2021 Regional Water Plan

Initially Prepared Plan

Prepared by:
Lavaca Regional Water Planning Group
with Assistance from AECOM

Prepared for:
Texas Water Development Board

March 2020

DRAFT

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AECOM Technical Services, Inc.

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Abbreviations Used in the Report

Ac-ft/yr	Acre-feet per year
CBGCD	Coastal Bend Groundwater Conservation District
DB22	TWDB Database containing RWP Data
DCP	Drought Contingency Plan
DOR	Drought of Record
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
GPCD	Gallons Per Capita Daily
LNRA	Lavaca-Navidad River Authority
LRWPA	Lavaca Regional Water Planning Area
LRWPG	Lavaca Regional Water Planning Group
MAG	Modeled Available Groundwater
MGD	Million gallons per day
MWP	Major Water Provider
nPF	Not Potentially Feasible
PF	Potentially Feasible
ROR	Run of River
RWP	Regional Water Plan
RWPG	Regional Water Planning Group
STWM	South Texas Watermaster
SWP	State Water Plan
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
USS	Unique Stream Segment
WAM	Water Availability Model
WCP	Water Conservation Plan
WMS	Water Management Strategy
WUG	Water User Group
WWP	Wholesale Water Provider

Water Measurements

Acre-foot (AF) = 43,560 cubic feet = 325,851 gallons
Acre-foot per year (ac-ft/yr) = 325,851 gallons per year = 893 gallons per day
Gallons per minute (gpm) = 1,440 gallons per day = 1.6 ac-ft/yr
Million gallons per day (mgd) = 1,000,000 gallons per day = 1,120 ac-ft/yr

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ES - Executive Summary

ES.1 Introduction

The 2021 Regional Water Planning process continues the planning process set forth by the 2016 Regional Water Plans (RWPs) for the State of Texas. Beginning in 2016, the 2021 RWP process sought to combine a variety of expertise and interests to prepare updated plans for the 16 unique planning regions within the state. These “initially prepared” Regional Water Plans were to be submitted to the Texas Water Development Board (TWDB) by March 3, 2020. Following a comment period from state agencies and the general public, these plans will be finalized and adopted by October 14, 2020, to be combined into the 2022 State Water Plan. In order to provide consistency and facilitate the compilation of the different regional plans, the TWDB requires the incorporation of the data from the completed regional plans into a standardized online database, referred to as TWDB DB22.

Data provided by the TWDB in DB22 Reports are included in **Appendix ES.A** through **ES.Y**.

1.1 Scope of Work

The scope of work was prepared through a public process and is reflected in the tasks below:

ES.1.1 Task 1 – Planning Area Description

Task 1 was intended to collect data and to provide a physical, social, and economic description of the Lavaca Regional Water Planning Area (LRWPA). The LRWPA is located along the southeastern Texas coast and consists of all of Lavaca and Jackson Counties, as well as Precinct 3 of Wharton County and the majority of the City of El Campo, as shown in *Error! Reference source not found.* of **Chapter 1.** The eastern portion of Wharton County, including a very small portion of El Campo, is included in the Lower Colorado Regional Water Planning Area and planning efforts are coordinated as necessary between this and other neighboring regions.

ES.1.2 Task 2A and 2B – Non-Population Related Water Demand Projections and Population and Population-Related Water Demand Projections

Tasks 2A and 2B were intended to prepare population and water demand projections for the LRWPA. **Chapter 2** summarizes this data and discusses the procedures used to obtain revised population and demand projections. These revised projections were then submitted to TWDB in a formal request to be accepted for use in the State Water Plan. The total demands for each county or portion of a county are shown in **Table ES-1** below. Since agriculture constitutes the dominant water use in the basin, nearly 90 percent of the demands shown are related to irrigation. In addition, Chapter 2 lists the Major Water Providers in the region. The Major Water Provider in the LRWPA is the Lavaca-Navidad River Authority (LNRA). Further information regarding population and water demand projections is available in **Chapter 2**.

Table ES- 1 Total Water Demands in Acre-Feet per Year

Counties	2020	2030	2040	2050	2060	2070
Jackson	93,199	93,277	93,228	93,207	93,200	93,201
Lavaca	18,788	18,076	17,557	17,079	16,631	16,391
Wharton (Region P)	94,317	94,408	94,474	94,556	94,651	94,741
LRWPA Total	206,304	205,761	205,259	204,842	204,482	204,333

ES.1.3 Task 3 – Water Supply Analyses

The availability of surface water and groundwater supplies were determined in Task 3. Surface water sources were determined to be limited under drought-of-record (DOR) conditions. The only surface water supply determined to be available during DOR was a supply of 79,000 acre-feet from Lake Texana, the only reservoir in the region; of this 79,000 acre-feet, 4,500 acre-feet is reserved for required releases for the bays and estuaries. This brings the available firm yield to 74,500 ac-ft for all decades in the planning horizon. This firm yield was determined using a modified version of the TCEQ Lavaca River WAM Run 3. A hydrologic request to use the modified model was submitted to and approved by the TWDB staff. Only a small portion of this supply is contracted through the Lavaca-Navidad River Authority (LNRA) to a customer within the region. The remaining supply is used to meet demands from outside of the region.

Groundwater supplies are responsible for meeting nearly all of the WUG demands within the LRWPA, although a portion of the Irrigation demands are met through surface water from the Colorado River in Region K through the Garwood Irrigation Division. Available groundwater for this planning cycle was based on the Desired Future Condition (DFC) of the Central Gulf Coast Aquifer, which was determined by the Groundwater Conservation Districts within Groundwater Management Area 15. The TWDB used a groundwater availability model (GAM) to convert the DFC into a volume of groundwater known as the Modeled Available Groundwater, or MAG. The MAG is considered the maximum amount of groundwater available for the regional water planning process from a particular aquifer.

Table ES- 2 Lavaca Region Groundwater Availability for Gulf Coast Aquifer

County	Basin	Year					
		2020	2030	2040	2050	2060	2070
Jackson	Colorado-Lavaca	28,025	28,025	28,025	28,025	28,025	28,025
	Lavaca	49,582	49,582	49,582	49,582	49,582	49,582
	Lavaca-Guadalupe	12,875	12,875	12,875	12,875	12,875	12,875
	County Total	***90,482***	***90,482***	***90,482***	***90,482***	***90,482***	***90,482***
Lavaca	Guadalupe	41	41	41	41	41	41
	Lavaca	19,811	19,811	19,811	19,811	19,811	19,811
	Lavaca-Guadalupe	401	401	401	401	401	401
	County Total	***20,253***	***20,253***	***20,253***	***20,253***	***20,253***	***20,253***
Wharton	Colorado	873	873	873	873	873	873
	Colorado-Lavaca	14,091	14,091	14,091	14,091	14,091	14,091
	Lavaca	62,992	62,992	62,992	62,992	62,992	62,992
	County Total	***77,956***	***77,956***	***77,956***	***77,956***	***77,956***	***77,956***

The Lavaca Regional Water Planning Group (LRWPG) was made aware in previous planning cycles that water demands in neighboring regions have caused a demand for water within the LRWPA sooner than initially expected. As such, the LRWPG understands that continued coordination with neighboring regional water planning groups is essential to maintaining consistency among the different regions and insuring that supplies and management strategies are properly developed. Based on the coordination that has occurred to date, implementation of water management strategies currently planned for Regions L and N are not expected to impact supplies in the LRWPA. For additional information regarding the determination of available water supplies, see **Chapter 3**.

ES.1.4 Task 4 – Identification of Water Needs

Task 4 was to determine the surpluses and shortages resulting from the division of available resources performed for Task 3. **Table ES-3** includes a summary of water shortages/needs for the LRWPA.

Table ES- 3 Water Needs in Acre-Feet per Year

County	WUG	Basin	2020	2030	2040	2050	2060	2070
WHARTON	IRRIGATION	LAVACA	-8,067	-8,067	-8,067	-8,067	-8,067	-8,067

The sum of projected shortages for the planning horizon is 8,067 ac-ft/year. While not identified in this Regional Water Plan, recent activity by existing and potential future customers of LNRA has shown that there may be new industrial demands in the region within the planning horizon. Currently, LNRA is looking at various water management strategy options to meet the potential needs. These strategies are discussed in **Chapter 5**. For additional information regarding the determination of water needs, see **Chapter 4**.

ES.1.5 Task 5 – Evaluation and Recommendation of Water Management Strategies and Water Conservation Recommendations

A process for the evaluation of feasibility of strategy implementation was developed in Task 5. Water management strategies were presented in a form so that all potential alternatives were identified and evaluated in accordance with local desires and needs. The costs of potential water management strategies (WMSs) were given the most consideration during the strategy selection process for meeting Irrigation needs because irrigators are sensitive to the increase in water prices and all shortages in the LRWPA were assumed to impact these users.

Several strategies considered for evaluation were for meeting Irrigation water needs. The remaining strategies were evaluated at the request of the project sponsor or were included to encourage conservation and drought management in the region. If a project sponsor wishes to be considered for certain types of State funding, the project that the funding is requested for must be included in the Regional and State Water Plan.

Potential WMSs that were recommended were those that met irrigation needs, have the potential to increase wholesale water provider supplies, and that could help municipalities use water more efficiently or reduce their water use during times of drought. Further discussion of recommended and alternative water management strategies is included in **Chapter 5**. In addition, a section was included in **Chapter 5** to discuss recommended conservation strategies. Water conservation plans are required for any entity seeking a TWDB loan, a new or amended surface water right, or current holders of existing surface water diversion permits under certain circumstances.

ES.1.6 Task 6 – Impacts of the Regional Water Plan

The purpose of Task 6 was to determine the effects of water management strategies on water resources, agricultural resources, and natural resources. In addition, determination of social and economic impacts resulting from voluntary redistribution of water from rural regions to population centers was considered. This activity was part of a consensus-based planning effort to include local concerns in the statewide water supply planning process.

Overall, the recommended strategies keep the groundwater levels at a sustainable level and have no impact on spring flows. As a result of drought management, conservation, and reuse strategies being implemented, there is only a slight reduction in instream flows and bay and estuaries flows during times of drought. Frequency targets for meeting freshwater inflow goals to Lavaca Bay that were met using the unmodified TCEQ WAM Run 3 continue to be met when incorporating the water management strategies into the model. The LRWPG balanced meeting water needs with good stewardship of water, agricultural, and natural resources within the Region.

ES.1.7 Task 7 – Drought Response Information, Activities, and Recommendations

Task 7 presents all necessary requirements for drought management and contingency plans. Drought contingency plans are required of certain water right owners and applicants. These documents have become integral to providing a reliable supply of water throughout the State.

The LRWPG acknowledged that the Drought Contingency Plan for the LNRA is the best drought management tool for surface water supplies in the Lavaca Region. LNRA uses multiple triggers at each stage that include water surface elevations of the lake as well as a broad trigger that allows for any additional scenario that would cause the LNRA to notify its customers that a drought stage has been triggered.

Throughout the region, the Drought Contingency Plans for groundwater users are developed specifically to their use and location. Aquifer properties can vary across the region and it can be difficult to require the same triggers for all users of a particular groundwater source that covers several counties. The LRWPG acknowledges that the municipalities that use groundwater have the best knowledge to develop their Drought Contingency Plan triggers and responses.

ES.1.8 Task 8 – Unique Stream Segments, Reservoir Sites, and Legislative Recommendations

Task 8 presents the RWPG’s unique stream segments, unique reservoir sites, and legislative, administrative, and regulatory recommendations.

No designation of unique stream segments or reservoir sites was recommended for the current round of regional water planning.

Several policy issues have been adopted by the LRWPG concerning regulatory and legislative issues. These recommendations are listed below and are described in detail in **Chapter 8**.

- Environmental Issues
- Ongoing RWPG Activities
- Inter-Regional Coordination
- Conservation Policy
- Sustainable Yield of the Gulf Coast Aquifer
- Support of the Rule of Capture

- Groundwater Conservation Districts
- Establishment of Fees for Groundwater Export
- Limits for Groundwater Conservation Districts

ES.1.9 Task 9 – Water Infrastructure Financing Recommendations

Task 9 includes information on how sponsors of the recommended water management strategies propose to finance projects. In SB 2 of the 77th Texas Legislature, the preparation of an infrastructure financing report was added to the regional planning process. **Chapter 9** of the Initially Prepared Plan introduces the following, while the Final Adopted Plan will address the following:

- The number of political subdivisions with identified needs that will be unable to finance their water infrastructure needs
- The amount of infrastructure costs in the RWPs that cannot be financed by the local political subdivisions
- Funding options, including state funding, that are proposed by the political subdivisions to finance water infrastructure costs that cannot be financed locally
- Additional roles the RWPG proposes for the state in financing the recommended water supply projects

ES.1.10 Task 10 – Public Participation

Public participation has been encouraged through the efforts of the Planning Group members as they take information back to the WUGs they represent. This was the most effective method of informing the public of the progress of the Plan. All of the members were active in meeting with various interest groups and making presentations. Public meetings were held throughout the planning cycle to review the population and water demand data; the supplies, surpluses, and shortages; and management strategies. Meetings of the Planning Group followed the Open Meetings Act requirements and were well attended by the members and non-voting members, but participation by the general public has been limited. Meeting events are summarized in **Chapter 10**.

ES.1.11 Task 11 – Implementation and Comparison to the Previous Regional Water Plan

Chapter 11 presents a discussion and survey of water management strategy projects that were recommended in the 2016 Regional Water Plan and have since been implemented, as well as providing a summary comparison of the 2021 Regional Water Plan to the 2016 Regional Water Plan with respect to population, demands, water availability and supplies, and water management strategies.

APPENDIX ES

ES.A – TWDB DB22 Report – WUG Population

ES.B – TWDB DB22 Report – WUG Demand

ES.C – TWDB DB22 Report – WUG Category Summary

ES.D – TWDB DB22 Report – Source Availability

ES.E – TWDB DB22 Report – WUG Existing Water Supply

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ES.I – TWDB DB22 Report – Source Water Balance (Availability – WUG Supply)

ES.J – TWDB DB22 Report – WUG Data Comparison to 2016 Regional Water Plan

ES.K – TWDB DB22 Report – Source Data Comparison to 2016 Regional Water Plan

ES.L – TWDB DB22 Report – WUG Unmet Needs

ES.M – TWDB DB22 Report – WUG Unmet Needs Summary

ES.N – TWDB DB22 Report – Recommended WUG WMS

ES.O – TWDB DB22 Report – Recommended Projects Associated with WMS

ES.P – TWDB DB22 Report – Alternative WUG WMS

ES.Q – TWDB DB22 Report – Alternative Projects Associated with WMS

ES.R – TWDB DB22 Report – WUG Management Supply Factor

ES.S – TWDB DB22 Report – Recommended WMS Supply Associated with New or Amended Inter-Basin Transfer Permit

ES.T – TWDB DB22 Report – WUGs Recommended WMS Supply Associated with a New or Amended Inter-Basin Transfer Permit and Total Recommended Conservation WMS Supply

ES.U – TWDB DB22 Report – Sponsored Recommended Water WMS Supplies Unallocated to WUG

ES.V – TWDB DB22 Report – WMS Strategy Supplies by WMS Type

ES.W – TWDB DB22 Report – WMS Strategy Supplies by Source Type

ES.X – TWDB DB22 Report – Major Water Provider Existing Sales and Transfers

ES.Y – TWDB DB22 Report – Major Water Provider WMS Summary

Region P Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER	2,236	2,315	2,348	2,375	2,392	2,403
COLORADO-LAVACA BASIN TOTAL	**2,236**	**2,315**	**2,348**	**2,375**	**2,392**	**2,403**
EDNA	5,747	5,949	6,034	6,105	6,150	6,177
GANADO	2,080	2,153	2,184	2,209	2,224	2,236
COUNTY-OTHER	4,064	4,206	4,267	4,317	4,349	4,368
LAVACA BASIN TOTAL	**11,891**	**12,308**	**12,485**	**12,631**	**12,723**	**12,781**
COUNTY-OTHER	479	496	503	509	512	515
LAVACA-GUADALUPE BASIN TOTAL	**479**	**496**	**503**	**509**	**512**	**515**
JACKSON COUNTY TOTAL	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**
COUNTY-OTHER	33	33	33	33	33	33
GUADALUPE BASIN TOTAL	**33**	**33**	**33**	**33**	**33**	**33**
HALLETTSVILLE	2,820	2,820	2,820	2,820	2,820	2,820
MOULTON	874	874	874	874	874	874
SHINER	2,054	2,054	2,054	2,054	2,054	2,054
YOAKUM*	3,701	3,701	3,701	3,700	3,701	3,701
COUNTY-OTHER	9,776	9,776	9,776	9,777	9,776	9,776
LAVACA BASIN TOTAL	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**
COUNTY-OTHER	5	5	5	5	5	5
LAVACA-GUADALUPE BASIN TOTAL	**5**	**5**	**5**	**5**	**5**	**5**
LAVACA COUNTY TOTAL	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**
EL CAMPO*	1,658	1,735	1,797	1,851	1,900	1,944
COUNTY-OTHER*	175	197	214	230	244	256
COLORADO BASIN TOTAL	**1,833**	**1,932**	**2,011**	**2,081**	**2,144**	**2,200**
EL CAMPO*	10,148	10,621	11,000	11,327	11,631	11,899
COUNTY-OTHER*	750	844	919	984	1,044	1,098
COLORADO-LAVACA BASIN TOTAL	**10,898**	**11,465**	**11,919**	**12,311**	**12,675**	**12,997**
EL CAMPO*	290	304	314	324	332	340
WHARTON COUNTY WCID 1	1,076	1,146	1,201	1,248	1,293	1,331
COUNTY-OTHER*	2,523	2,839	3,093	3,311	3,512	3,692
LAVACA BASIN TOTAL	**3,889**	**4,289**	**4,608**	**4,883**	**5,137**	**5,363**
WHARTON COUNTY TOTAL	**16,620**	**17,686**	**18,538**	**19,275**	**19,956**	**20,560**
REGION P POPULATION TOTAL	**50,489**	**52,068**	**53,137**	**54,053**	**54,846**	**55,522**

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

Region P Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
COUNTY-OTHER	234	232	227	225	226	227
MANUFACTURING	10,549	10,627	10,627	10,627	10,627	10,627
MINING	10	10	8	6	4	3
LIVESTOCK	415	415	415	415	415	415
IRRIGATION	22,372	22,372	22,372	22,372	22,372	22,372
COLORADO-LAVACA BASIN TOTAL	**33,580**	**33,656**	**33,649**	**33,645**	**33,644**	**33,644**
EDNA	878	880	869	869	874	877
GANADO	237	236	232	231	231	233
COUNTY-OTHER	426	421	411	409	410	411
MANUFACTURING	146	147	147	147	147	147
MINING	39	41	31	22	14	10
LIVESTOCK	1,289	1,289	1,289	1,289	1,289	1,289
IRRIGATION	45,136	45,136	45,136	45,136	45,136	45,136
LAVACA BASIN TOTAL	**48,151**	**48,150**	**48,115**	**48,103**	**48,101**	**48,103**
COUNTY-OTHER	50	50	49	48	48	49
MANUFACTURING	229	231	231	231	231	231
MINING	21	22	16	12	8	6
LIVESTOCK	178	178	178	178	178	178
IRRIGATION	10,990	10,990	10,990	10,990	10,990	10,990
LAVACA-GUADALUPE BASIN TOTAL	**11,468**	**11,471**	**11,464**	**11,459**	**11,455**	**11,454**
JACKSON COUNTY TOTAL	**93,199**	**93,277**	**93,228**	**93,207**	**93,200**	**93,201**
COUNTY-OTHER	4	4	4	4	4	4
LIVESTOCK	37	37	37	37	37	37
GUADALUPE BASIN TOTAL	**41**	**41**	**41**	**41**	**41**	**41**
HALLETTSVILLE	641	628	617	611	610	610
MOULTON	179	175	171	170	169	169
SHINER	485	475	467	463	462	462
YOAKUM*	658	641	627	619	618	618
COUNTY-OTHER	1,258	1,212	1,174	1,154	1,150	1,150
MANUFACTURING	563	625	625	625	625	625
MINING	2,544	1,860	1,416	977	537	297
LIVESTOCK	3,650	3,650	3,650	3,650	3,650	3,650
IRRIGATION	8,692	8,692	8,692	8,692	8,692	8,692
LAVACA BASIN TOTAL	**18,670**	**17,958**	**17,439**	**16,961**	**16,513**	**16,273**
COUNTY-OTHER	1	1	1	1	1	1
LIVESTOCK	76	76	76	76	76	76
LAVACA-GUADALUPE BASIN TOTAL	**77**	**77**	**77**	**77**	**77**	**77**
LAVACA COUNTY TOTAL	**18,788**	**18,076**	**17,557**	**17,079**	**16,631**	**16,391**
EL CAMPO*	313	320	325	331	339	347
COUNTY-OTHER*	23	25	26	28	30	31
COLORADO BASIN TOTAL	**336**	**345**	**351**	**359**	**369**	**378**
EL CAMPO*	1,918	1,958	1,989	2,028	2,078	2,125
COUNTY-OTHER*	99	107	113	121	128	134
MANUFACTURING*	34	34	34	34	34	34
MINING*	6	6	5	3	2	1
LIVESTOCK*	184	184	184	184	184	184
IRRIGATION*	4,858	4,858	4,858	4,858	4,858	4,858
COLORADO-LAVACA BASIN TOTAL	**7,099**	**7,147**	**7,183**	**7,228**	**7,284**	**7,336**

