons for five consecutive days or 1,900,000 gallons on a single day.	Request that wholesale customers implement mandatory conservation measures and Stage 2 of DCP. Prepare monthly water usage allocation in preparation for pro-rata curtailment.
Severe	When total daily water demand equals or exceeds 1,900,000 gallons for five consecutive days or 2,200,000 gallons on a single day.	Request that wholesale customers implement additional mandatory conservation measures and Stage 3 of DCP. Initiate pro-rata curtailment of water diversions/deliveries.
Emergency	When there exist major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or natural or man-made contamination of the water supply source(s).	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Sam Rayburn/B.A. Steinhagen System (Lower Neches Valley Authority)

The LNVA adopted its most recent drought contingency plan in 2012. The triggers and actions are based on water elevations in the Sam Rayburn Reservoir. These are outlined in Table 7.18 below.

The Cities of Port Arthur and Groves purchase water from the LNVA. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.18 Sam Rayburn/B. A. Steinhagen System Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Moderate	When Sam Rayburn Reservoir has remained below the following critical water supply level for a continuous 30-day period. Seasonal critical lake level shall be defined as follows: Lake Level: Time Period 158.0 MSL: January 1 - March 31 160.0 MSL: April 1 - July 31 158.0 MSL: August 1 - August 31 156.0 MSL: September 1 - December 31	Request municipal customers implement voluntary conservation, including restriction of lawn irrigation. Request municipal customers prohibit other non-essential uses. Request industrial customers evaluate measures to minimize process water use and encourage basic water conservation practices. Request irrigation customers monitor use to prevent water waste.
Severe	When the water surface elevation in Sam Rayburn Reservoir falls below 153.0 MSL for a continuous period of 20 days. With Sam Rayburn water surface at elevation 153.0 MSL the remaining water in the conservation pool is sufficient to sustain LNVA's water use demands for approximately one year without significant rainfall in the basin.	Initiate pro-rata curtailment of deliveries if necessary. Request municipal customers evaluate mandatory conservation measures, both outdoors and indoors. Request industrial customers minimize process water use and encourage basic water conservation practices. LNVA personnel will monitor irrigation use to prevent water waste.
Extreme	When the water surface elevation in Sam Rayburn Reservoir falls below 151.5 MSL for a continuous period of 10 days. At a water surface at elevation of 151.5 MSL sufficient water remains in the Sam Rayburn Reservoir water conservation pool to sustain LNVA's water use demands for approximately six months without significant rainfall in the basin.	Severe level measures plus curtailment of irrigation deliveries as appropriate.
Exceptional	When the water surface elevation in Sam Rayburn Reservoir falls below 149.00 MSL for a continuous period of 3 days. Once the water surface elevation in Sam Rayburn Reservoir falls to 149.00 MSL, the water remaining in the conservation pool at Lake BA Steinhagen will only be sufficient to sustain LNVA's water use demands for approximately three months without significant rainfall in the basin. An emergency water supply may be made available from the inactive pool of Sam Rayburn Reservoir upon approval of the US Army Corps of Engineers.	Initiate pro-rata curtailment of deliveries if the situation dictates. Direct municipal customers to initiate mandatory conservation measures, including prohibition of outdoor water use and practices to minimize indoor water use. Direct industrial customers to minimize process water use to the extent feasible and encourage basic water conservation practices among employees. Cease releases from Rayburn/Steinhagen for interruptible water supplies.
Emergency	Upon the failure of a major component of the water supply, the pumps or canals in the LNVA's distribution system or the contamination of the canals or source water supply which substantially curtails LNVA's ability to supply water to its customers.	Assess the severity of the problem, and identify actions needed and time required to solve the problem. If necessary, notify city, county, and/or state emergency response officials for assistance. Undertake necessary actions as needed.

Lake Striker (Angelina-Nacogdoches WCID)

The Angelina-Nacogdoches WCID adopted its most recent drought contingency plan in 2009. The triggers and actions are based on water elevations in the lake. These are outlined in Table 7.19 below.

Table 7.19 Lake Striker Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	When the water level in Lake Striker Reservoir drops to 290.00 amsl.	Request that customers implement voluntary conservation measures and Stage 1 of their DCPs
Moderate	When the water level in Lake Striker Reservoir drops to 288.00 amsl.	Initiate pro-rata curtailment of diversions/deliveries and implement a surcharge if the situation dictates. Request that customers initiate mandatory conservation measures and Stage 2 of their DCPs.
Severe	When the water level in Lake Striker Reservoir drops to 286.00 amsl.	Initiate additional pro-rata curtailment of diversions/deliveries. Request that customers initiate additional mandatory conservation measures and Stage 3 of their DCPs.
Emergency	When the water level in Lake Striker Reservoir is at 284.00 amsl.	Initiate additional pro-rata curtailment of diversions/deliveries. Request that customers initiate additional mandatory conservation measures and additional stages of their DCPs.

Toledo Bend Reservoir (Sabine River Authority)

The SRA adopted its most recent drought contingency plan in 2014. The triggers and actions are based on water elevations in the reservoir and downstream flows in the Sabine River. These are outlined in Table 7.20 below.

The GM WSC purchases water from the SRA. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.20 Toledo Bend Reservoir Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	• The water surface elevation in Toledo Bend falls to and remains at or below 165.1 feet for fourteen consecutive days, or • The flow measured by the U.S. Geological Survey (USGS) gage on the Sabine River near Ruliff, Texas falls to and remains at or below the mild conditions flow in Table 10 of the SRA DCP for fourteen consecutive days.	Request that customers implement Stage 1 of their DCPs.
Moderate	• The water surface elevation in Toledo Bend falls to and remains at or below 162.2 feet for fourteen consecutive days, or • The flow measured by the USGS gage on the Sabine River near Ruliff, Texas, falls to and remains at or below the moderate conditions flow in Table 10 of the SRA DCP	Initiate pro-rata curtailment of diversions/deliveries if the situation dictates. If appropriate, request that customers prohibit non-essential outdoor uses, such as lawn irrigation, vehicle washing, filling of swimming pools, or routine maintenance of facilities.
Severe	• The water surface elevation in Toledo Bend falls to and remains at or below 156 feet for fourteen consecutive days, or • The flow measured by the USGS gage on the Sabine River near Ruliff, Texas, falls to the severe conditions flow in Table 10 of the SRA DCP for fourteen consecutive days.	Initiate pro-rata curtailment of diversions/deliveries if the situation dictates. If appropriate, request that customers prohibit all outdoor water use (except for livestock watering) and initiate measures to reduce indoor water use.
Emergency	• There is a major contamination or a major required drawdown of Toledo Bend for emergency repairs of major infrastructure, or • The failure of a major component of the pumps or canals in the John W. Simmons Gulf Coast Canal System significantly impacts the supply of water to its customers.	Initiate pro-rata curtailment of diversions/deliveries if the situation dictates. Request that customers prohibit all outdoor water use (except for livestock watering) and initiate measures to reduce indoor water use.

Lake Tyler/Lake Tyler East/Lake Bellwood (Tyler)

Tyler adopted its most recent drought contingency plan in August 2014. The triggers and actions are based on water demands, production and storage capacity, and weather conditions. These are outlined in Table 7.21 below.

The Southern Utilities Company purchases water from Tyler. Recommendations for aligning these DCPs are presented in Section 7.2.2.

Table 7.21 Lake Tyler/Lake Tyler East/Lake Bellwood Triggers and Potential Actions

Drought Stage	Trigger	Potential Action
Mild	a. Average daily water consumption reaches 85% of production capacity. Production capacity is defined as on line capacity in case of failure of a water source. b. Consumption (85%) has existed for a period of three days. c. Weather conditions are considered in drought classification determination. Predicted long, hot or dry periods are to be considered in the impact analysis.	Encourage implementation of voluntary water conservation measures.
Moderate	a. Average daily water consumption reaches 90% of rated production capacity for a three day period. Production capacity is defined as on line capacity in case of failure or shut down of one or both water treatment plants. b. Weather conditions indicate mild drought will exist five (5) days or more. c. One or more ground storage tank is taken out of service during mild drought period. d. Storage capacity (water level) is not being maintained during period of 100% rated production period. e. Existence of any one listed condition for a duration of 3-6 hours.	Implement mandatory water conservation measures, including every-fourth-day outdoor water use schedule and limited outdoor water use hours.
Severe	a. Average daily water consumption reaches 100% of production capacity. Production capacity is defined as on line capacity in case of failure or shut down of one or both water treatment facilities. b. Average daily water consumption will not enable storage levels to be maintained. c. System demand exceeds available high service pump capacity. d. Any two (2) conditions listed in moderate drought classification occurs at the same time for a 24 hour period. e. Water system is contaminated either accidentally or intentionally. Severe condition is reached immediately upon detection. f. Water system fails - from acts of God, (tornadoes, hurricanes) or man. Severe condition is reached immediately upon detection.	Curtail use of water for vehicle washing, window washing, outdoor watering, and non-essential water uses. Limit water use by other commercial users and industries.
Emergency	• There is a major contamination or a major required drawdown of Toledo Bend for emergency repairs of major infrastructure, or • The failure of a major component of the pumps or canals in the John W. Simmons Gulf Coast Canal System significantly impacts the supply of water to its customers.	Initiate pro-rata curtailment of diversions/deliveries if the situation dictates. Request that customers prohibit all outdoor water use (except for livestock watering) and initiate measures to reduce indoor water use.

Surface Water Supplies without Site-Specific Drought Contingency Plans

The ETRWPG did not receive drought contingency plans from suppliers that use water from these lakes. Therefore, the ETRWPG recommends drought triggers and response actions based primarily on the water volume stored in the reservoir (Table 7.22). These recommendations are generic in nature, and no site-specific studies have been performed to develop them. They are meant to provide guidance until site-specific drought contingency plans are developed and submitted. Drought response actions in addition to those recommended in Table 7.22 may also be appropriate. Site-specific plans may include other types of triggers, including those related to local water demands and operation of water supply systems.