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

Region P Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
EL CAMPO*	55	56	57	58	59	61
WHARTON COUNTY WCID 1	184	190	195	200	207	213
COUNTY-OTHER*	333	359	381	406	429	452
MINING*	12	13	9	7	5	3
STEAM ELECTRIC POWER*	2,060	2,060	2,060	2,060	2,060	2,060
LIVESTOCK*	650	650	650	650	650	650
IRRIGATION*	83,588	83,588	83,588	83,588	83,588	83,588
LAVACA BASIN TOTAL	**86,882**	**86,916**	**86,940**	**86,969**	**86,998**	**87,027**
WHARTON COUNTY TOTAL	**94,317**	**94,408**	**94,474**	**94,556**	**94,651**	**94,741**
REGION P DEMAND TOTAL	**206,304**	**205,761**	**205,259**	**204,842**	**204,482**	**204,333**

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

Region P Water User Group (WUG) Category Summary

MUNICIPAL	2020	2030	2040	2050	2060	2070
POPULATION	30,448	31,357	31,979	32,512	32,979	33,376
DEMAND (acre-feet per year)	5,548	5,559	5,549	5,580	5,647	5,715
EXISTING SUPPLIES (acre-feet per year)	6,948	6,948	6,948	6,948	6,948	6,948
NEEDS (acre-feet per year)*	0	0	0	0	0	0

COUNTY-OTHER	2020	2030	2040	2050	2060	2070
POPULATION	20,041	20,711	21,158	21,541	21,867	22,146
DEMAND (acre-feet per year)	2,428	2,411	2,386	2,396	2,426	2,459
EXISTING SUPPLIES (acre-feet per year)	3,237	3,237	3,237	3,237	3,237	3,237
NEEDS (acre-feet per year)*	0	0	0	0	0	0

MANUFACTURING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	11,521	11,664	11,664	11,664	11,664	11,664
EXISTING SUPPLIES (acre-feet per year)	11,583	11,664	11,664	11,664	11,664	11,664
NEEDS (acre-feet per year)*	0	0	0	0	0	0

MINING	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	2,632	1,952	1,485	1,027	570	320
EXISTING SUPPLIES (acre-feet per year)	2,636	2,636	2,636	2,636	2,636	2,636
NEEDS (acre-feet per year)*	0	0	0	0	0	0

STEAM ELECTRIC POWER	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	2,060	2,060	2,060	2,060	2,060	2,060
EXISTING SUPPLIES (acre-feet per year)	2,060	2,060	2,060	2,060	2,060	2,060
NEEDS (acre-feet per year)*	0	0	0	0	0	0

LIVESTOCK	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	6,479	6,479	6,479	6,479	6,479	6,479
EXISTING SUPPLIES (acre-feet per year)	6,479	6,479	6,479	6,479	6,479	6,479
NEEDS (acre-feet per year)*	0	0	0	0	0	0

IRRIGATION	2020	2030	2040	2050	2060	2070
DEMAND (acre-feet per year)	175,636	175,636	175,636	175,636	175,636	175,636
EXISTING SUPPLIES (acre-feet per year)	167,569	167,569	167,569	167,569	167,569	167,569
NEEDS (acre-feet per year)*	8,067	8,067	8,067	8,067	8,067	8,067

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Region P Source Availability

GROUNDWATERSOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
GULF COAST AQUIFER SYSTEM	JACKSON	COLORADO-LAVACA	FRESH	28,025	28,025	28,025	28,025	28,025	28,025
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA	FRESH/ BRACKISH	49,582	49,582	49,582	49,582	49,582	49,582
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA-GUADALUPE	FRESH	12,875	12,875	12,875	12,875	12,875	12,875
GULF COAST AQUIFER SYSTEM	LAVACA	GUADALUPE	FRESH	41	41	41	41	41	41
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA	FRESH	19,811	19,811	19,811	19,811	19,811	19,811
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA-GUADALUPE	FRESH	401	401	401	401	401	401
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO	FRESH	873	873	873	873	873	873
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO-LAVACA	FRESH	14,091	14,091	14,091	14,091	14,091	14,091
GULF COAST AQUIFER SYSTEM	WHARTON	LAVACA	FRESH	62,992	62,992	62,992	62,992	62,992	62,992
GROUNDWATERSOURCE AVAILABILITY TOTAI				**188,691**	**188,691**	**188,691**	**188,691**	**188,691**	**188,691**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
TEXANA LAKE/RESERVOIR	RESERVOIR**	LAVACA	FRESH	74,500	74,500	74,500	74,500	74,500	74,500
SURFACE WATER SOURCE AVAILABILITY TOTAI				**74,500**	**74,500**	**74,500**	**74,500**	**74,500**	**74,500**

REGION P SOURCE AVAILABILITY TOTAI	**263,191**	**263,191**	**263,191**	**263,191**	**263,191**	**263,191**

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

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

Region P Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	331	331	331	331	331	331
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	10,549	10,627	10,627	10,627	10,627	10,627
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	10	10	10	10	10	10
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	415	415	415	415	415	415
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	22,372	22,372	22,372	22,372	22,372	22,372
		COLORADO-LAVACA BASIN TOTAL	**33,677**	**33,755**	**33,755**	**33,755**	**33,755**	**33,755**
EDNA	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	1,281	1,281	1,281	1,281	1,281	1,281
GANADO	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	340	340	340	340	340	340
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	602	602	602	602	602	602
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	146	147	147	147	147	147
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	41	41	41	41	41	41
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	1,289	1,289	1,289	1,289	1,289	1,289
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	45,136	45,136	45,136	45,136	45,136	45,136
		LAVACA BASIN TOTAL	**48,835**	**48,836**	**48,836**	**48,836**	**48,836**	**48,836**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	71	71	71	71	71	71
MANUFACTURING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	50	50	50	50	50	50
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	179	181	181	181	181	181
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	22	22	22	22	22	22
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	178	178	178	178	178	178
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	10,990	10,990	10,990	10,990	10,990	10,990
		LAVACA-GUADALUPE BASIN TOTAL	**11,490**	**11,492**	**11,492**	**11,492**	**11,492**	**11,492**
		JACKSON COUNTY TOTAL	**94,002**	**94,083**	**94,083**	**94,083**	**94,083**	**94,083**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	4	4	4	4	4	4
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	37	37	37	37	37	37
		GUADALUPE BASIN TOTAL	**41**	**41**	**41**	**41**	**41**	**41**
HALLETTSVILLE	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	846	846	846	846	846	846
MOULTON	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	234	234	234	234	234	234
SHINER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	641	641	641	641	641	641
YOAKUM*	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	860	860	860	860	860	860
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	1,611	1,611	1,611	1,611	1,611	1,611
MANUFACTURING	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	625	625	625	625	625	625
MINING	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	2,544	2,544	2,544	2,544	2,544	2,544
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	3,650	3,650	3,650	3,650	3,650	3,650
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	8,692	8,692	8,692	8,692	8,692	8,692
		LAVACA BASIN TOTAL	**19,703**	**19,703**	**19,703**	**19,703**	**19,703**	**19,703**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	1	1	1	1	1	1
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	76	76	76	76	76	76
		LAVACA-GUADALUPE BASIN TOTAL	**77**	**77**	**77**	**77**	**77**	**77**
		LAVACA COUNTY TOTAL	**19,821**	**19,821**	**19,821**	**19,821**	**19,821**	**19,821**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	347	347	347	347	347	347
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	31	31	31	31	31	31
		COLORADO BASIN TOTAL	**378**	**378**	**378**	**378**	**378**	**378**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	2,125	2,125	2,125	2,125	2,125	2,125
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	134	134	134	134	134	134
MANUFACTURING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	34	34	34	34	34	34
MINING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	6	6	6	6	6	6
LIVESTOCK*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	184	184	184	184	184	184
IRRIGATION*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	4,858	4,858	4,858	4,858	4,858	4,858

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

Region P Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
		COLORADO-LAVACA BASIN TOTAL	**7,341**	**7,341**	**7,341**	**7,341**	**7,341**	**7,341**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	61	61	61	61	61	61
WHARTON COUNTY WCID 1	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	213	213	213	213	213	213
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	452	452	452	452	452	452
MINING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	13	13	13	13	13	13
STEAM ELECTRIC POWER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	2,060	2,060	2,060	2,060	2,060	2,060
LIVESTOCK*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	650	650	650	650	650	650
IRRIGATION*	K	COLORADO RUN-OF-RIVER	16,000	16,000	16,000	16,000	16,000	16,000
IRRIGATION*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	59,521	59,521	59,521	59,521	59,521	59,521
		LAVACA BASIN TOTAL	**78,970**	**78,970**	**78,970**	**78,970**	**78,970**	**78,970**
		WHARTON COUNTY TOTAL	**86,689**	**86,689**	**86,689**	**86,689**	**86,689**	**86,689**
		REGION P EXISTING WATER SUPPLY TOTAL	**200,512**	**200,593**	**200,593**	**200,593**	**200,593**	**200,593**

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Region P Water User Group (WUG) Needs/Surplus

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Needs/Surplus report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Surplus volumes are shown as positive values, and needs are shown as negative values in parentheses.

	(NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY - COLORADO-LAVACA BASIN						
COUNTY-OTHER	97	99	104	106	105	104
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	2	4	6	7
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA BASIN						
EDNA	403	401	412	412	407	404
GANADO	103	104	108	109	109	107
COUNTY-OTHER	176	181	191	193	192	191
MANUFACTURING	0	0	0	0	0	0
MINING	2	0	10	19	27	31
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	21	21	22	23	23	22
MANUFACTURING	0	0	0	0	0	0
MINING	1	0	6	10	14	16
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
LAVACA COUNTY - LAVACA BASIN						
HALLETTSVILLE	205	218	229	235	236	236
MOULTON	55	59	63	64	65	65
SHINER	156	166	174	178	179	179
YOAKUM*	202	219	233	241	242	242
COUNTY-OTHER	353	399	437	457	461	461
MANUFACTURING	62	0	0	0	0	0
MINING	0	684	1,128	1,567	2,007	2,247
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
WHARTON COUNTY - COLORADO BASIN						
EL CAMPO*	34	27	22	16	8	0
COUNTY-OTHER*	8	6	5	3	1	0
WHARTON COUNTY - COLORADO-LAVACA BASIN						
EL CAMPO*	207	167	136	97	47	0
COUNTY-OTHER*	35	27	21	13	6	0
MANUFACTURING*	0	0	0	0	0	0
MINING*	0	0	1	3	4	5

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

Region P Water User Group (WUG) Needs/Surplus

LIVESTOCK*	0	0	0	0	0	0
IRRIGATION*	0	0	0	0	0	0
WHARTON COUNTY - LAVACA BASIN						
EL CAMPO*	6	5	4	3	2	0
WHARTON COUNTY WCID 1	29	23	18	13	6	0
COUNTY-OTHER*	119	93	71	46	23	0
MINING*	1	0	4	6	8	10
STEAM ELECTRIC POWER*	0	0	0	0	0	0
LIVESTOCK*	0	0	0	0	0	0
IRRIGATION*	(8,067)	(8,067)	(8,067)	(8,067)	(8,067)	(8,067)

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

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

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

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY - COLORADO-LAVACA BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA BASIN						
EDNA	0	0	0	0	0	0
GANADO	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
LAVACA COUNTY - LAVACA BASIN						
HALLETTSVILLE	0	0	0	0	0	0
MOULTON	0	0	0	0	0	0
SHINER	0	0	0	0	0	0
YOAKUM*	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
WHARTON COUNTY - COLORADO BASIN						
EL CAMPO*	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
WHARTON COUNTY - COLORADO-LAVACA BASIN						
EL CAMPO*	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
MANUFACTURING*	0	0	0	0	0	0
MINING*	0	0	0	0	0	0
LIVESTOCK*	0	0	0	0	0	0

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

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

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY - COLORADO-LAVACA BASIN						
IRRIGATION*	0	0	0	0	0	0
WHARTON COUNTY - LAVACA BASIN						
EL CAMPO*	0	0	0	0	0	0
WHARTON COUNTY WCID 1	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
MINING*	0	0	0	0	0	0
STEAM ELECTRIC POWER*	0	0	0	0	0	0
LIVESTOCK*	0	0	0	0	0	0
IRRIGATION*	0	0	0	0	0	0

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

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

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

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Region P Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
GULF COAST AQUIFER SYSTEM	JACKSON	COLORADO-LAVACA	FRESH	4,897	4,897	4,897	4,897	4,897	4,897
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA	FRESH/ BRACKISH	893	893	893	893	893	893
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA-GUADALUPE	FRESH	1,564	1,564	1,564	1,564	1,564	1,564
GULF COAST AQUIFER SYSTEM	LAVACA	GUADALUPE	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA	FRESH	108	108	108	108	108	108
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA-GUADALUPE	FRESH	324	324	324	324	324	324
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO	FRESH	842	842	842	842	842	842
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO-LAVACA	FRESH	6,279	6,279	6,279	6,279	6,279	6,279
GULF COAST AQUIFER SYSTEM	WHARTON	LAVACA	FRESH	83	83	83	83	83	83
GROUNDWATER SOURCE WATER BALANCE TOTAI				**14,990**	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
TEXANA LAKE/RESERVOIR	RESERVOIR**	LAVACA	FRESH	0	0	0	0	0	0
SURFACE WATER SOURCE WATER BALANCE TOTAI				**0**	**0**	**0**	**0**	**0**	**0**

REGION P SOURCE WATER BALANCE TOTAI	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**

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

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

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

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
JACKSON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	700	1,004	43.4%	700	1,004	43.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	700	710	1.4%	675	687	1.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JACKSON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	59,801	78,498	31.3%	59,801	78,498	31.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	59,801	78,498	31.3%	59,801	78,498	31.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JACKSON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,034	1,882	82.0%	1,034	1,882	82.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,034	1,882	82.0%	1,034	1,882	82.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JACKSON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,005	10,924	987.0%	1,005	11,005	995.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	670	10,924	1530.4%	820	11,005	1242.1%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JACKSON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	73	73	0.0%	73	73	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	70	70	0.0%	19	19	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
JACKSON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,157	1,621	40.1%	1,157	1,621	40.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,155	1,115	-3.5%	1,153	1,110	-3.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAVACA COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	1,241	1,616	30.2%	1,241	1,616	30.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	1,241	1,263	1.8%	1,130	1,155	2.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAVACA COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	8,357	8,692	4.0%	8,357	8,692	4.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	8,357	8,692	4.0%	8,357	8,692	4.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAVACA COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,043	3,763	84.2%	2,043	3,763	84.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,043	3,763	84.2%	2,043	3,763	84.2%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAVACA COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	705	625	-11.3%	705	625	-11.3%
PROJECTED DEMAND TOTAL (acre-feet per year)	490	563	14.9%	705	625	-11.3%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
LAVACA COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,544	2,544	0.0%	2,544	2,544	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,544	2,544	0.0%	297	297	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

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

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
LAVACA COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,029	2,581	27.2%	2,029	2,581	27.2%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,029	1,963	-3.3%	1,832	1,859	1.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | COUNTY-OTHER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	767	617	-19.6%	767	617	-19.6%
PROJECTED DEMAND TOTAL (acre-feet per year)	588	455	-22.6%	767	617	-19.6%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | IRRIGATION WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	99,403	80,379	-19.1%	99,403	80,379	-19.1%
PROJECTED DEMAND TOTAL (acre-feet per year)	149,688	88,446	-40.9%	149,688	88,446	-40.9%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	50,285	8,067	-84.0%	50,285	8,067	-84.0%
WHARTON COUNTY | LIVESTOCK WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	789	834	5.7%	789	834	5.7%
PROJECTED DEMAND TOTAL (acre-feet per year)	789	834	5.7%	789	834	5.7%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | MANUFACTURING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	133	34	-74.4%	133	34	-74.4%
PROJECTED DEMAND TOTAL (acre-feet per year)	95	34	-64.2%	133	34	-74.4%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | MINING WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	19	19	0.0%	19	19	0.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	18	18	0.0%	4	4	0.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | MUNICIPAL WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	2,531	2,746	8.5%	2,531	2,746	8.5%
PROJECTED DEMAND TOTAL (acre-feet per year)	2,284	2,470	8.1%	2,531	2,746	8.5%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
WHARTON COUNTY | STEAM ELECTRIC POWER WUG TYPE						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	0	2,060	100.0%	0	2,060	100.0%
PROJECTED DEMAND TOTAL (acre-feet per year)	0	2,060	100.0%	0	2,060	100.0%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	0	0	0.0%	0	0	0.0%
REGION P						
EXISTING WUG SUPPLY TOTAL (acre-feet per year)	184,331	200,512	8.8%	184,331	200,593	8.8%
PROJECTED DEMAND TOTAL (acre-feet per year)	233,596	206,304	-11.7%	231,778	204,333	-11.8%
WATER SUPPLY NEEDS TOTAL (acre-feet per year)*	50,285	8,067	-84.0%	50,285	8,067	-84.0%

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Data Comparison to 2016 RWP report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG county and category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

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

	2020 PLANNING DECADE			2070 PLANNING DECADE		
	2016 RWP	2021 RWP	DIFFERENCE (%)	2016 RWP	2021 RWP	DIFFERENCE (%)
JACKSON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	76,386	90,482	18.5%	76,386	90,482	18.5%
LAVACA COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	20,385	20,253	-0.6%	20,373	20,253	-0.6%
RESERVOIR* COUNTY						
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	74,500	74,500	0.0%	74,500	74,500	0.0%
WHARTON COUNTY						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	99,753	77,956	-21.9%	99,753	77,956	-21.9%
REGION P						
GROUNDWATER AVAILABILITY TOTAL (acre-feet per year)	196,524	188,691	-4.0%	196,512	188,691	-4.0%
SURFACE WATER AVAILABILITY TOTAL (acre-feet per year)	74,500	74,500	0.0%	74,500	74,500	0.0%

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

Region P Water User Group (WUG) Unmet Needs

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**

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

Region P Water User Group (WUG) Unmet Needs Summary

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zerc so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
EDNA	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	33	33	33	33	33	33
EL CAMPO*	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	86	88	89	91	93	95
EL CAMPO*	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1812	0	117	190	283	301	308
GANADO	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	47	47	47	47	47	47
HALLETTSVILLE	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	48	47	46	46	46	46
HALLETTSVILLE	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1911	0	31	50	73	98	124
IRRIGATION, WHARTON*	P	IRRIGATION CONSERVATION	DEMAND REDUCTION	$200	$200	15,229	15,229	15,229	15,229	15,229	15,229
MANUFACTURING, JACKSON	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	1,101	1,101	1,101	1,101	1,101
MANUFACTURING, LAVACA	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	63	63	63	63	63
MANUFACTURING, WHARTON*	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	3	3	3	3	3
MOULTON	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	36	35	34	34	34	34
MOULTON	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$2031	0	9	13	20	26	32
SHINER	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	49	48	47	46	46	46
SHINER	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1404	0	24	38	56	75	94
WHARTON COUNTY WCID 1	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	28	29	29	30	31	32
WHARTON COUNTY WCID 1	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$6000	0	10	7	4	4	4
YOAKUM*	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	16	16	16	15	15	15
YOAKUM*	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$4681	0	32	47	39	38	38

REGION P RECOMMENDED WMS SUPPLY TOTAL						15,572	16,962	17,082	17,213	17,283	17,344

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

Region P Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
EL CAMPO	YES	2030	MUNICIPAL CONSERVATION - EL CAMPO	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$3,671,000
EL CAMPO	YES	2030	REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$7,881,000
HALLETTSVILLE	YES	2030	MUNICIPAL CONSERVATION - HALLETTSVILLE	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$1,502,000
IRRIGATION, WHARTON	NO	2020	IRRIGATION CONSERVATION - ON FARM	CONSERVATION - AGRICULTURAL	$7,239,000
IRRIGATION, WHARTON	NO	2020	IRRIGATION CONSERVATION - TAILWATER RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$19,092,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2030	LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; DIVERSION AND CONTROL STRUCTURE; PUMP STATION	$41,781,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$289,977,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$49,900,000
MOULTON	NO	2030	MUNICIPAL CONSERVATION - MOULTON	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$410,000
SHINER	YES	2030	MUNICIPAL CONSERVATION - SHINER	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$810,000
WHARTON COUNTY WCID 1	NO	2030	MUNICIPAL CONSERVATION - WHARTON COUNTY WCID 1	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL	$409,000
YOAKUM	YES	2020	MUNICIPAL CONSERVATION - YOAKUM	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$85,984

REGION P RECOMMENDED CAPITAL COST TOTAL	**$422,757,984**

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

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
IRRIGATION, WHARTON*	P	EXPAND USE OF GROUNDWATER	P | GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	$66	$66	8,067	8,067	8,067	8,067	8,067	8,067
IRRIGATION, WHARTON*	P	IRRIGATION CONSERVATION	DEMAND REDUCTION	$0	$0	633	633	633	633	633	633
MANUFACTURING, JACKSON	P	DROUGHT MANAGEMENT - MANUFACTURING	DEMAND REDUCTION	$4570	$4570	1,096	1,096	1,096	1,096	1,096	1,096
REGION P ALTERNATIVE WMS SUPPLY TOTA						9,796	9,796	9,796	9,796	9,796	9,796

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

Region P Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$260,074,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LAKE TEXANA DREDGING	DREDGE TO RECOVER CAPACITY	$51,377,000

REGION P ALTERNATIVE CAPITAL COST TOTAL	**$311,451,000**

Region P Water User Group (WUG) Management Supply Factor

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin, the combined total of existing and future supply is divided by the total projected demand. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
COUNTY-OTHER, JACKSON	1.4	1.4	1.5	1.5	1.5	1.5
COUNTY-OTHER, LAVACA	1.3	1.3	1.4	1.4	1.4	1.4
COUNTY-OTHER, WHARTON*	1.3	1.3	1.3	1.2	1.2	1.1
EDNA	1.5	1.5	1.5	1.5	1.5	1.5
EL CAMPO*	1.1	1.2	1.2	1.2	1.2	1.2
GANADO	1.6	1.6	1.7	1.7	1.7	1.7
HALLETTSVILLE	1.4	1.5	1.5	1.6	1.6	1.7
IRRIGATION, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, LAVACA	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, WHARTON*	1.0	1.0	1.0	1.0	1.1	1.1
LIVESTOCK, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, LAVACA	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, WHARTON*	1.1	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, JACKSON	1.0	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, LAVACA	1.1	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, WHARTON*	1.1	1.0	1.0	1.0	1.0	1.0
MINING, JACKSON	1.0	1.0	1.3	1.8	2.8	3.8
MINING, LAVACA	1.0	1.4	1.8	2.6	4.7	8.6
MINING, WHARTON*	1.0	1.0	1.3	1.8	2.8	4.4
MOULTON	1.5	1.6	1.6	1.7	1.7	1.8
SHINER	1.4	1.5	1.6	1.6	1.6	1.7
STEAM ELECTRIC POWER, WHARTON*	1.0	1.0	1.0	1.0	1.0	1.0
WHARTON COUNTY WCID 1	1.3	1.3	1.3	1.2	1.2	1.2
YOAKUM*	1.3	1.3	1.3	1.3	1.3	1.4

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

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

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

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

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

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

BENEFITTING WUG NAME | BASIN	WMS SOURCE ORIGIN BASIN | WMS NAME	WMS SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070

Region P Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

WMS NAME	WMS SPONSOR	SOURCE NAME	UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
DIRECT REUSE - EL CAMPO	EL CAMPO	P | DIRECT NON-POTABLE REUSE	0	560	560	560	560	560
LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	LAVACA NAVIDAD RIVER AUTHORITY	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	0	23,500	0	0	0	0
LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	LAVACA NAVIDAD RIVER AUTHORITY	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	0	0	30,000	30,000	30,000	30,000
LNRA DESALINATION - BRACKISH GROUNDWATER	LAVACA NAVIDAD RIVER AUTHORITY	P | GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	0	0	4,800	4,800	4,800	4,800
LNRA DESALINATION - BRACKISH SURFACE WATER	LAVACA NAVIDAD RIVER AUTHORITY	P | NAVIDAD RIVER TIDAL FRESH/BRACKISH	0	0	1,652	1,652	1,652	1,652
TOTAL UNALLOCATED STRATEGY SUPPLIES			**0**	**24,060**	**37,012**	**37,012**	**37,012**	**37,012**

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

Region P Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

WMS TYPE *	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
DROUGHT MANAGEMENT	343	343	341	342	345	348
GROUNDWATER WELLS & OTHER	0	0	0	0	0	0
IRRIGATION CONSERVATION	15,229	15,229	15,229	15,229	15,229	15,229
MUNICIPAL CONSERVATION	0	223	345	475	542	600
OTHER CONSERVATION	0	1,167	1,167	1,167	1,167	1,167
NEW MAJOR RESERVOIR	0	0	0	0	0	0
SEAWATER DESALINATION	0	0	0	0	0	0
AQUIFER STORAGE & RECOVERY	0	0	0	0	0	0
CONJUNCTIVE USE	0	0	0	0	0	0
OTHER STRATEGIES	0	0	0	0	0	0
INDIRECT REUSE	0	0	0	0	0	0
OTHER DIRECT REUSE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	0	0	0	0	0
OTHER SURFACE WATER	0	0	0	0	0	0
GROUNDWATER DESALINATION	0	0	0	0	0	0
TOTAL STRATEGY SUPPLIES	**15,572**	**16,962**	**17,082**	**17,213**	**17,283**	**17,344**

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region P Water User Group (WUG)
Recommended Water Management Strategy (WMS) Supplies by Source Type

SOURCE SUBTYPE*	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	0	0	0	0	0
GROUNDWATER	0	0	0	0	0	0
GROUNDWATER TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
DIRECT NON-POTABLE REUSE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	0	0	0	0	0
INDIRECT NON-POTABLE REUSE	0	0	0	0	0	0
INDIRECT POTABLE REUSE	0	0	0	0	0	0
REUSE TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
ATMOSPHERE	0	0	0	0	0	0
GULF OF MEXICO	0	0	0	0	0	0
LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
OTHER LOCAL SUPPLY	0	0	0	0	0	0
RAINWATER HARVESTING	0	0	0	0	0	0
RESERVOIR	0	0	0	0	0	0
RESERVOIR SYSTEM	0	0	0	0	0	0
RUN-OF-RIVER	0	0	0	0	0	0
SURFACE WATERTOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
REGION P TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region P Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

LAVACA NAVIDAD RIVER AUTHORITY- WWP	**WATER VOLUMES (ACRE-FEET PER YEAR)**					
DATA DESCRIPTION	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
PROJECTED WHOLESALE CONTRACT DEMANDS	73,850	73,850	73,850	73,850	73,850	73,850
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	73,850	73,850	73,850	73,850	73,850	73,850
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**

Region P Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale o water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

LAVACA NAVIDAD RIVER AUTHORITY | LAVACA OFF-CHANNEL RESERVOIR						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
RELATED UNALLOCATED WMS WATER VOLUMES	0	23,500	30,000	30,000	30,000	30,000
WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION					
LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; DIVERSION AND CONTROL STRUCTURE; PUMP STATION					
LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION					

LAVACA NAVIDAD RIVER AUTHORITY | LNRA DESALINATION						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
RELATED UNALLOCATED WMS WATER VOLUMES	0	0	6,452	6,452	6,452	6,452
WMS RELATED MWP SPONSORED PROJECTS	PROJECT DESCRIPTION					
LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATEF INTAKE; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK					

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Chapter 1– Description of the Lavaca Regional Water Planning Area

1.1 Introduction and Background

Sections 16.051 and 16.055 of the Texas Water Code direct the Executive Administrator of the Texas Water Development Board (TWDB) to prepare and maintain a comprehensive State Water Plan as a flexible guide for the development and management of all water resources in Texas in order to ensure that sufficient supplies of water will be available at a reasonable cost to further the State's economic growth. Section 16.056 requires the TWDB to amend the plan as needed in response to increased knowledge and changing conditions.

In February 1998, the TWDB adopted rules establishing 16 regional water planning areas and designated the initial members of the regional water planning groups representing 11 interests. Each Regional Water Planning Group (RWPG) has the option to add interest group categories and members. With technical and financial assistance from the TWDB, and in accordance with planning guidelines it set forth, the RWPGs prepared a consensus-based Regional Water Plan (RWP) for 2001. The TWDB assembled the Regional Water Plans into a new 2002 State Water Plan (SWP). Subsequent cycles of planning have resulted in water plan updates at 5-year intervals, including 2006, 2011, and 2016 Regional Water Plans (compiled by TWDB into the 2007, 2012, and 2017 State Water Plans, respectively). The fifth cycle of regional water planning has produced an "initially prepared" Regional Water Plan that was required to be submitted to the TWDB by March 3, 2020 and is to be finalized and adopted and submitted to the TWDB in October of 2020. Subsequently, by January of 2022, the TWDB will prepare the 2022 State Water Plan which will incorporate the adopted Regional Water Plans.

This chapter summarizes the results of Task 1 of the current planning cycle and describes the Lavaca Regional Water Planning Area.

1.2 Description of the Lavaca Regional Water Planning Area

The Lavaca Regional Water Planning Area is located along the southeastern Texas coast and consists of all of Lavaca and Jackson Counties, as well as Precinct 3 of Wharton County and the majority of the City of El Campo, as shown in *Figure 1-1*. The eastern portion of Wharton County, including a very small portion of El Campo, is included in the Lower Colorado Regional Water Planning Area and planning efforts are coordinated as necessary between this and other neighboring regions.

The Lavaca Region is bounded by Victoria and DeWitt Counties to the southeast, Gonzales and Fayette Counties to the northwest, Colorado County to the northeast, Matagorda County and the remainder of Wharton County to the east, and Calhoun County, Lavaca Bay, and Carancahua Bay to the south. The Lavaca Region is located in the Lavaca, Lavaca-Guadalupe Coastal, and the Colorado-Lavaca Coastal River Basins.

The Lavaca Region is located in the Gulf Coastal Plains region of Texas and contains both Gulf Coast prairies and marshes and Blackland Prairies. The Gulf Coast prairies and marshes encompass the majority of the region. These habitats contain marsh and saltwater grasses in tidal areas and bluestems and tall grasses inland. Hardwoods grow in limited amounts in the bottomlands. The upland soils consist of clays, clay loams, sandy loams, and black soils. The natural grasses make the region ideal for cattle grazing, and the productive soils and typically flat topography support the farming of rice, sorghums, corn, cotton, wheat, and hay.

Figure 1-1
General Location Map

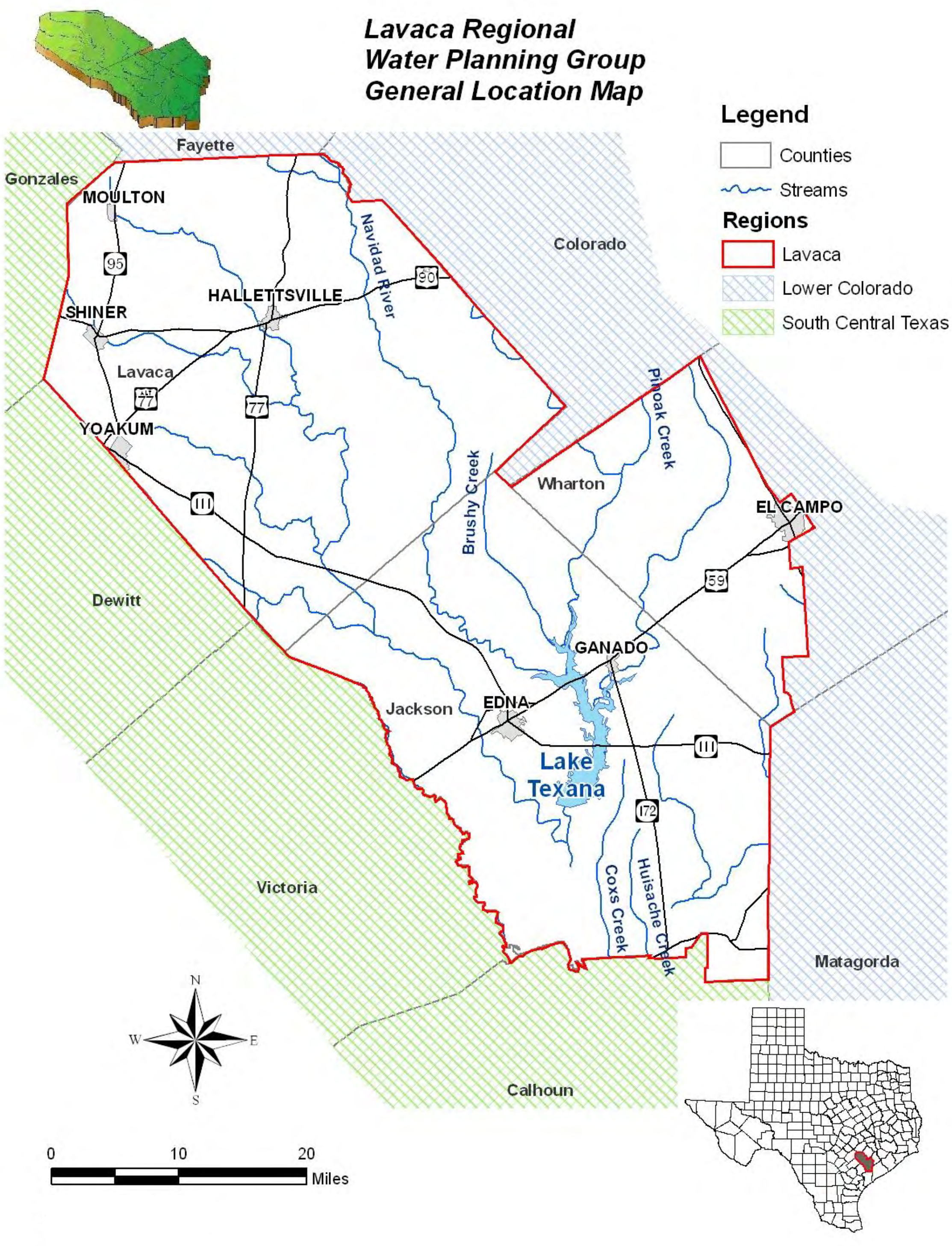
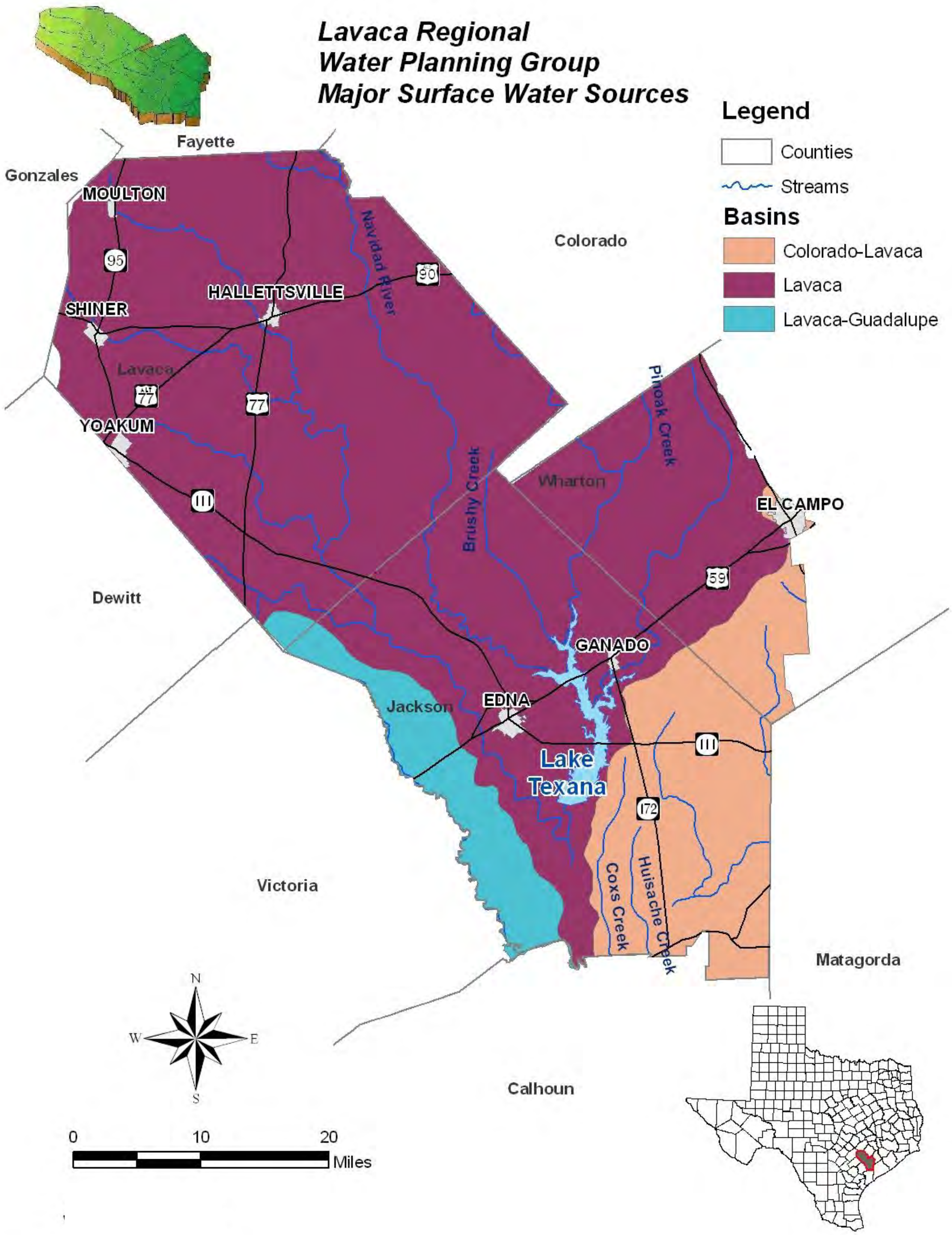


Figure 1-2
Major Surface Water Sources



The Blackland Prairies are mainly shrink-swell clays that form cracks in dry weather. A large amount of timber grows along the streams, and even though it was originally grasslands, most of the area has been cultivated with productive grasses. The land is used as croplands and grasslands and the grasslands are used as pastures. According to the USGS ecoregion description, the major crops supported by the Blackland Prairies are cotton, grain sorghum, corn, wheat, pecans, soybeans, and hay.