Table 7.22 Recommended Triggers and Potential Actions for Lakes Without Site-Specific Drought Contingency Plans

Drought Stage	Trigger	Potential Action
Mild	Water volume stored in the lake drops to 80 percent of the conservation storage capacity	• Increase public education efforts on ways to reduce water use. • Encourage reduction of non-essential water use and auditing of irrigation systems. • Implement maximum twice per week watering for hose-end sprinklers and automatic irrigation systems. • Limit hours of irrigation to reduce evaporative losses. • Prohibit water waste, such as operating an irrigation system with broken spray heads or excessive runoff.
Moderate	Water volume stored in the lake drops to 60 percent of the conservation storage capacity	• Continue actions implemented in the previous stage. • Initiate engineering studies to evaluate water supply alternatives. • Accelerate public education efforts on ways to reduce water use. • Eliminate non-essential water use. • Implement maximum once per week watering for hose-end sprinklers and automatic irrigation systems.
Severe	Water volume stored in the lake drops to 40 percent of the conservation storage capacity	• Continue actions implemented in the previous stage. • Implement water supply alternatives. • Increase frequency of media releases explaining water supply conditions. • Prohibit outdoor watering with hose-end sprinklers and automatic irrigation systems. • Prohibit washing of paved areas or hosing of buildings (exceptions for public health and safety). • Limit vehicle washing to commercial car washes. • Prohibit permitting of new swimming pools. • Prohibit operation of ornamental fountains or ponds that use potable water except where necessary to support aquatic life. • Initiate measure to reduce indoor water use. • Initiate surcharge on excessive water use • Establish water allocations for each customer to be used if conditions worsen.
Emergency	• Water volume stored in the lake drops to 30 percent of the conservation storage capacity; or • Major water line breaks or pump or system failures occur; or • Natural or man-made contamination of the water supply source(s) occurs; • Water levels have declined to the point where water withdrawal is impeded or equipment could be damaged by normal operation; or • Other emergency conditions exist	• Implement water supply alternatives. • Increase frequency of media releases explaining water supply conditions. • Increase surcharge on excessive water use. • Initiate water allocation by customer.

7.5.2 Drought Trigger Conditions for Run-of-River and Ground Water Supplies.

Run-of-river and ground water supplies typically serve many water users over a broad geographical area. Some water providers may have drought contingency plans, while other water users, particularly agricultural or industrial users, may not have drought contingency plans. For these water supplies, the ETRWPG proposes to use the U.S. Drought Monitor for Texas as a trigger for drought response actions.[2] This information is easily accessible through the U.S. Drought Monitor web site and is updated regularly. It does not require monitoring of well water levels or stream gages, and drought triggers can identified on a local basis. Table 7.23 shows the drought severity classifications adopted by the U.S. Drought Monitor and the associated Palmer Drought Index.

Table 7.23 Drought Severity Classification

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

U.S. Drought Monitor: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

[2] http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX

The ETRWPG recommends the following actions based on each of the drought classifications listed above:

- Abnormally Dry – Entities should review the status of supplies and demands to determine if implementation of a DCP stage is necessary.
- Moderate Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage is necessary. Other potential actions include voluntary water conservation measures, such as restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.
- Severe Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should begin considering alternative supplies. Other potential actions include mandatory water conservation measures, such as restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.
- Extreme Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should begin to plan implementation of alternative supplies and prepare monthly water usage allocations in preparation for water rationing. Other potential actions include additional mandatory water conservation measures, such as more stringent restrictions on lawn watering days and hours, vehicle washing, pool filling, and non-essential water uses.
- Exceptional Drought – Entities should review the status of supplies and demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. Entities should implement alternative supplies. Other potential actions include additional mandatory water conservation measures, such as prohibition of outdoor watering and non-essential water uses. If necessary, entities should implement water rationing.

7.5.3 Region-Specific Model Drought Contingency Plans. Model DCPs for use by WUGs in the ETRWPA are provided in Appendix 7A. Model DCPs were developed for a public water supplier and for an irrigation water user.

7.6 Drought Management Water Management Strategies

Drought management and emergency response measures are important planning tools for all water suppliers. They are temporary measures that are implemented when certain criteria are met and are terminated when these criteria are no longer met. They are intended to preserve water resources for the most essential uses when water supplies are threatened by extraordinary conditions, such as:

- A multi-year drought,
- An unexpected increase in demand,
- The inability to use a water supply due to a chemical spill or due to invasive species,
- A water supply system component failure, or
- A water management strategy is not fully implemented when it is needed.

The ETRWPG supports implementation of DCPs under appropriate conditions by water providers in order to prolong the availability of existing water supplies and reduce impacts to water users and local economies. However, drought management and emergency response measures are not a reliable source of additional supplies to meet growing demands. Therefore, drought management measures are not recommended as a water management strategy to provide additional supplies for the ETRWPA.

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