The counties have hot and humid summers which are occasionally relieved by thunderstorms. The average growing seasons are 311 days in Jackson County, 270 days in Lavaca County, and 291 days in Wharton County. The mean rainfall is approximately 43.6 inches annually for the region. Average temperatures for the region vary, from lows of 41 degrees F in January to highs of 94 degrees F in July. Jackson County encompasses 857 square miles (mi^2); Lavaca County encompasses 970 mi^2; and Wharton County encompasses 1,094.4 mi^2, of which approximately half is in the planning area.[1]

1.2.1 Governmental Authorities in the Lavaca Planning Region

The primary governmental entities in the region are municipal and county governments. Jackson and Lavaca Counties are included on the Golden Crescent Regional Planning Commission, which was established in 1968. This commission also includes the counties of Calhoun, DeWitt, Goliad, Gonzales, and Victoria, which are located in the South Central Texas Regional Water Planning Area (Region L). Member cities within Jackson and Lavaca Counties include Edna, Ganado, Hallettsville, Moulton, Shiner, and Yoakum. The Commission assists in developing opportunities for intergovernmental coordination to increase economic opportunities for the region as well as other regional concerns such as environmental resources and transportation. The Jackson County Soil and Water Conservation District, Jackson County Navigation District, Jackson County Hospital District, Lavaca County Soil and Water Conservation District, and the Lavaca-Navidad River Authority (LNRA) are additional special districts created under Texas Law. The Jackson Countywide Drainage District and the Jackson County Rural Fire and Emergency Services Districts are also included in the Lavaca Region.

Wharton County is a member of the Houston-Galveston Area Council of Governments (H-GAC), which was established in 1966 and includes 12 other counties located to the east and north of Wharton County. H-GAC is focused on economic development for the region, as well as on environmental issues such as evaporation and air quality, solid waste, geographic information systems and demographic information, and social and nutrition services to senior citizens. El Campo is also a representing city of the H-GAC.

In addition to these entities, there are several regulatory authorities that influence long-range water planning in the Lavaca Region. The South Texas Watermaster (STWM) monitors the regional water uses in seven south central Texas river basins, including the Lavaca River Basin. The STWM plays a role in allocation of water supplies by user in the event of drought conditions. Field investigations also play a role in locating illegal diversions of water. With regard to the state, TWDB, Texas Commission on Environmental Quality (TCEQ), and Texas Parks & Wildlife Department (TPWD) are responsible for gathering information on water supply and quality. LNRA manages the surface water supplies in Jackson County. There are also soil and water conservation districts in the region.

The Lavaca Region also lies within Groundwater Management Area 15. Groundwater Management Areas (GMA) were created to provide for organized planning of groundwater resources and are responsible for working with Groundwater Conservation Districts (GCDs) within the GMA boundaries to define “Desired Future Conditions” for the GMA. Desired Future Conditions are the quantified condition of groundwater resources within a groundwater management area that would occur at one or more specific future times. Groundwater Conservation Districts (GCD) meet collectively within the Groundwater Management Area and determine Desired Future Conditions (DFCs), which then are utilized to model groundwater resources and establish appropriate levels of groundwater use to

[1] Source: Texas State Historical Association. *Texas Almanac* 2018-2019.

realize the DFCs. The Lavaca Region includes the Coastal Bend Groundwater Conservation District (GCD) in Wharton County, and the Texana GCD in Jackson County. The primary focus of these districts is to preserve and protect groundwater supplies in their respective counties for future generations, and the districts are responsible for working with GMA 15. The original management plans for the Coastal Bend and Texana districts were certified by TWDB on September 28, 2004. Subsequently, an updated groundwater management plan for the Coastal Bend GCD was approved by TWDB on November 4, 2009, on November 10, 2014, and then again on April 10, 2018. An updated groundwater management plan for the Texana GCD was approved by TWDB on June 13, 2016. The Lavaca County GCD was created by the 80th Texas Legislature on May 25, 2007 but due to lack of local support, it is not currently in existence.

1.2.2 General Economic Conditions

The regional planning area is described below on a county-by-county basis. Source information is provided in *Appendix 1A*.

The economy of Jackson County includes petroleum production, plastics manufacturing, and agribusiness. The major agricultural interests in Jackson County include corn, cotton, rice, grain sorghum, and beef cattle. These agricultural products had a market value of approximately $101.8 million in 2018.

The economy of Lavaca County includes varied manufacturing, oil and gas production, agribusiness, and tourism. The major agricultural interests in Lavaca County include cattle, forage, poultry, rice, corn, and grain sorghum, with a market value of approximately $61.9 million in 2018.

The economy of Wharton County includes oil, agribusiness, hunting leases, varied manufacturing, and government services. The major agricultural interests in Wharton County include rice, grain sorghum, cotton, milo, corn, eggs, turf grass, beef cattle, aquaculture, and soybeans; with a market value of approximately $373.6 million for the entire county in 2018 (the county is only partially contained in the Lavaca Region).

According the U.S. Census Bureau, the 2013-2017 median household income was approximately $58,504 for Jackson County, $51,708 for Lavaca County, and $50,145 for all of Wharton County. The Texas median household income was approximately $57,051 during the same period. Unemployment in 2017 was approximately 4.0 percent in Jackson County, 3.6 percent in Lavaca County, and 4.5 percent in Wharton County.

The value of properties within the Lavaca Region has increased substantially in recent years, as shown in *Table 1–1*.

Table 1–1 Property Value by County

County	2005 Property Value	2013 Property Value	2018 Property Value
Jackson	$1,416,741,983	$2,459,407,498	$2,839,195,180
Lavaca	$2,335,053,537	$4,209,668,856	$4,596,168,697
Wharton	$2,651,668,721	$4,532,539,863	$4,628,596,988

Source: *Texas Almanac* 2008-2009, 2013-2014, 2018-2019 (http://www.texasalmanac.com/topics/counties/home)

1.3 Population and Municipal Water Use in the Lavaca Region

A summary of population and water usage by county is shown in *Table 1–2*. The Lavaca Regional Water Planning Area (LRWPA) 2010 Census population was 49,031. Cities in the LRWPA include Hallettsville, Moulton, Shiner, and Yoakum in Lavaca County; Edna and Ganado in Jackson County; and El Campo in Wharton County, the largest city in the region.

Table 1–2 Population and Water Usage by County for the Lavaca Regional Water Planning Area

		County		
		Jackson	**Lavaca**	**Wharton**
Year 2010 Census Population		14,075	19,263	15,693
Year 2010 Reported Water Usage (acre–feet)	Municipal	1,713	2,601	2,277
	Manufacturing	470	459	5
	Mining	49	66	62
	Steam Electric	0	0	0
	Livestock	1,220	2,091	532
	Irrigation	43,758	5,965	67,371

1.4 Non-Municipal Water Use in the Lavaca Region

According to the 2016 Water Use Survey Estimate, irrigated agriculture constitutes over 93 percent of the total water use in Jackson, Lavaca, and Wharton counties. Municipal water accounts for three percent, the second largest share of use categories in the region. Livestock use in the Lavaca Region accounted for less than two percent of 2016 use and manufacturing, steam-electric, and mining water use make up approximately 1 percent of 2016 use.

In previous plans, the prevalence of water conservation practices in the area was also studied using aerial photography and GIS. It was found that approximately 14,232 of the rice acres in the LRWPA were found to be improved with conservation practices. The majority of this acreage, over 13,000 acres, was identified in Wharton County.

1.5 Lavaca Regional Water Supply Sources and Providers

The available water supply within the region includes both groundwater and surface water. Groundwater is provided nearly exclusively by the Gulf Coast Aquifer. Primary surface water sources are the Navidad and Lavaca Rivers and Lake Texana. Additional information regarding water sources and providers in the Lavaca Region is discussed at length in *Chapter 3* of this plan.

1.5.1 Groundwater Sources

The majority of water currently used in the Lavaca Region is groundwater. In 2011, at the start of the most recent drought, the Lavaca Region pumped approximately 216,000 acre-feet of groundwater to supply domestic, agricultural, municipal, and industrial uses. This trend of primarily relying on groundwater is expected to continue in the Lavaca Region due to relatively low demand for municipal water and the rural nature of the area, which makes large scale distribution systems economically infeasible. Agricultural needs will also likely continue to be met through groundwater resources due to the lack of availability and affordability of large surface water supplies.

The Gulf Coast Aquifer is the only major aquifer in the Lavaca Region and is the predominant supply source, serving approximately 86 percent of the total supply. The Jackson Group is a minor aquifer and is located in the northwestern corner of Lavaca County, to the northwest of the Town of Moulton. There are no minor aquifers located in Jackson or Wharton Counties.

For more information about groundwater resources and availability in the Lavaca Region, see *Section 3.3* of this plan.

1.5.2 Surface Water Sources

The major river basins that are located (at least partially) within the Lavaca Regional Water Planning Area include the Lavaca, Colorado-Lavaca, and the Lavaca-Guadalupe Basins. Approximately 90 percent of the geographic area of Lavaca Region is located within the Lavaca River Basin, which has a total drainage area of 2,318 square miles and includes the Lavaca and Navidad Rivers. Smaller tributaries in the Lavaca Region include the Arenosa, Big Rocky, Brushy, Chicolete, Clarks, Coxs, East Carancahua, Huisache, Mixon, Pinoak, Rocky, Sandy, West Carancahua, and East and West Mustang Creeks. *Figure 1-2* shows the location of the Lavaca Basin and adjacent basins. There are no major springs in the Lavaca Region.

1.5.3 Use by Source

Average groundwater pumpage for 2010 to 2012 (recent drought years) was 63,295 ac-ft/yr in Jackson County, 12,988 ac-ft/yr in Lavaca County, and 153,570 ac-ft/yr for the entirety of Wharton County (including the portion of Wharton County located in Region K). Water levels have remained relatively stable in the region, with some declines and some increases over the last several decades. Additional discussion of aquifer conditions is provided in *Section 3.2.3* of this plan.

The only reservoir in the Lavaca Regional Water Planning Area is Lake Texana. The available firm yield of Lake Texana is 74,500 ac-ft. The Lavaca and Navidad Rivers also supply some run-of-river water to the Lavaca Region, primarily for irrigation purposes. See *Chapter 3* for more information on current water supplies.

1.5.4 Major Water Providers

A major water provider is, by definition used for regional water planning purposes, a Water User Group or a Wholesale Water Provider of particular significance to the region's water supply as determined by the Regional Water Planning Group. This may include public or private entities that provide water for any water use category. As determined by the LRWPG, the Lavaca-Navidad River Authority (LNRA) is considered the only major water provider located in the Lavaca Region for this planning cycle.

The LNRA operates and maintains Lake Texana. Water transfers outside the Lavaca Region account for most of the water sales from Lake Texana. Of the 74,500 ac-ft of available firm yield and 12,000 ac-ft available on an interruptible basis, 75,068 ac-ft are dedicated for water uses outside the region. The following amounts are contracted annually:

- 178 ac-ft firm yield to the City of Point Comfort in Calhoun County
- 31,440 ac-ft firm yield to the City of Corpus Christi and surrounding areas
- 12,000 ac-ft interruptible water to the City of Corpus Christi and surrounding areas
- 41,200 ac-ft firm yield to Formosa Plastics in Calhoun County and Jackson County
- 594 ac-ft firm yield to the Calhoun County Navigation District in Calhoun County
- 56 ac-ft firm yield held in reserve

A total of 1,032 ac-ft firm yield is committed to Inteplast (manufacturing), located in Jackson County, within the LRWPA. An additional 10,400 ac-ft of firm yield has been committed to Formosa Plastics for use in Jackson County, within the LRWPA.

1.6 Water Quality and Natural Resources

A table of state, local, and regional planning information reports and data compiled for the 2021 Lavaca Regional Water Plan study is attached in *Appendix 1A*. A summary of some of this information pertaining to water planning follows.

1.6.1 Water Quality

The Lavaca River Basin contains 277 stream miles. It is primarily drained by two major rivers: the Lavaca River and the Navidad River. The Lavaca River originates in the southern portion of Fayette County and outfalls into Lavaca Bay while the Navidad River also originates in Fayette County but flows into Lake Texana, and from there continues to its confluence with the Lavaca River, approximately 8 miles downstream of the Palmetto Bend Dam.

The Lavaca River Basin is divided into 5 classified stream segments numbered 1601 through 1605. Approximately 60 percent of the Lavaca River Basin is drained by the Navidad River and its tributaries, while the Lavaca River and its tributaries drain the remaining 40 percent. Stream segment uses and water quality considerations for the Lavaca River basin are shown in *Table 1–3*.

The primary agricultural issue in the Lavaca Region is the availability of sufficient quantities of irrigation water for rice farming under drought of record conditions. Natural resources, on the other hand, are impacted from both water quantity and water quality issues. Stream segments in the Lavaca River Basin with water quality concerns are listed in *Table 1–4*. The stream segments that have water quality concerns within the Lavaca Region, as designated in the 2016 Draft Texas Water Quality Inventory conducted by TCEQ are discussed below.

The primary water quality issue for all of the surface water stream segments and the major groundwater aquifers in the LRWPA is the increasing potential for water contamination due to nonpoint source pollution. Nonpoint source pollution is precipitation runoff that, as it flows over the land, picks up various pollutants that adhere to plants, soils, and man-made objects and eventually infiltrates into the groundwater table or flows into a surface water stream. Another nonpoint source of pollution is the accidental spill of toxic chemicals near streams or over recharge zones that can send a concentrated pulse of contaminated water through stream segments and/or aquifers. Public water supply groundwater wells that currently only use chlorination water treatment, and domestic groundwater wells that may not treat the water before consumption, are especially vulnerable to nonpoint source pollution, as are the habitats of threatened and endangered species that live in and near seeps and certain stream segments. Nonpoint sources of pollution are difficult to control. There has been increased awareness of this issue which has sparked additional research and interest in the initiation of nonpoint source pollution abatement programs.

Two surface water quality indicators are dissolved oxygen (DO) and the associated biochemical oxygen demand (BOD). DO is a measure of the amount of oxygen that is available in the water for metabolism by microbes, fish, and other aquatic organisms. BOD is a measure of the amount of organic material, containing carbon and/or nitrogen, in a body of water that is available as a food source to microbial and other aquatic organisms that require the consumption of DO from the water to metabolize the organic material. The historical basin-wide concentrations of DO are indicative of relatively unpolluted waters. The primary manmade sources of BOD in bodies of water are the discharge of municipal and industrial waste, as well as nonpoint source pollution from urban and agricultural runoff. Data from the 2016 Draft Texas Water Quality Inventory conducted by TCEQ indicates that there are portions of one classified stream segments with a concern for DO, based on the State Stream Standards Criteria in the Lavaca Regional Water Planning Area (*Table 1–4)*.

Table 1–3 Stream Segment Uses and Water Quality Criteria in the Lavaca River Basin 2017

Colorado River Basin			Uses[1]			State Stream Standards Criteria[2]						
Stream Segment #	**Stream Segment Name**	**SB 1 Planning Region**	**Recreation**	**Aquatic Life**	**Water Supply**	**Chloride Annual Avg. (mg/L)**	**Sulfate Annual Avg (mg/L)**	**TDS Annual Avg (mg/L)**	**DO (mg/L)**	**pH Range**	**Fecal Coliform (30-day Geometric mean CFU/100ml)**	**Temp (°F)**
1601	Lavaca River Tidal	P	PCR	H					4	6.5–9.0	35	95
1602	Lavaca River Above Tidal	P	PCR	H	PS	200	100	700	5	6.5–9.0	126	91
1602A[2]	Big Brushy Creek	P		H					5			
1602B[2]	Rocky Creek	P		H					5			
1603	Navidad River Tidal	P	PCR	H					4	6.5–9.0	35	91
1604	Lake Texana	P	PCR	H	PS	100	50	500	5	6.5–9.0	126	93
1604A[2]	East Mustang Creek	P		I					4			
1605	Navidad River Above Lake Texana	P	PCR	H	PS	100	50	550	5	6.5–9.0	126	91
1605A[2]	West Navidad River	P		H					5			

Source: *Lavaca-Navidad River Authority Basin Summary Report*, Lavaca-Navidad River Authority, prepared by Water Monitoring Solutions, Inc. for the Lavaca – Navidad River Authority in cooperation with the Texas Commission on Environmental Quality 2017; Water Quality Criteria accurate as of 2017.

[1] Uses: PCR = Primary Contact Recreation; H = High; I = Intermittent; PS = Public Water Supply

[2] Criteria: Standards set by the TCEQ do not guarantee the water to be usable for municipal, domestic, irrigation, livestock, &/or industrial uses; this causes the above screening process to be misleading for certain segments, especially for salinity.

Table 1–4 Stream Segment Water Quality Concerns in the Lavaca Region

Stream Segment #	Stream Segment	Aquatic Life Use	Nutrient Enrichment	Algal / Bacterial Growth	Sediment Contaminants	Public Water Supply	Narrative Criteria
1601	**Lavaca River Tidal**						
1602	**Lavaca River Above Tidal**		**Concern[1]**	**Concern[1]**			
1602A	**Big Brushy Creek**						
1602B	**Rocky Creek**		**Concern[1]**	**Concern[1]**			
1602C	**Lavaca River Above Campbell Branch**	**Concern[1]**					
1603	**Navidad River Tidal**						
1604	**Lake Texana**		**Concern[2]**	**Concern[2]**			
1604A	**East Mustang Creek**						
1605	**Navidad River Above Lake Texana**						
1605	**West Navidad River**						

[1]Source: TCEQ 2016 DRAFT Texas Water Quality Inventory
[2]Indicated by LNRA, 2017

Another set of surface water quality parameters are termed “nutrients” and includes nitrogen (Kjeldahl nitrogen, nitrite+nitrate, and ammonia nitrogen), phosphorus (phosphates, orthophosphates, and total phosphorus), sulfur, potassium, calcium, magnesium, iron, and sodium. Nutrients are monitored by the TCEQ as a part of the Clean Rivers Program (CRP); however, there are currently no government mandated standards for assessing the level of concern posed by nutrients. Currently, naturally occurring background levels reported by the USGS or data collected by the TCEQ are used to determine the level of concern for nutrients. Based on 2016 data from TCEQ and LNRA, there are three portions of stream segments, as well as Lake Texana, with a concern for nutrients in the Lavaca Regional Water Planning Area (*Table 1–4*).

Fecal coliform are usually harmless bacteria that are present in human and/or animal waste. However, the presence of this organism can be an indicator for the possible presence of disease-causing bacteria and viruses that are also found in human/animal wastes. Municipal waste is treated to remove most of the bacterial and viral contaminants so that safe levels will exist in the receiving surface water body. Therefore, when fecal coliform is detected, the most likely source of contamination is nonpoint source pollution, which can include agricultural runoff as well as runoff from failed septic systems. A wastewater treatment plant point source could also be the source of contamination if the system is not functioning properly or if overwhelmed by flood waters. In recent years, TCEQ has changed the indicator bacteria from the generic “fecal coliform” to be *Escherichia Coli* for non-tidal surface waters and *Enterococci* for tidal waters.

1.6.2 Recreational and Natural Resources

Lake Texana is the main recreational area in the Lavaca Region. There are ten public boat ramps, a 250-acre Mustang Wilderness Campground for primitive camping, a marina, picnic sites, Brackenridge Recreation Complex, which includes the Brackenridge Park campground (240 acres), Brackenridge Main Event Center Complex (180 acres), Texana Park (590 acres), kayaking, and boating. Brackenridge Recreation Complex and Lake Texana State Park are located across State Highway (SH) 111 from each other, on the west side of the SH 111 Bridge. Some of the recreational activities enjoyed at these parks are camping, boating, fishing, and picnicking. The area has good nature-viewing opportunities including birding, and sometimes alligators can be found in park coves. Hunting and fishing are very popular recreational activities throughout the entire Lavaca Region. Deer and waterfowl hunting are the most common. The Gulf Coastal Plains support a wide variety of animal species. The threatened, endangered, or rare species within Jackson, Lavaca, and Wharton Counties are shown in *Table 1-5*.

LNRA operates Lake Texana to provide freshwater inflows for the bay and estuary in order to reduce high salinity events in Lavaca Bay and to protect coastal habitats. LNRA has an agreement with the Texas Parks and Wildlife Department and the TCEQ for a freshwater release program.

The Texas Parks & Wildlife Department (TPWD) currently manages 47 Wildlife Management Areas (WMAs) in the state with a total of 714,049 acres. WMAs were established as sites to perform research on wildlife populations and habitat, conduct education on sound resource management, and to provide public hunting, hiking, camping, bird watching and a host of other outdoor recreational opportunities. The D.R. Wintermann WMA lies within Region P, encompassing 246 acres.

Table 1–5 Threatened, Endangered, and Rare Species Found in Jackson, Lavaca, and Wharton Counties

Threatened	
American Peregrine Falcon	*Falco peregrinus anatum*
Bald Eagle	*Haliaeetus leucocephalus*
Blue sucker	*Cycleptus elongatus*
Cagle's map turtle	*Graptemys caglei*
Green sea turtle	*Chelonia mydas*
Loggerhead sea turtle	*Caretta caretta*
Louisiana black bear	*Ursus americanus luteolus*
Peregrine Falcon	*Falco peregrinus*
Reddish Egret	*Egretta rufescens*
Smooth pimpleback	*Quadrula houstonensis*
Sooty Tern	*Sterna fuscata*
Texas fawnsfoot	*Truncilla macrodon*
Texas horned lizard	*Phrynosoma cornutum*
Texas pimpleback	*Quadrula petrina*
Texas scarlet snake	*Cemophora coccinea lineri*
Texas tortoise	*Gopherus berlandieri*
Timber rattlesnake	*Crotalus horridus*
White-faced Ibis	*Plegadis chihi*
White-tailed Hawk	*Buteo albicaudatus*
Wood Stork	*Mycteria americana*
Endangered	
Attwater's Greater Prairie-Chicken	*Tympanuchus cupido attwateri*
Houston toad	*Anaxyrus houstonensis*
Interior Least Tern	*Sterna antillarum athalassos*
Kemp's Ridley sea turtle	*Lepidochelys kempii*
Red wolf	*Canis rufus*
Smalltooth sawfish	*Pristis pectinata*
West Indian manatee	*Trichechus manatus*
Whooping Crane	*Grus americana*
Rare	
American eel	*Anguilla rostrata*
Arctic Peregrine Falcon	*Falco peregrinus tundrius*
Awnless bluestem	*Bothriochloa exaristata*
Brown Pelican	*Pelecanus occidentalis*
Crayfish	*Cambarellus texanus*
Green beebalm	*Monarda viridissima*
Henslow's Sparrow	*Ammodramus henslowii*
Indianola beakrush	*Rhynchospora indianolensis*
Marsh-elder dodder	*Cuscuta attenuata*
Mountain Plover	*Charadrius montanus*
Plains spotted skunk	*Spilogale putorius interrupta*
Red Knot	*Calidris canutus rufa*
Sharpnose shiner	*Notropis oxyrhynchus*
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*
Snowy Plover	*Charadrius alexandrinus*
South Texas spikesedge	*Eleocharis austrotexana*
Southern Crawfish Frog	*Lithobates areolatus areolatus*
Sprague's Pipit	*Anthus spragueii*
Texas diamondback terrapin	*Malaclemys terrapin littoralis*
Texas tauschia	*Tauschia texana*
Threeflower broomweed	*Thurovia triflora*
Welder machaeranthera	*Psilactis heterocarpa*
Western Burrowing Owl	*Athene cunicularia hypugaea*
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*

Source: Texas Parks & Wildlife Department, Wildlife Division, Non-game and Rare Species and Habitat Assessment programs. County Lists of Texas' Special Species (Jackson, Lavaca, and Wharton Counties, updated September 2018).

1.6.3 Navigation

Navigation within the Lavaca Regional Water Planning Area is generally recreational in nature, with boaters and fishermen utilizing rivers and streams as well as Lake Texana. There is also heavy recreational use in the bays and estuaries at the southern end of the Region. The strategies considered in the current list of potential water management strategies for the 2021 Lavaca Regional Water Plan are not anticipated to adversely impact navigation in the Region.

1.6.4 Threats to Agricultural and Natural Resources

The Regional Water Plan Guidelines (31 TAC §357.30(7)) require that planning groups identify threats to the State's agricultural and natural resources due to issues with water quantity or water quality problems related to supply. Any potential threat to agricultural resources would be of particular concern for the Lavaca Region, as irrigated agriculture is by far the largest water user in the Region. Irrigation in the Region relies almost exclusively on groundwater. Groundwater conditions have been favorable and should continue to be favorable within the Lavaca Region for the pumping of substantial quantities of good quality water. There is the potential for agriculture in some portions of the Region to experience shortages under drought conditions coupled with peak production, with the likely result being temporary use of groundwater resources beyond the average recharge rate. *Chapter 5* discusses a number of potential water management strategies that can help address these water shortages for agriculture.

Natural resources in the Region, particularly streams and riparian habitat, can also be impacted by drought conditions. Flows for many streams in the Region show a high seasonal variability and flows in some streams may be drastically reduced or eliminated under prolonged dry conditions. Irrigation return flows play an important role in maintaining streamflows during moderately dry conditions. While observations of streamflow during a recent drought event indicate that irrigation returns and streamflow are both minimal under exceptional drought conditions, it is likely that for moderately dry conditions the increased amount of groundwater entering a stream through irrigation return flows would help to sustain habitat that would otherwise be water-stressed. *Chapter 5* discusses how threats to natural resources can be managed while meeting water shortages in the region.

1.7 Existing Water Plans

1.7.1 Existing Regional and Local Water Management Plans

Lavaca-Navidad River Authority (LNRA) has published a *Land Management Plan* and a *Water Resource Management Plan*, which addresses use and development of the LNRA property and the organization's water rights and includes future water development strategies. These plans were developed in accordance with Texas Water Code Section 11.173(b). In addition, each of LNRA's major water customers has a TCEQ-approved water conservation and drought contingency plan. LNRA, TCEQ, and USGS cooperative program has routinely collected water quality monitoring data in Lake Texana since 1988. Through this program, the USGS and LNRA have been collecting annual pesticide monitoring data since 1992 at stations on Lake Texana. The Texas State Soil and Water Conservation Board (TSSWCB) has a water quality management plan on file for LNRA and has developed management plans and studies to control nonpoint source pollution from agriculture and silviculture (LNRA 1997).

> "Lake Texana has excellent water quality. The LNRA intends to maintain the present condition of the lake and has instituted management practices designed to monitor and protect current water quality and wildlife diversity. Streamflows will continue to be monitored by LNRA and USGS at various locations in the Lavaca-Navidad Basin. Lavaca River streamflows are monitored near Hallettsville and Edna, while upstream of Lake Texana, flow monitoring stations are maintained near Hallettsville, Speaks, Morales, and Strane Park on the Navidad mainstem and

> on its three major tributaries; Sandy, West Mustang Creek, and East Mustang Creek" (*Land and Water Resource Management Plan for Lake Texana and Associated Project Lands 1997*).

LNRA's water quality monitoring program includes contracts with the USGS and the Guadalupe-Blanco River Authority, which provides laboratory analyses of water samples. This program was developed under the auspices of the Clean Rivers Program (CRP), a statewide effort administered by the TCEQ to encourage the assumption of responsibility for water quality monitoring by local entities already managing water supplies, and the management of water quality on a river basin basis, rather than by political subdivisions whose interests may cut across multiple river basins or be restricted to portions of basins. Locations, parameters, and details of sample collection, handling, and analytical methodologies for the CRP are detailed in the Quality Assurance Project Plan (QAPP) prepared by LNRA which is filed with, and approved by, TCEQ every two years.

LNRA has designated a Lavaca Basin CRP Steering Committee to advise LNRA on water quality issues and priorities. Since FY2005, LNRA has been conducting the following water quality monitoring under the Clean Rivers Program QAPP:

- 20 parameters including field data (e.g. dissolved oxygen, water temperature, pH, specific conductivity, salinity, flow) and conventional water chemistry analyses including total suspended solids (TSS), sulfate, chloride, ammonia and nitrate + nitrite nitrogen, total phosphate, total alkalinity, total organic carbon (TOC), turbidity, total hardness
- *E. coli* bacterial analyses in Lake Texana and in the Lavaca River
- Chlorophyll-a analysis in Lake Texana

Water sampling sites are fixed and include: Lake Texana and its inflows (West and East Mustang Creeks, Sandy Creek, Navidad River), the Lavaca River both above tidal and below the Palmetto Bend spillway to Lavaca Bay, and Rocky Creek.

In addition to CRP monitoring, LNRA contracts with the United States Geological Survey (USGS) to do additional flow and water quality monitoring in the Lavaca Basin. Streamflows at multiple gaging stations (Lavaca River near Edna and Hallettsville, Dry Creek near Edna, Providence City, Sublime Sandy Creek near Louise, West Mustang Creek near Ganado, East Mustang Creek near Louise, and the Navidad River near Speaks, Morales, and Strane Park) are monitored directly by radio telemetry into LNRA's computer-based hydrologic data collection system. USGS monitors in Dry Creek and in Lake Texana and its four inflows for metals and organics (pesticides) in both the water column and in the bottom sediments.

LNRA has developed a Geographic Information System (GIS) electronic database to store geographic and attribute data for the Lavaca Basin. This system uses base maps of aerial photographs or USGS topographic maps and overlays data upon these electronic maps in layers. This system is computer-based, and updates/changes can be made relatively easily. Hard-copy maps may be printed as needed. Information layers in the LNRA GIS include:

- Wastewater treatment plants with attributes such as capacity, type, date of permit renewal, contact information, etc.
- City and town information
- Soils
- Gas and oil wells
- Gas and oil pipelines
- Water quality sampling sites

- Rivers, streams, roads, county lines
- Water permit holders
- Cultural resources
- Land use
- Parks and trails
- Observation wells
- Piezometers
- Boat ramps
- Threatened species locations
- Injection disposal wells
- Confined animal feeding operations (CAFOs)
- Precipitation and stream flow gages

LNRA is notified of TCEQ discharge permit applications and EPA NPDES applications for point source discharges and industrial stormwater runoff permits. These are reviewed by LNRA, and appropriate actions are taken (i.e., submission of written comments, negotiation with applicants, requests for hearings and party status) to assure protection of Lake Texana water quality.

Master plan information is not available for the cities in the Lavaca Region. These cities are relatively small, there is relatively low municipal usage, and there is very little expected growth in municipal usage. The Texana and Coastal Bend GCDs create their own groundwater management plans, as described in *Section 1.2.1*,

1.7.2 Current Preparations for Drought

The Lavaca-Navidad River Authority developed a Water Conservation Plan and Drought Contingency Plan in 1995 and they have been updated multiple times. Most recently, both plans were updated April 2014 in accordance with the TCEQ guidance for the Lavaca River Basin including Lake Texana. The goals of the Water Conservation Plan are to reduce the quantity of water required through implementation of efficient water supply and water use practices, without eliminating any use. The Drought Contingency Plan provides procedures for both voluntary and mandatory actions to temporarily reduce water usage during a water shortage crisis. The drought of record period for the Lavaca Region is December 1952 through April 1957. More details related to drought preparation and response are discussed in *Chapter 7* of this report.

Multiple smaller entities within the Lavaca Regional Water Planning Area also maintain Water Conservation and Drought Contingency Plans in accordance with TCEQ requirements. A survey of these entities by LRWPG indicates that none of these entities implemented drought restrictions in 2011.

1.7.3 Water Loss Audits

House Bill 3338, passed by the 78th Texas Legislature (2003), requires public utilities providing potable water to file water audits with the TWDB once every five years giving the most recent year's water loss. TWDB subsequently commissioned a study of available loss data. For the first phase of water auditing, a number of issues have been identified with the data provided, and work to correct inconsistencies is ongoing. Year 2015-2018 water loss audit information was provided to the LRWPG by TWDB. Nine public utilities in the LRWPA submitted water loss audit data as part of the required

2015 submittal to TWDB. Limited data was submitted in 2016-2018, so the 2015 data is used for this report. Total loss rates for the utilities within the LRWPA were found to vary from 5.9 to 34.3 percent, with Edna and La Ward (part of County-Other) having the lowest reported percentage, and Moulton having the highest. Losses may vary annually and could currently be higher or lower.

Total losses are not limited to loss from known leaks, although for some utilities' leakage is responsible for a majority of lost water. Total loss also includes meter inaccuracy, unmetered or unauthorized water use, unidentified line leaks, and storage overflows. Real loss accounts for reported breaks and leaks, and unreported loss. Real loss rates for the utilities within the LRWPA were found to vary from 5.9 to 34.3 percent, with Edna having the lowest reported percentage, and Moulton having the highest.

Table 1-6 below summarizes the 2015 water audit data available for the Lavaca Regional Water Planning Area, which includes nine submitted water audits.

Table 1-6: Water Loss Audit Summary for the Lavaca Region

Region P 9 Audits Submitted	System Input Volume 1,625,622,369	Authorized Consumption 1,406,128,409 86.5%	Billed Consumption 1,359,814,492 83.6%	Billed Metered 1,359,814,492 83.6%	Revenue Water 1,359,814,492 83.6%
				Billed Unmetered 0 0.0%	
			Unbilled Consumption 46,313,917 2.8%	Unbilled Metered 22,675,557 1.4%	Non-revenue Water 265,807,877 16.4%
				Unbilled Unmetered 23,638,360 1.5%	
		Water Loss 219,493,960 13.5%	Apparent Loss 86,055,652 5.3%	Unauthorized Consumption 4,064,056 0.3%	
				Customer Meter Accuracy Loss 80,021,596 4.9%	
				Systematic Data Handling Discrepency 1,970,000 0.1%	
			Real Loss 133,438,309 8.2%	Reported Breaks and Leaks 24,014,990 1.5% Unreported Loss 109,423,319 6.7%	

Source: 2015 Summary of Water Loss Audit Data by Gallons and Percentage by Region with Statewide Totals

The LRWPG recognizes the value of advanced metering infrastructure (AMI) and leak detecting technologies in providing more accurate water accountability.

APPENDIX 1A

Sources Used

Document	Description/Importance
Texas State Historical Association. *Texas Almanac: 2008-2009, 2013-2014, 2018-2019.*	Provides background information and statistics on Texas and each county.
TWDB. *2017 State Water Plan.*	The official water plan for Texas. Describes current use and supply, identifies water management measures and environmental concerns, and offers recommendations.
U.S. Census Bureau. *Total Population Estimates for Texas Counties and Places.* Census 2010.	Resource for population estimates for Texas counties and places in various years.
U.S. Census Bureau. *2013-2017 American Community Survey 5-Year Estimates.*	Resource for economic characteristics in Texas counties.
Texas Workforce Commission. *Labor Force Statistics for Texas Counties 2000-Present* (2017). http://www.txcip.org/tac/census/morecountyinfo.php?MORE=1042	Resource for unemployment rates in Texas counties.
Lavaca-Navidad River Authority. *Lavaca-Navidad River Authority Basin Summary Report, Texas Clean Rivers Report 2017.* http://www.lnra.org/docs/water-quality-program/fy2017-lnra-basin-summary-report-final.pdf?sfvrsn=0	Summarizes Stream Segment Uses and Water Quality Criteria in the Lavaca River Basin in 2017.
Texas Clean Rivers Program and TCEQ. 2016. *Draft 2016 Texas Water Quality Inventory.*	Summarizes the water quality issues for each segment of the Texas river basins.
Lavaca-Navidad River Authority. *Lavaca-Basin Summary Report FY 2007.* http://www.lnra.org/docs/water-quality-program/final2007.pdf	Provides background information in the Lavaca River Basin.
Texas Parks and Wildlife Department, Wildlife Division, Non-game and Rare Species and Habitat Assessment programs. County Lists of Texas' Special Species. [Lavaca County, Jackson County, and Wharton County: 2018].	Lists endangered, threatened, and rare species for each county.

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Chapter 2 – Presentation of Population and Water Demands

2.1 Introduction

2.1.1 Scope of Work

This chapter presents the results of Task 2A and 2B of the project scope, which addresses updated population and water demand data for the region and outlines the guidelines and methodology used for the update. Also, to provide consistency and facilitate the compilation of the different regional plans, TWDB required the incorporation of this data into a standardized online database referred to as TWDB DB22. This information is contained within the following tables.

- *Table 2-1* – Lavaca Region Water User Group Population by Utility and Rural County
- *Table 2-2* – Water Demand by Water User Group, County, and Basin
- *Table 2-4* – Lavaca Region Water Demands on LNRA (Major Water Provider)

2.1.2 Background

Senate Bill 1 (SB 1), 75th Texas Legislature, established a new approach to the preparation of the State Water Plan, requiring local consensus on regional plans first. Each regional planning group works with the Texas Water Development Board (TWDB) to develop a regional water plan per TWDB guidelines. Each regional planning group of the state, including the Lavaca Regional Water Planning Group (Lavaca RWPG) prepared and submitted regional plans in 2001, 2006, 2011, and 2016. The Lavaca Regional Water Planning Group contracted with AECOM to prepare the 2021 Lavaca Regional Water Plan.

One primary goal of the regional water planning process is to identify water supply development strategies that will be reliable during times of drought for all users in the State. Quantifying existing and future water demands is the initial step in the planning effort. Each regional planning group works with the Texas Water Development Board (TWDB) to develop population and water demand projections for the 50-year planning horizon, and this chapter documents the methodology and results of this effort by the Lavaca RWPG.

2.1.3 Description of the Region[1]

The Lavaca Region is comprised of Jackson County, Lavaca County, and Precinct 3 of Wharton County, including the majority of the City of El Campo. The eastern portion of Wharton County is included in the Lower Colorado Regional Water Planning Area (Region K). The Lavaca Region had a population of 49,000 in 2010. As a rural area with a large agriculture sector, the water demand in the Lavaca Region is largely associated with agricultural irrigation. See *Figure 1-1* (in *Chapter 1* of this document) for a map of Lavaca Regional Water Planning Area.

[1] *Chapter 1: Description of the Lavaca Regional Water Planning Area*

2.2 Methodology and Projections[2]

The following methodology for generation of population and water demand projections was developed in accordance with TWDB guidance and relevant scope items for the 2021 Regional Water Planning effort.

2.2.1 General

The Texas Water Development Board (TWDB) distributed draft population, municipal water demand, and mining water demand projections via a December 2016 communication for review by the Lavaca Regional Water Planning Group (Lavaca RWPG). A second TWDB communication in June 2017 accompanied the TWDB's draft irrigation, steam-electric power, manufacturing, and livestock water demand. These communications also included a summary of the projection methodologies and specific steps a regional planning group must follow in requesting revisions to the projections, if necessary. Once submitted to TWDB by the regional planning groups, the projection revision requests were also reviewed by the Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and the Texas Department of Agriculture prior to being approved by TWDB in spring 2018.

TWDB rules require that projection analyses be performed for each identified municipal and non-municipal water user group (WUG). Municipal Water User Groups are defined as:

a. Privately-owned utilities that provide an average of more than 100 acre-feet per year for municipal use for all owned water systems;
b. Water systems serving institutions or facilities owned by the state or federal government that provide more than 100 acre-feet per year for municipal use;
c. All other Retail Public Utilities not covered in (a) and (b) that provide more than 100 acre-feet per year for municipal use;
d. Collective Reporting Units, or groups of Retail Public Utilities that have a common association and are requested for inclusion by the RWPG; and
e. Municipal and domestic water use, referred to as County-Other, not included in (a)-(d)

Non-municipal water user groups include manufacturing, irrigation, steam-electric power generation, mining, and livestock water use, and are also referred to within each county (i.e., Jackson County Mining, Jackson County Manufacturing, etc.) The planning process also designates Wholesale Water Providers (WWP), which are persons or entities having contracts to sell any volume of water wholesale. In addition to Wholesale Water Providers, a new requirement is for the regions to determine the Major Water Providers (MWP) in the region. Major Water Providers are defined as a Water User Group or Wholesale Water Provider of particular significance to the region's water supply, as determined by the regional planning group. The Lavaca RWPG has designated the Lavaca-Navidad River Authority (LNRA) as the only Major Water Provider within the Lavaca Region. Associated water commitments for the LNRA are identified within the plan and discussed in detail in *Section 2.3* of this chapter.

The Lavaca RWPG analyzed all TWDB-provided draft population and water demand projections and requested input from the utilities and counties in the region regarding population and water demand projections. The Lavaca RWPG considered changes where appropriate and justifiable by TWDB requirements, finally requesting TWDB revisions to the draft municipal, irrigation, manufacturing, steam-electric, and livestock demand projections. No revisions were requested to the TWDB draft projections for population or for mining demands. The detailed methodologies and resulting finalized

[2] TWDB Exhibit C General Guidelines for Fifth Cycle of Regional Water Plan Development

population and demand projections of this process are discussed in the following sections of this chapter.

2.2.2 Population Projections

Population changes, along with daily water use per person, directly drive municipal water demand changes. Thus, establishing accurate population estimates and projections is a primary goal in the regional water planning process. The Lavaca Region is relatively rural compared to more densely populated areas of the state, and municipal water demand is a smaller share of the total water demand for the Lavaca Region. The population projections in this plan were developed in accordance with TWDB guidelines, utilizing the 2010 US Census data and growth projections established by the Office of the State Demographer.

Previous regional and state water plans have been aligned with political boundaries, such as city limits, rather than water utility service areas for municipal demands. As part of the current planning process, TWDB rule changes now defines municipal water user group (WUG) planning as being utility-based, and the emphasis of the development of draft projections for the 2021 Regional Water Plans (RWPs) was on the transition of the 2017 State Water Plan (SWP) population projections and the associated water demand projections from political boundaries to utility service area boundaries. As with other projections during this planning effort, TWDB staff distributed draft population data and projections for planning group review.

The population projections indicate that the population of the Lavaca Region will increase approximately 10 percent from 50,489 in the year 2020 to 55,522 in the year 2070. Population in Jackson County is projected to increase 7.5 percent over the planning horizon from 14,606 in 2020 to 15,699 people in 2070. Wharton County is split between two regional water planning areas, with the western portion of Wharton County located in the Lavaca Region and the eastern portion considered part of the Lower Colorado Regional Water Planning Area. The Lavaca Region portion of Wharton County is expected to see a 24 percent population increase, from 16,620 in 2020 to 20,560 in 2070. State Demographer projections in Lavaca County indicate the population may slightly decrease in the future, so for the purposes of this plan, Lavaca County population was held constant in the planning horizon at 19,263 people in each decade.

It was identified during a Lavaca RWPG meeting that there was some concern that areas of Lavaca County are increasing in population, which is not shown in the draft projections. It was discussed that there was not sufficient data to support a revision request during this planning cycle. The next round of planning will incorporate the 2020 U.S. Census count, which may provide support to show population growth in Lavaca County for the planning horizon. For this planning cycle, available water supplies and water management strategies can be identified to meet anticipated water needs.

After the review, the Lavaca RWPG agreed that no revision requests would be submitted to the TWDB regarding the draft population projections. The draft TWDB population projections were formally approved by the Lavaca RWPG at the October 2, 2017 meeting with no recommended revisions. The population projections were formally adopted by the TWDB and the projections were incorporated into the TWDB online database (DB22). Population projections are included in *Table 2-1* at the end of the chapter and are also provided in *Appendix 2B* “Population and Water Demand Data Reports from Texas Water Development Board (DB22).”

2.2.3 Municipal Water Demand Projections

After population is established for each water user group, the second key variable in the TWDB’s municipal water demand projections is per capita daily use, which represents the average number of gallons of water used per person per day (also noted commonly as gallons per capita daily and abbreviated as GPCD). Municipal water demand projections are the product of population projections and per capita daily use projections for each water user group.

The per capita daily use estimate is unique for each municipal reporting entity and generally determined using responses to the TWDB's 2011 Water Use Survey. The year 2011 is generally considered a "dry-year" for much of the State of Texas and this dataset is assumed to be representative of water use during times of drought. In projecting per capita daily use for future decades of the planning horizon, the TWDB reduced per capita use assuming future water efficiency savings due to federal standards of plumbing fixtures and appliances.

For this planning cycle, the draft municipal water demand projections incorporated GPCD values that were carried over from the 2017 State Water Plan. These values were based on city boundaries. The TWDB also provided, for information purposes, historical GPCD estimates that reflected the new utility boundaries. The Lavaca RWPG agreed that the utility boundary GPCD values better represent the new utility-based planning, and requested to the TWDB a revision that the utility boundary GPCD values be used for calculating the municipal water demand projections.

Municipal water demand for the Lavaca Region is projected to increase slightly over the planning horizon, due to a moderate increase in population projections coupled with a gradual projected decline in per capita use. The resulting Lavaca Region municipal demand projections range from 7,976 acre-feet per year in 2020 to 8,174 acre-feet per year in 2070.

These municipal water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented for each municipal water user group by county, river basin, and decade in *Table 2-2*. The GPCD values used to calculate municipal water demand projections are provided in *Table 2-3*. Data is also provided in a different format in *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB22)."

Embedded within the municipal water demand projections are estimated savings due to plumbing codes and water-efficient appliances, as determined by the TWDB. These estimated savings, in acre-feet of water, are summarized in a table provided in *Appendix 2C*.

2.2.4 Irrigation Water Demand Projections

Agricultural water use within the Lavaca Region is by far the greatest use in the area, with these demands making up more than 90 percent of the total demand in the region. As such, it is important to the Lavaca RWPG that the irrigation water demands are planned for as accurately as possible during times of drought.

For this planning cycle, the methodology the TWDB used to develop the draft irrigation water demand projections was to take the average irrigation water use estimate by county for the years 2010-2014 and hold it constant for the 2020-2070 planning decades.

The Lavaca RWPG agreed that for the Lavaca Regional Water Planning Area, a three-year period from 2011-2013 better represented the drought / dry-year period than the five-year period from 2010-2014. Based on local knowledge, the intensity of the drought did not begin until 2011. At the October 2, 2017 Lavaca RWPG meeting, the Lavaca RWPG approved to request that the TWDB revise the irrigation demand projections for the region to reflect the average irrigation water use during 2011-2013 for all three counties (Jackson, Lavaca, and Wharton).

These revised irrigation water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented by county, river basin, and decade in *Table 2-2*. Data is also provided in a different format in *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB22)."

2.2.5 Steam-Electric Water Demand Projections

For this planning cycle, the methodology the TWDB used to develop the draft steam-electric water demand projections is for the 2020 projections to be based on the highest water use volume from 2010-2014, plus new planned facility demands, and minus scheduled retiring facility demands. The draft projections were kept constant from 2020-2070.

The draft projections for the Lavaca Region included two facilities in Wharton County that came online in 2016 and 2017, The Lavaca RWPG identified that one of the facilities is located in the Region K portion of Wharton County, rather than in the Lavaca Region portion of Wharton County. At the October 2, 2017 Lavaca RWPG meeting, the Lavaca RWPG agreed to request that the TWDB move the demand for that facility to Region K.

These revised steam-electric water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented by county, river basin, and decade in *Table 2-2*. Data is also provided in a different format in *Appendix 2B* “Population and Water Demand Data Reports from Texas Water Development Board (DB22).”

2.2.6 Manufacturing Water Demand Projections

For regional water planning purposes, manufacturing water use is considered to be the cumulative water demand by county and river basin for all industries within specified industrial classifications (SIC) as calculated by the TWDB.

For this planning cycle, the methodology the TWDB used to develop the draft manufacturing water demand projections is for the 2020 projections to be based on the highest water use volume from 2010-2014, using data from the annual water use survey. The most recent 10-year projections for employment growth from the Texas Workforce Commission were used as a proxy for increasing demand by manufacturing sectors between 2020 and 2030. The manufacturing water demands were then held constant from 2030-2070.

In reviewing the draft projections, the Lavaca RWPG discussed two revisions. At the October 2, 2017 Lavaca RWPG meeting, the Lavaca RWPG agreed to request that the TWDB make the following revisions:

- The Lavaca-Navidad River Authority (LNRA) informed the LRWPG that they had recently executed a water contract with an existing manufacturing customer for 10,400 AF of water in Jackson County. This demand will begin in 2020, and carry through to 2070. This additional demand of 10,400 AF was added on to the draft projection demand in all decades for Jackson County.
- On July 31st, TWDB staff sent an email containing a spreadsheet called SupportingData-ManufacturingAdditionalWaterUse.xlsx. The email explained the spreadsheet as “Unaccounted manufacturing water use data estimated through additional survey of wholesale water providers and groundwater conservation districts and analysis of establishment and employment data by industry from the U.S. County Business Patterns. This additional water use estimate for each county can be used to supplement the draft manufacturing demand projections.” The spreadsheet showed 34 AF of potentially unaccounted for water use in Wharton County within Region P. This additional demand of 34 AF was added on to the draft projection demand in all decades for Wharton County.

These revised manufacturing water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented by county, river basin, and decade in *Table 2-2*.

Data is also provided in a different format in *Appendix 2B* “Population and Water Demand Data Reports from Texas Water Development Board (DB22).”

2.2.7 Mining Water Demand Projections

The mining water demand projections from the 2017 State Water Plan were carried over as the draft mining water demand projections for this planning cycle. During the last planning cycle, the TWDB mining water demand projections were developed through a TWDB-contracted study with the Bureau of Economic Geology. The study estimated current mining water use and projected that use across the planning horizon utilizing data collected from trade organizations, government agencies, and other industry representatives. Individual projections were made for sectors including oil and gas aggregates, coal and lignite, and other mining activities. These projections were then summed for each county.

At the October 2, 2017 Lavaca RWPG meeting, the Lavaca RWPG agreed to approve the draft mining water demand projections without requesting any revisions. These unchanged mining water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented by county, river basin, and decade in *Table 2-2*. Data is also provided in a different format in *Appendix 2B* “Population and Water Demand Data Reports from Texas Water Development Board (DB22).

2.2.8 Livestock Water Demand Projections

The TWDB draft livestock water demand projections utilized an average of TWDB’s 2010-2014 livestock water use estimates for the 2020 projections. Water use estimates apply a water use coefficient for each livestock category to county level inventory estimates from the Texas Agricultural Statistics Service. The rate of change for projections from the 2016 Regional Water Plans was then applied to the new base. In the case of the Lavaca Region, the livestock water demand was constant from 2020-2070.

At the October 2, 2017 LRWPG meeting, the Lavaca RWPG discussed the TWDB methodology for the calculation of the historical livestock water use estimates. Overall, the RWPG was comfortable with the methodology, with the exception of the water rate per head for fed/other cattle. The TWDB methodology used 15 GPCD. The RWPG had concerns that 15 GPCD did not sufficiently take into consideration the number of pregnant/lactating cattle and their increased water needs, as well as the hot, humid temperatures the region experiences. The LRWPG approved to request that the TWDB use 30 GPCD to calculate the water demands for fed/other cattle for all three counties. The request nearly doubled the livestock water demand for the region as compared to the draft projections.

These revised livestock water demand projections were adopted by the TWDB for use in the 2021 Lavaca Regional Water Plan and are presented by county, river basin, and decade in *Table 2-2*. Data is also provided in a different format in *Appendix 2B* “Population and Water Demand Data Reports from Texas Water Development Board (DB22).”

2.3 Major Water Providers

The sole Major Water Provider (MWP) in the Lavaca Regional Water Planning Area, as determined by the Lavaca RWPG, is the Lavaca-Navidad River Authority (LNRA), which holds rights to the firm yield of Lake Texana. Lavaca Region demands on LNRA are given in *Table 2-4* at the end of the chapter. The majority of the water supplied by LNRA goes to meet demands outside of the Lavaca Region. All existing contracts for water from LNRA are shown in *Table 2-5*. *Chapter 5* will consider potential water management strategies to increase LNRA’s water supplies, which may provide water for existing and future customers in and outside of the region.

Table 2-1
Lavaca Region Water User Group Population by Individual Water Utility or Rural County

Region	Water User Group	County Name	P2020	P2030	P2040	P2050	P2060	P2070	Region Split Pop.(1)	County Split Pop.(2)
P	EDNA	JACKSON	5,747	5,949	6,034	6,105	6,150	6,177		
P	GANADO	JACKSON	2,080	2,153	2,184	2,209	2,224	2,236		
P	COUNTY-OTHER	JACKSON	6,779	7,017	7,118	7,201	7,253	7,286		
		JACKSON Total	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**		
P	HALLETTSVILLE	LAVACA	2,820	2,820	2,820	2,820	2,820	2,820		
P	MOULTON	LAVACA	874	874	874	874	874	874		
P	SHINER	LAVACA	2,054	2,054	2,054	2,054	2,054	2,054		
P	YOAKUM	LAVACA	3,701	3,701	3,701	3,700	3,701	3,701	P	P
P	COUNTY-OTHER	LAVACA	9,814	9,814	9,814	9,815	9,814	9,814		
		LAVACA Total	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**		
P	EL CAMPO	WHARTON	12,096	12,660	13,111	13,502	13,863	14,183	P	
P	WHARTON COUNTY WCID 1	WHARTON	1,076	1,146	1,201	1,248	1,293	1,331		
P	COUNTY OTHER	WHARTON	3,448	3,880	4,226	4,525	4,800	5,046	P	
		WHARTON Total	**16,620**	**17,686**	**18,538**	**19,275**	**19,956**	**20,560**	***P***	
		LRWPA TOTAL	**50,489**	**52,068**	**53,137**	**54,053**	**54,846**	**55,522**		

1) If “P” is present in the column titled “Region Split Pop.”, the Water User Group is located in more than one region, and the projections listed in the row represent only the Water User Group’s population projections within that particular region, not the Water User Group’s total population projections.

2) If “P” is present in the column “County Split Pop.”, the Water User Group is located in more than one county, and the projections listed in the row represent only the Water User Group’s population projections within that particular county, not the Water User Group’s total population projections.

Table 2-2
Water Demand by Water User Group, County, and Basin

WUG Name	WUG County	WUG Basin	Water Demand (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	JACKSON	COLORADO-LAVACA	234	232	227	225	226	227
COUNTY-OTHER	JACKSON	LAVACA	426	421	411	409	410	411
COUNTY-OTHER	JACKSON	LAVACA-GUADALUPE	50	50	49	48	48	49
EDNA	JACKSON	LAVACA	878	880	869	869	874	877
GANADO	JACKSON	LAVACA	237	236	232	231	231	233
IRRIGATION	JACKSON	COLORADO-LAVACA	22,372	22,372	22,372	22,372	22,372	22,372
IRRIGATION	JACKSON	LAVACA	45,136	45,136	45,136	45,136	45,136	45,136
IRRIGATION	JACKSON	LAVACA-GUADALUPE	10,990	10,990	10,990	10,990	10,990	10,990
LIVESTOCK	JACKSON	COLORADO-LAVACA	415	415	415	415	415	415
LIVESTOCK	JACKSON	LAVACA	1,289	1,289	1,289	1,289	1,289	1,289
LIVESTOCK	JACKSON	LAVACA-GUADALUPE	178	178	178	178	178	178
MANUFACTURING	JACKSON	COLORADO-LAVACA	10,549	10,627	10,627	10,627	10,627	10,627
MANUFACTURING	JACKSON	LAVACA	146	147	147	147	147	147
MANUFACTURING	JACKSON	LAVACA-GUADALUPE	229	231	231	231	231	231
MINING	JACKSON	COLORADO-LAVACA	10	10	8	6	4	3
MINING	JACKSON	LAVACA	39	41	31	22	14	10
MINING	JACKSON	LAVACA-GUADALUPE	21	22	16	12	8	6
COUNTY-OTHER	LAVACA	GUADALUPE	4	4	4	4	4	4
COUNTY-OTHER	LAVACA	LAVACA	1,258	1,212	1,174	1,154	1,150	1,150
COUNTY-OTHER	LAVACA	LAVACA-GUADALUPE	1	1	1	1	1	1
HALLETTSVILLE	LAVACA	LAVACA	641	628	617	611	610	610
IRRIGATION	LAVACA	LAVACA	8,692	8,692	8,692	8,692	8,692	8,692
LIVESTOCK	LAVACA	GUADALUPE	37	37	37	37	37	37
LIVESTOCK	LAVACA	LAVACA	3,650	3,650	3,650	3,650	3,650	3,650
LIVESTOCK	LAVACA	LAVACA-GUADALUPE	76	76	76	76	76	76

Table 2-2
Water Demand by Water User Group, County, and Basin (Continued)

WUG Name	WUG County	WUG Basin	Water Demand (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	LAVACA	LAVACA	563	625	625	625	625	625
MINING	LAVACA	LAVACA	2,544	1,860	1,416	977	537	297
MOULTON	LAVACA	LAVACA	179	175	171	170	169	169
SHINER	LAVACA	LAVACA	485	475	467	463	462	462
YOAKUM	LAVACA	LAVACA	658	641	627	619	618	618
COUNTY-OTHER	WHARTON	COLORADO	23	25	26	28	30	31
COUNTY-OTHER	WHARTON	COLORADO-LAVACA	99	107	113	121	128	134
COUNTY-OTHER	WHARTON	LAVACA	333	359	381	406	429	452
EL CAMPO	WHARTON	COLORADO	313	320	325	331	339	347
EL CAMPO	WHARTON	COLORADO-LAVACA	1,918	1,958	1,989	2,028	2,078	2,125
EL CAMPO	WHARTON	LAVACA	55	56	57	58	59	61
IRRIGATION	WHARTON	COLORADO-LAVACA	4,858	4,858	4,858	4,858	4,858	4,858
IRRIGATION	WHARTON	LAVACA	83,588	83,588	83,588	83,588	83,588	83,588
LIVESTOCK	WHARTON	COLORADO-LAVACA	184	184	184	184	184	184
LIVESTOCK	WHARTON	LAVACA	650	650	650	650	650	650
MANUFACTURING	WHARTON	COLORADO-LAVACA	34	34	34	34	34	34
MINING	WHARTON	COLORADO-LAVACA	6	6	5	3	2	1
MINING	WHARTON	LAVACA	12	13	9	7	5	3
STEAM-ELECTRIC	WHARTON	LAVACA	2,060	2,060	2,060	2,060	2,060	2,060
WHARTON COUNTY WCID 1	WHARTON	LAVACA	184	190	195	200	207	213

Table 2-3
Gallons Per Capita Per Day (GPCD) Values

WUG Name	WUG County	Gallons Per Capita Per Day (GPCD)					
		2020	2030	2040	2050	2060	2070
COUNTY-OTHER	JACKSON	93.6	89.4	86.2	84.5	84.2	84.2
EDNA	JACKSON	136.3	132.0	128.6	127.1	126.8	126.8
GANADO	JACKSON	101.8	97.9	94.8	93.2	92.9	92.9
COUNTY-OTHER	LAVACA	114.9	110.7	107.3	105.4	105.1	105.1
HALLETTSVILLE	LAVACA	202.9	198.8	195.3	193.4	193.1	193.1
MOULTON	LAVACA	182.6	178.3	174.6	173.4	173.1	173.1
SHINER	LAVACA	210.8	206.6	203.1	201.2	200.8	200.8
YOAKUM	LAVACA	158.7	154.6	151.2	149.4	149.1	149.1
COUNTY-OTHER	WHARTON	117.7	113.0	109.8	109.5	109.2	109.1
EL CAMPO	WHARTON	168.7	164.6	161.4	159.8	159.5	159.5
WHARTON COUNTY WCID 1	WHARTON	152.4	148.1	144.9	143.4	143.1	143.1

Table 2-4
Lavaca Region Water Demands on Lavaca-Navidad River Authority (Major Water Provider)

WUG Name	WUG County	Water Demand (ac-ft/yr)					
		2020	2030	2040	2050	2060	2070
Manufacturing	Jackson	10,874	10,955	10,955	10,955	10,955	10,955

Table 2-5
Lavaca-Navidad River Authority Water Sales Agreements

Customer / Use*	Supply Volume (ac-ft/yr)
Calhoun County Navigation District	594
Held in reserve	56
City of Corpus Christi (firm supply)	31,440
City of Corpus Christi (interruptible supply)	12,000
City of Point Comfort	178
Formosa Plastics Corporation	41,200
Inteplast Corporation	1,032
TOTAL	**86,500**

*An additional 4,500 ac-ft/yr of firm yield is used for environmental flows

APPENDIX 2A

Sample Correspondence to Water User Groups

AECOM
9400 Amberglen Blvd
Austin, TX 78729
www.aecom.com

512 454 4797 tel
512 454 8807 fax

February 27, 2017

Subject: Lavaca Regional Water Planning Area (Region P)
Draft Projected Population and Water Demands for 2021 Regional Water Plan
Please Review and Respond

Dear Water User Group Representative:

The Texas Water Development Board (TWDB) has developed and released for review the **draft population and municipal water demand projections** intended for use in developing the 2021 Region P Water Plan. The Lavaca Regional Water Planning Group (Region P) is currently reviewing the draft projections for the region and is **seeking input from local utilities** to either verify the projections appear accurate or request that the TWDB consider revising the numbers.

As part of the 2021 Regional Water Plan, the consultant team is currently performing tasks related to the allocation of water supply and demand for Water User Groups (WUGs) in our region to determine projected future water shortages. A WUG consists of a demand center to which water resources can be allocated. Municipal WUGs are associated with populations within and outside of water utility service areas, and the projections of these populations are used to estimate future water demands. This utility-based planning method is slightly different from previous planning cycles, where city limits were also used to determine population areas. As a result, please note that the draft population and municipal demand projections provided by TWDB in the attached table should represent your entire water utility service area. For city water utilities, this may be less than or greater than the population within the city limits.

The draft population projections that have been provided by the TWDB for the 2021 Region P Water Plan use the 2010 Census data as a base, which the State Demographer and TWDB staff have projected out into the future. The associated municipal water demand projections rely on per capita water use as reported in the 2011 Water Use Survey to the TWDB, which have then been projected out to 2070. Addiitionally, the per capita water use values have been modified for anticipated plumbing code efficiency savings, which can explain why water demands might decrease over time.

The attached table lists all of the municipal WUGs located within Region P in alphabetical order. Rural areas that did not meet the criteria for being defined as an individual WUG are listed as "County-Other" in the table. If a WUG is located in more than one county and/or region, each of the county/region components and a summed total are shown to provide the entire picture.

We are asking that you review the population and demand projections for your WUG and respond with either:

- The numbers represent reasonable projections and require no revision, or

- You would like to revise your projections and *can provide information to support your request*.

If **no revisions** are requested, a quick call or email to let us know you've reviewed the numbers and have no changes would be very appreciated. My contact information is at the end of this letter.

If you believe adjustments to the population and/or water demand projections may be warranted, please contact me so we can disuss your entity and what documentation might be needed by TWDB to back up a modification. Please contact me at your earliest convenience, preferably no later than **May 1, 2017**.

In addition, if after reviewing the water demand numbers, you have concerns regarding whether your current water supplies are able to meet your future water demands, Region P would be very glad to talk with you about what types of water management strategies would be appropriate to recommend for your WUG in the 2021 Region P Water Plan. Having a strategy or project recommended in a Region Water Plan can help in the process of applying for certain types of State funding.

You may contact me with any additional questions you have regarding the draft projections or regional water planning. I may be reached directly at (512) 457-7798 or at jaime.burke@aecom.com. For additional information, please also visit Region P's website at http://www.lnra.org/water/lavaca-regional-water-planning-group and the TWDB's regional water planning webpage http://www.twdb.texas.gov/waterplanning/rwp/index.asp.

Thank you for taking the time to help support the regional water planning process in Texas.

Sincerely,

Jaime Burke, P.E.
Project Manager
AECOM
Consultant for the Lavaca Regional Water Planning Group (Region P)
Direct 512-457-7798
jaime.burke@aecom.com

Enclosure – Table containing TWDB draft projections for all municipal WUGs in Region P

Copy: File

APPENDIX 2B

Population and Water Demand Data Reports from Texas Water Development Board (DB22)

Region P Water User Group (WUG) Population

	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER	2,236	2,315	2,348	2,375	2,392	2,403
COLORADO-LAVACA BASIN TOTAL	**2,236**	**2,315**	**2,348**	**2,375**	**2,392**	**2,403**
EDNA	5,747	5,949	6,034	6,105	6,150	6,177
GANADO	2,080	2,153	2,184	2,209	2,224	2,236
COUNTY-OTHER	4,064	4,206	4,267	4,317	4,349	4,368
LAVACA BASIN TOTAL	**11,891**	**12,308**	**12,485**	**12,631**	**12,723**	**12,781**
COUNTY-OTHER	479	496	503	509	512	515
LAVACA-GUADALUPE BASIN TOTAL	**479**	**496**	**503**	**509**	**512**	**515**
JACKSON COUNTY TOTAL	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**
COUNTY-OTHER	33	33	33	33	33	33
GUADALUPE BASIN TOTAL	**33**	**33**	**33**	**33**	**33**	**33**
HALLETTSVILLE	2,820	2,820	2,820	2,820	2,820	2,820
MOULTON	874	874	874	874	874	874
SHINER	2,054	2,054	2,054	2,054	2,054	2,054
YOAKUM	3,701	3,701	3,701	3,700	3,701	3,701
COUNTY-OTHER	9,776	9,776	9,776	9,777	9,776	9,776
LAVACA BASIN TOTAL	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**
COUNTY-OTHER	5	5	5	5	5	5
LAVACA-GUADALUPE BASIN TOTAL	**5**	**5**	**5**	**5**	**5**	**5**
LAVACA COUNTY TOTAL	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**
EL CAMPO	1,658	1,735	1,797	1,851	1,900	1,944
COUNTY-OTHER	175	197	214	230	244	256
COLORADO BASIN TOTAL	**1,833**	**1,932**	**2,011**	**2,081**	**2,144**	**2,200**
EL CAMPO	10,148	10,621	11,000	11,327	11,631	11,899
COUNTY-OTHER	750	844	919	984	1,044	1,098
COLORADO-LAVACA BASIN TOTAL	**10,898**	**11,465**	**11,919**	**12,311**	**12,675**	**12,997**
EL CAMPO	290	304	314	324	332	340
WHARTON COUNTY WCID 1	1,076	1,146	1,201	1,248	1,293	1,331
COUNTY-OTHER	2,523	2,839	3,093	3,311	3,512	3,692
LAVACA BASIN TOTAL	**3,889**	**4,289**	**4,608**	**4,883**	**5,137**	**5,363**
WHARTON COUNTY TOTAL	**16,620**	**17,686**	**18,538**	**19,275**	**19,956**	**20,560**
REGION P TOTAL POPULATION	**50,489**	**52,068**	**53,137**	**54,053**	**54,846**	**55,522**

Region P Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
COUNTY-OTHER	234	232	227	225	226	227
MANUFACTURING	10,549	10,627	10,627	10,627	10,627	10,627
MINING	10	10	8	6	4	3
LIVESTOCK	415	415	415	415	415	415
IRRIGATION	22,372	22,372	22,372	22,372	22,372	22,372
COLORADO-LAVACA BASIN TOTAL	**33,580**	**33,656**	**33,649**	**33,645**	**33,644**	**33,644**
EDNA	878	880	869	869	874	877
GANADO	237	236	232	231	231	233
COUNTY-OTHER	426	421	411	409	410	411
MANUFACTURING	146	147	147	147	147	147
MINING	39	41	31	22	14	10
LIVESTOCK	1,289	1,289	1,289	1,289	1,289	1,289
IRRIGATION	45,136	45,136	45,136	45,136	45,136	45,136
LAVACA BASIN TOTAL	**48,151**	**48,150**	**48,115**	**48,103**	**48,101**	**48,103**
COUNTY-OTHER	50	50	49	48	48	49
MANUFACTURING	229	231	231	231	231	231
MINING	21	22	16	12	8	6
LIVESTOCK	178	178	178	178	178	178
IRRIGATION	10,990	10,990	10,990	10,990	10,990	10,990
LAVACA-GUADALUPE BASIN TOTAL	**11,468**	**11,471**	**11,464**	**11,459**	**11,455**	**11,454**
JACKSON COUNTY TOTAL	**93,199**	**93,277**	**93,228**	**93,207**	**93,200**	**93,201**
COUNTY-OTHER	4	4	4	4	4	4
LIVESTOCK	37	37	37	37	37	37
GUADALUPE BASIN TOTAL	**41**	**41**	**41**	**41**	**41**	**41**
HALLETTSVILLE	641	628	617	611	610	610
MOULTON	179	175	171	170	169	169
SHINER	485	475	467	463	462	462
YOAKUM	658	641	627	619	618	618
COUNTY-OTHER	1,258	1,212	1,174	1,154	1,150	1,150
MANUFACTURING	563	625	625	625	625	625
MINING	2,544	1,860	1,416	977	537	297
LIVESTOCK	3,650	3,650	3,650	3,650	3,650	3,650
IRRIGATION	8,692	8,692	8,692	8,692	8,692	8,692
LAVACA BASIN TOTAL	**18,670**	**17,958**	**17,439**	**16,961**	**16,513**	**16,273**
COUNTY-OTHER	1	1	1	1	1	1
LIVESTOCK	76	76	76	76	76	76
LAVACA-GUADALUPE BASIN TOTAL	**77**	**77**	**77**	**77**	**77**	**77**
LAVACA COUNTY TOTAL	**18,788**	**18,076**	**17,557**	**17,079**	**16,631**	**16,391**
EL CAMPO	313	320	325	331	339	347
COUNTY-OTHER	23	25	26	28	30	31
COLORADO BASIN TOTAL	**336**	**345**	**351**	**359**	**369**	**378**
EL CAMPO	1,918	1,958	1,989	2,028	2,078	2,125
COUNTY-OTHER	99	107	113	121	128	134
MANUFACTURING	34	34	34	34	34	34
MINING	6	6	5	3	2	1
LIVESTOCK	184	184	184	184	184	184
IRRIGATION	4,858	4,858	4,858	4,858	4,858	4,858

Region P Water User Group (WUG) Demand

	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
COLORADO-LAVACA BASIN TOTAL	**7,099**	**7,147**	**7,183**	**7,228**	**7,284**	**7,336**
EL CAMPO	55	56	57	58	59	61
WHARTON COUNTY WCID 1	184	190	195	200	207	213
COUNTY-OTHER	333	359	381	406	429	452
MINING	12	13	9	7	5	3
STEAM ELECTRIC POWER	2,060	2,060	2,060	2,060	2,060	2,060
LIVESTOCK	650	650	650	650	650	650
IRRIGATION	83,588	83,588	83,588	83,588	83,588	83,588
LAVACA BASIN TOTAL	**86,882**	**86,916**	**86,940**	**86,969**	**86,998**	**87,027**
WHARTON COUNTY TOTAL	**94,317**	**94,408**	**94,474**	**94,556**	**94,651**	**94,741**
REGION P TOTAL DEMAND	**206,304**	**205,761**	**205,259**	**204,842**	**204,482**	**204,333**

APPENDIX 2C

Region P Municipal Water Demand Savings Due to Plumbing Codes and Water-Efficient Appliances

Passive Conservation Savings for Municipal WUGs in Region P by County - in ACFT (for 2021 RWP)

Region	County	EntityName	2020	2030	2040	2050	2060	2070
P	JACKSON	COUNTY-OTHER, JACKSON	71.68	106.74	133.79	149.22	152.74	153.52
P	JACKSON	EDNA	62.19	93.29	117.54	129.25	132.27	132.92
P	JACKSON	GANADO	21.39	31.71	39.58	44.09	45.17	45.43
P	LAVACA	COUNTY-OTHER, LAVACA	100.59	145.77	183.69	204.49	208.10	208.10
P	LAVACA	HALLETTSVILLE	28.62	41.70	52.75	58.79	59.83	59.83
P	LAVACA	MOULTON	9.19	13.45	17.07	18.19	18.51	18.51
P	LAVACA	SHINER	21.24	30.85	38.95	43.35	44.08	44.08
P	LAVACA	YOAKUM	38.39	55.55	69.52	77.13	78.48	78.48
P	WHARTON	COUNTY-OTHER, WHARTON	39.74	65.28	86.15	93.92	101.19	106.66
P	WHARTON	EL CAMPO	126.14	190.45	243.20	275.41	287.59	294.70
P	WHARTON	WHARTON COUNTY WCID 1	11.58	17.84	23.06	26.00	27.39	28.25
P Total			**530.75**	**792.64**	**1,005.32**	**1,119.84**	**1,155.34**	**1,170.48**

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Chapter 3 – Analysis of Current Water Supplies

3.1 Introduction

The available water supply within the region includes both groundwater and surface water. Groundwater is provided from the Gulf Coast Aquifer System. Primary surface water sources are the Navidad and Lavaca Rivers and Lake Texana.

Much of the regional water demand is supplied by groundwater. Approximately 86 percent of the existing water supplies come from groundwater. The Gulf Coast Aquifer System is the predominant supply source.

Surface water supplies are obtained from Lake Texana and run-of-river (ROR) flows from the Lavaca and Navidad Rivers and some creeks. In addition, the portion of the Garwood Irrigation District within the Lavaca Region receives some surface water supplies from the Colorado River in Region K. The majority of the Lavaca Regional Water Planning Area (LRWPA) is located in the Lavaca River Basin. Surface water supplies account for approximately 14 percent of the total existing water supplies. The only reservoir in the Lavaca Region is Lake Texana, and there are no major springs in the LRWPA.

This chapter summarizes the results of Task 3 and describes the resources available to the LRWPA and their allocation to WUGs throughout the LRWPA. Also, to provide consistency and facilitate the compilation of the different regional plans, TWDB required the incorporation of this data into a standardized online database referred to as TWDB DB22. DB22 reports that contain this information are identified below and are located in *Appendix 3A* accompanying this chapter.

- *Table 3A-1* – Region P Source Availability
- *Table 3A-2* – Region P Water User Group (WUG) Existing Water Supply
- *Table 3A*-3 – Region P Source Water Balance (Availability – WUG Supply)

Some of the information contained within this chapter is based on information published in *Chapter 1 – Description of the Lavaca Regional Water Planning Area*. For a complete and detailed list of sources, see references for *Chapter 1*.

3.2 Identification of Groundwater Sources

3.2.1 Groundwater Aquifers

The only major aquifer in the Lavaca Region is the Gulf Coast Aquifer System. This aquifer accounts for nearly all of the groundwater supply to the LRWPA. The Jackson Group, a minor aquifer in northwest Lavaca County, provides small amounts of supply for domestic and livestock uses.

The Gulf Coast Aquifer System consists of four general water-producing units. The shallowest is the Chicot aquifer, followed by the Evangeline and Jasper aquifers and then the Catahoula Sandstone. These formations are composed of interbedded layers of sand, silt, and clay, with minor amounts of small gravel in some locations. Shale can also be present at deeper depths, below the base of the Evangeline aquifer where the Burkeville confining zone exists and separates the Evangeline aquifer from the Jasper aquifer. The aquifer beds vary in thickness and composition and are normally discontinuous over extended distances.

The Chicot and Evangeline aquifers provide large amounts of freshwater. The aquifers contain freshwater to depths that range from 1,400 to 1,700 feet in the portion of Wharton County in the LRWPA, according to Report 270.

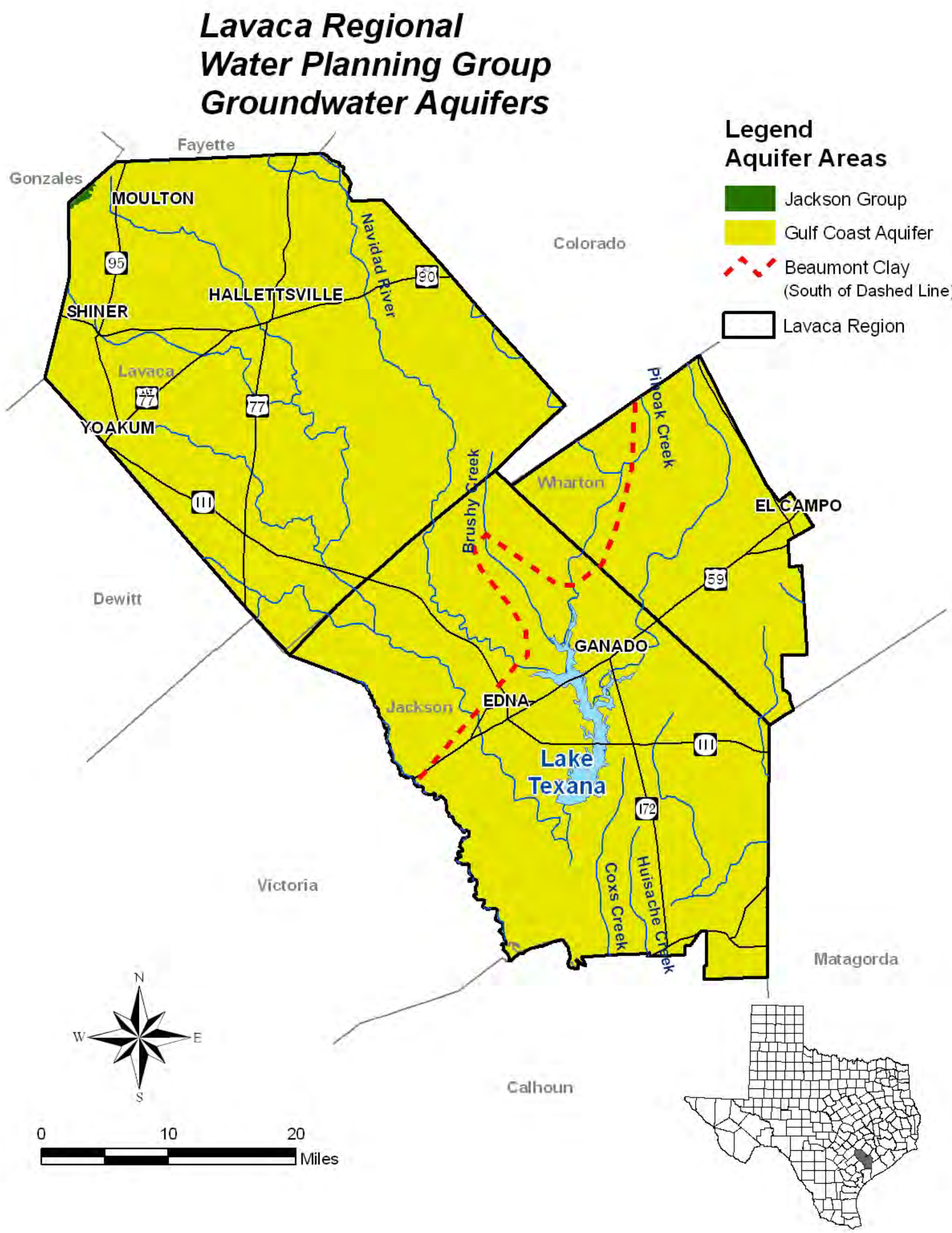
Recharge to the aquifers is principally from the infiltration of precipitation and streamflow. Average annual rainfall in the LRWPA ranges from about 34 to 46 inches per year. The eastern portion of the region experiences the upper end of the average annual rainfall amounts.

The geographic coverage of the Gulf Coast Aquifer System within the Lavaca Region is shown in *Figure 3-1*. The area includes the Jasper, Evangeline, and Chicot aquifer formations. The Gulf Coast Aquifer System parallels the coast, covers the Lavaca Region, and also extends outside the LRWPA to the northeast and southwest.

The Jackson Group, a minor aquifer, is located in the northwestern portion of Lavaca County. The aquifer provides small amounts of water to domestic and livestock wells in the very northwestern reaches of the LRWPA. Only a small part of the Jackson Group occurs in the very northwestern part of Lavaca County northwest of the Town of Moulton.

There are no minor aquifers present in Jackson or Wharton Counties for which estimates of groundwater availability have previously been provided, as groundwater in the two counties is pumped from the Gulf Coast Aquifer System. Data and text from TWDB and U.S. Geological Survey reports for Wharton and Jackson Counties do not reference minor aquifers in these two counties.

Figure 3-1
Groundwater Aquifers



3.2.2 Groundwater Use Overview

Groundwater in the region is pumped for domestic, agricultural, municipal, and industrial uses. According to the Texas Water Development Board historical groundwater pumpage estimates, in 2011, at the start of the most recent drought, the Lavaca Region pumped approximately 216,000 ac-ft of groundwater for these purposes. Agricultural irrigation accounts for approximately 92 percent of the groundwater pumped in the region. Wells used for agricultural irrigation tend to be deeper than the more shallow wells used for pumping water for livestock purposes. Municipal and public usage, which includes usage for cities, communities, parks, campgrounds, and water districts, represents approximately 5 percent of the groundwater pumped. Approximately 3 percent of groundwater pumped in the LRWPA is for industrial and mining needs, including manufacturing and other industrial uses.

3.2.3 Aquifer Conditions

Groundwater conditions have been historically favorable and will likely continue to be favorable within the Lavaca Region for the pumping of substantial quantities of good quality water. That being said, recent drought years have shown that unusual increases in pumping for extended periods in neighboring regions could potentially impact domestic wells in the Lavaca Region.

The Gulf Coast Aquifer System was deposited in a manner that resulted in substantial thicknesses of sand that contain fresh (good quality) groundwater. The aquifer has about 200 to 450 feet of sand that contains freshwater in Lavaca County. Sand thickness tends to be greater in the southeastern part of the county. In Jackson and Wharton Counties within the LRWPA, the Gulf Coast Aquifer System contains about 300 to 700 feet of freshwater sands in most of the area. In the southern part of Jackson County, north of Lavaca Bay, a limited area of the aquifer has 0 to 200 feet of sand that contains freshwater of less than 1,000 milligrams per liter (mg/L) total dissolved solids (TDS).

A Central Gulf Coast Groundwater Availability Model (GAM) was developed for the Central Gulf Coast Aquifer System in the LRWPA, and the model is described in a report prepared by TWDB entitled *Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999.* The model divides the Gulf Coast Aquifer into four layers that are the Chicot aquifer, Evangeline aquifer, Burkeville Confining System, and the Jasper aquifer. The main layers of the model that provide substantial amounts of water are the Chicot, Evangeline, and Jasper aquifers. For modeling purposes, the Catahoula Sandstone in northwestern Lavaca County is considered to be hydraulically connected to the Jasper aquifer. Further to the southeast, the Catahoula contains a greater percentage of fine-grained material and functions as a confining layer below the Jasper aquifer.

Based on the GAM, the estimated transmissivity for the Chicot aquifer in the LRWPA ranges from less than 15,000 gallons per day per foot (gpd/ft) near the outcrop up to 220,000 gpd/ft near southern Wharton County and eastern Jackson County. The Evangeline aquifer transmissivity ranges from less than 7,500 gpd/ft near the outcrop up to 85,000 gpd/ft in eastern Wharton County. The Central Gulf Coast GAM estimates that the transmissivity for the Jasper aquifer ranges from about 250 gpd/ft in eastern Lavaca County to 7,500 gpd/ft in eastern Wharton County. Pumping test data from a City of Hallettsville (Lavaca County) public supply well completed in the Jasper aquifer show transmissivity values ranging from 4,500 gpd/ft to 10,000 gpd/ft. The transmissivity values for the Chicot and Evangeline aquifers indicate that they are capable of transmitting large quantities of water to wells. The transmissivity values calculated from the City of Hallettsville well indicate that the Jasper aquifer is capable of transmitting moderate quantities of water to wells.

The development of large quantities of groundwater within the LRWPA has resulted in potentiometric head decline in the Gulf Coast Aquifer System. Data in TWDB Report 289, combined with water level changes since about 1970, indicate that the potentiometric head in the Chicot aquifer has declined approximately 20 feet, and up to possibly 80-120 feet since 1900 as a result of the pumping that has occurred in the area. For the Evangeline aquifer, approximately 20 to possibly 100 feet of potentiometric head decline has occurred since 1900 as the result of the withdrawals of groundwater. The depth interval screened by the large capacity wells in the Lavaca Region normally ranges from about 300 to 600 feet, with some wells' screening depths as deep as 1,200 to 1,400 feet. Static water levels measured in the wells normally range from about 50 to 120 feet. This illustrates that there is a substantial amount of available drawdown in the wells that will continue to sustain the overall pumpage in the LRWPA.

Static (non-pumping) water levels have been measured in wells in Wharton and adjoining counties for decades to help monitor the response of the aquifer to pumpage. The wells screen the Chicot and/or Evangeline aquifers. Water levels have remained relatively stable in the region, with some declines and some increases over the last several decades.

Figure 3-2 and *Figure 3-3* below show the static water level since 2010 for Well 66-53-406 and Well 66-61-302, respectively, in the western part of Wharton County. During the most recent drought (2011-2014), the potential that a prolonged drought combined with potential continued increased pumping in neighboring regions could result in larger water level declines was a cause of concern. These figures show that while water levels in the aquifer in western Wharton County did drop during the drought, the aquifer has recharged itself since 2014 and by 2017-2018 was back to levels similar to those before the drought occurred. In addition, the figures show the seasonal variation in water level on an annual basis.

Figure 3-2
Static Water Levels in West Wharton County (Well 66-53-406)

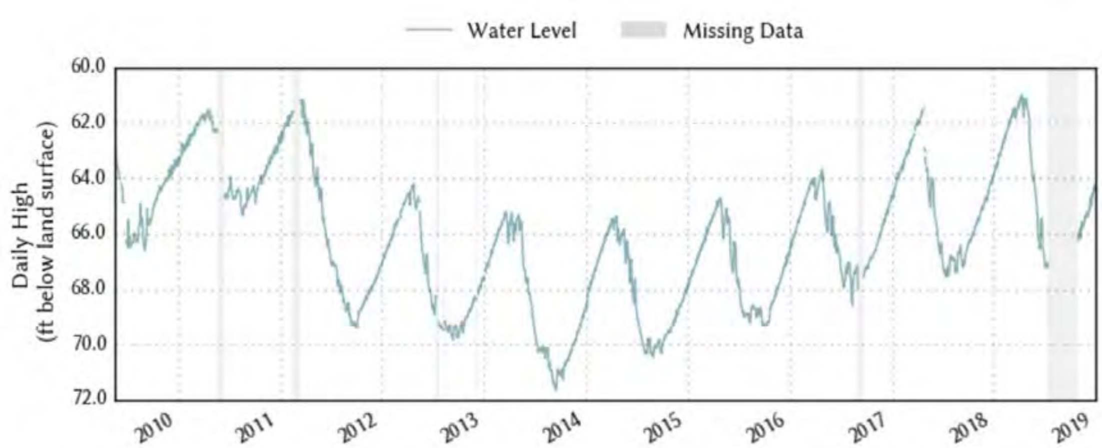
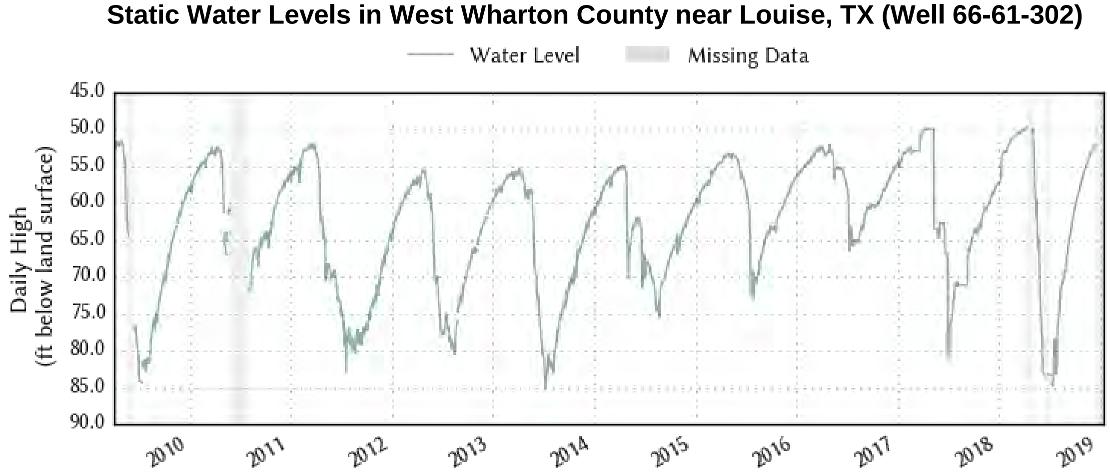


Figure 3-3
Static Water Levels in West Wharton County near Louise, TX (Well 66-61-302)



3.2.4 Groundwater Quality

Water samples have been collected from wells for water chemistry analysis for over 40 years within the LRWPA. Groundwater in the LRWPA is generally of good quality, although test results for some wells have shown tested constituents above the maximum contaminant level. In general, the areas with groundwater quality issues occur in Lavaca County where water demand is lower than the estimates of available groundwater supply. In Jackson and Wharton Counties, data show that the groundwater for large capacity production is of good quality, has not been adversely impacted by past pumping, and should not be adversely impacted by estimated future pumping.

3.2.5 Water Level Monitoring Program for the LRWPA

A Water Level Monitoring Program for the LRWPA was developed as part of the 2006 planning cycle. The Water Leveling Monitoring Program was designed to assess changes in groundwater pumping conditions that occur through the irrigation season. An objective of the study was to estimate the effects that increases in pumpage during the irrigation season could have on water levels in wells and on the pumping rates and pumping lifts of wells. The irrigation and public supply wells located in the study area provide data that reflect the response of the aquifer to the pumping. This information has relevance to the overall pumping costs that agriculture has to shoulder in providing water for irrigated crops and how water levels and pumping rates could change if there were a significant change in groundwater pumping in the region.

A number of conclusions were drawn from data collected as part of the program between its inception in 2001 through the spring of 2005. Results indicated that pumping rates of the large capacity irrigation wells can decline a few hundred gallons per minute during the irrigation season due to static water level decline and resulting in increased pumping lift. In turn, the increased pumping lift through the irrigation season can result in an estimated 10 to 15 percent increase in the cost of pumping water. The data show that the seasonal fluctuations in static water levels in wells were greater in 2002 and 2003 than in 2004 because there was less precipitation and probably higher amounts of pumping in the growing seasons of 2002 and 2003 than during the growing season of 2004. Within the study area, there was a small rise in the static water levels in wells from 2001 through the spring of 2005. The small rise in static water levels probably is the result of less groundwater pumping, particularly in 2004. The static water level fluctuations during the irrigation season normally are greater in the deeper wells that are pumped at higher rates and less in the shallower wells that normally do not have as high pumping rates or total pumped volume.

3.2.6 Subsidence Effects

Land surface subsidence is best described as follows: the artesian pressure within the confining layers of the aquifer keeps the clays fully saturated and at the same pressure as the aquifer sand layers above and below the clay layers. As water is pumped from the sands the pressure is reduced in them and the pressure in the clays begins decreasing as small amounts of water flow from clays to the sands. As water flows from the clays, the clay matrix compresses slightly. This, in turn, results in a small amount of subsidence of the land surface.

Data show that small amounts of land surface subsidence have resulted from the withdrawal of groundwater that helps to support the economic viability of the Lavaca Region. Available data indicate subsidence of up to 1.5 feet in the southeastern part of Jackson County with lesser subsidence in other areas for 1900 through the mid-1970s.[1] Subsidence since the 1970s is estimated to have been relatively minor in the LRWPA.

[1] TWDB Report 289, *Digital Models for Simulation of Groundwater Hydrology of the Chicot and Evangeline Aquifers Along the Gulf Coast of Texas* (May 1985)

3.2.7 Public Supply Groundwater Usage

The Lavaca Region relies on groundwater to provide all of the municipal water supply. This accounts for approximately 4.2 percent, or 8,416 ac-ft of the existing supplies in the LRWPA. Within the LRWPA, Jackson County accounts for approximately 21.7 percent, or 1,827 ac-ft of the region's municipal groundwater usage; Lavaca County accounts for 38.3 percent, or 3,226 ac-ft; and Wharton County accounts for 40.0 percent, or 3,363 ac-ft. There are eleven major municipal users scattered throughout the LRWPA. The major municipal users in Jackson County are Edna, Ganado, and the County-Other category with approximately 48, 13, and 39 percent of the county's municipal groundwater usage, respectively. Municipal users represent water utilities with an annual usage of at least 100 ac-ft/yr or approximately 33 million gallons per year, while County-Other represents water utilities with a usage of less than 100 ac-ft/yr, as well as property owners, parks, campgrounds, and other areas supplied by domestic wells. The major municipal users in Lavaca County are Hallettsville, Moulton, Shiner, Yoakum, and County-Other with approximately 20, 6, 15, 20, and 39 percent of the county's municipal groundwater usage, respectively. The major municipal users in Wharton County are El Campo, Wharton County WCID 1, and County-Other with approximately 75, 6 and 19 percent of the county's municipal groundwater usage, respectively.

3.2.8 Agricultural Groundwater Usage

According to data obtained from the TWDB, pumpage in Wharton County within the LWRPA has averaged more than 80,000 ac-ft/yr since 1967. From 1984 through 2003, pumpage within the region averaged about 99,000 ac-ft/yr with the principal usage being the irrigation of rice. The pumpage for rice irrigation is distributed throughout the region within Wharton County. The location of the region boundary in Wharton County is shown in *Figure 3-1*. This figure also shows the eastern portion of Jackson County which immediately adjoins Wharton County to the southwest.

In 2011, groundwater pumped for agricultural practices, principally irrigation, accounted for approximately 95 percent or 194,150 ac-ft of the groundwater pumped in the Lavaca Region. In terms of the region's total agricultural groundwater pumpage, Jackson County accounted for about 45 percent; Lavaca County, 5 percent; and Wharton County, 50 percent of the groundwater pumped. Agricultural pumpage represents water that is used for livestock purposes and irrigation of crops. Groundwater used for irrigation represented approximately 99 percent of the groundwater pumped for agriculture in the LRWPA. The main crop is rice with smaller acreages of cotton, grain sorghum, soybeans, turfgrass, aquaculture, and corn.

The LRWPA's agricultural irrigated areas are scattered throughout Wharton and Jackson Counties and are concentrated in the southeastern part of Lavaca County. Groundwater pumpage accounted for about 97 percent of the water supplied for irrigated agriculture in 2011. The remainder of the water was provided by surface water from creeks and rivers. Surface water was used in combination with groundwater to irrigate some areas in southern and western Jackson County, and surface water from the Colorado River was used to irrigate about 1,500 acres in the northwestern part of Wharton County.

Projected agricultural irrigation demands for the 2020 through 2070 planning horizon are 78,498 ac-ft/yr for Jackson County, 8,692 ac-ft/yr for Lavaca County, and 88,446 ac-ft/yr for the portion of Wharton County within the LRWPA.

3.3 Groundwater Availability for the Central Gulf Coast Aquifer System

Available groundwater is the volume of groundwater that can be withdrawn from an individual aquifer in accordance with the principle by which the aquifer is being managed or an assumed management approach. That managing principle, typically stated as a sustainability goal, can be stated in various ways, and the mechanism through which availabilities are being stated throughout Texas is evolving.

Before the advent of Groundwater Management Areas (GMAs) (HB 1763, 79th Legislature), an aquifer, or portion of an aquifer, may or may not have had a governmental entity managing the way that aquifer was being managed. If an aquifer, or portion of an aquifer, was managed, it was by a Groundwater Conservation District whose jurisdiction can coincide with the boundary or boundaries of one or more counties or an aquifer. Most aquifers span multiple counties, and in that case the entire aquifer can be managed by one or more GCDs, with some portions not managed at all. GMAs are a different concept in that every county in the State is in one or more of sixteen GMAs, for the most part the major aquifers are not split across multiple GMAs, and the goal is to manage entire aquifer systems across political subdivisions in a consistent way.

The Lavaca Region is within GMA 15. The Groundwater Conservation Districts (GCD) within GMA 15 worked together to determine the desired future condition (DFC) of the Central Gulf Coast Aquifer System. Desired future conditions are essentially management goals for each aquifer. The DFCs for the Central Gulf Coast Aquifer System, adopted by GMA 15 on April 29, 2016, are summarized as follows:

- No more than 13 feet of average drawdown by 2069 relative to 2000 conditions. (all counties)
- Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 15 feet in December 2069 from estimated year 2000 conditions for Jackson County.
- Drawdown of the Gulf Coast Aquifer System shall not exceed an average of 18 feet in December 2069 from estimated year 2000 conditions for Lavaca County.
- Drawdown shall not exceed an average of 15 feet in Chicot and Evangeline Aquifers in December 2069 from estimated year 2000 conditions for Wharton County.

The Texas Water Development Board (TWDB) took the DFC for the aquifer and ran a groundwater availability model (GAM) that converted the DFC into a volume. This volume is considered the modeled available groundwater or MAG. The MAG, which is considered the maximum amount of groundwater available for the regional water planning process from a particular aquifer, is documented in TWDB reports, with the GMA 15 Central Gulf Coast Aquifer System MAG being documented in TWDB report GR 16-025_MAG, dated March 22, 2017. The report provides the MAG values for the Lavaca Region by county and basin, as shown in *Table 3-1*.

Table 3-1 Modeled Available Groundwater (MAG) Volumes for the Gulf Coast Aquifer System in the Lavaca Region (ac-ft/yr)

Region	County	Basin	Year				
			2020	2030	2040	2050	2060
P	Jackson	Colorado-Lavaca	28,025	28,025	28,025	28,025	28,025
		Lavaca	49,582	49,582	49,582	49,582	49,582
		Lavaca-Guadalupe	12,875	12,875	12,875	12,875	12,875
		County Total	***90,482***	***90,482***	***90,482***	***90,482***	***90,482***
P	Lavaca	Guadalupe	41	41	41	41	41
		Lavaca	19,811	19,811	19,811	19,811	19,811
		Lavaca-Guadalupe	401	401	401	401	401
		County Total	***20,253***	***20,253***	***20,253***	***20,253***	***20,253***
P	Wharton	Colorado	873	873	873	873	873
		Colorado-Lavaca	14,091	14,091	14,091	14,091	14,091
		Lavaca	62,992	62,992	62,992	62,992	62,992
		County Total	***77,956***	***77,956***	***77,956***	***77,956***	***77,956***

In the GR16-025 MAG report, MAG values were determined for the years between 2000 and 2069. In the report, the MAG values are shown by Groundwater Conservation District / County out to 2069, but are only shown through 2060 for the MAG values by County and River Basin. *Table 3-1* shows these County/ River Basin MAG values through 2060. The regional water planning period is 2020 – 2070, though, so availability numbers must be shown for 2070 as well. Thus, the 2069 MAG values are used for the 2070 regional water planning decade. In the report, the MAG values for the year 2069 for the Groundwater Conservation Districts in Jackson County and Wharton County are the same as for 2060, but the MAG values for Lavaca County, which has no Groundwater Conservation District, decreases slightly from 2060 to 2069. *Table 3-2* below, shows the resultant availability numbers for the Gulf Coast Aquifer System within the Lavaca Region, which are used for planning purposes. As can be seen in the table, the 2070 availability for the Lavaca River Basin within Lavaca County decreases slightly from 2060 to 2070.

Table 3-2 Lavaca Region Groundwater Availability for the Gulf Coast Aquifer System (ac-ft/yr)

Region	County	Basin	Year					
			2020	2030	2040	2050	2060	2070
P	Jackson	Colorado-Lavaca	28,025	28,025	28,025	28,025	28,025	28,025
		Lavaca	49,582	49,582	49,582	49,582	49,582	49,582
		Lavaca-Guadalupe	12,875	12,875	12,875	12,875	12,875	12,875
		County Total	***90,482***	***90,482***	***90,482***	***90,482***	***90,482***	***90,482***
P	Lavaca	Guadalupe	41	41	41	41	41	41
		Lavaca	19,811	19,811	19,811	19,811	19,811	19,797
		Lavaca-Guadalupe	401	401	401	401	401	401
		County Total	***20,253***	***20,253***	***20,253***	***20,253***	***20,253***	***20,239***
P	Wharton	Colorado	873	873	873	873	873	873
		Colorado-Lavaca	14,091	14,091	14,091	14,091	14,091	14,091
		Lavaca	62,992	62,992	62,992	62,992	62,992	62,992
		County Total	***77,956***	***77,956***	***77,956***	***77,956***	***77,956***	***77,956***

3.4 Identification of Surface Water Sources

The LRWPA is located in the Lavaca, Colorado-Lavaca Coastal, and Lavaca-Guadalupe Coastal River Basins. Approximately 90 percent of the LRWPA is located in the Lavaca River Basin. A portion of the surface water supply is obtained from ROR water out of the Lavaca and Navidad Rivers. These are the two main rivers in the LRWPA. The remaining surface water from sources within the region is obtained from Lake Texana, the only reservoir in the region. Please refer to *Figure 1-2* for the location of major surface water sources. Surface water sources outside of the region include the Colorado River in Region K. A portion of the Garwood Irrigation District is located within the Lavaca Region and receives some surface water supplies from the Colorado River in Region K.

3.4.1 Available Surface Water

Surface water availability was estimated for the 2021 RWP using a modified version of the 2014 TCEQ Water Availability Model (WAM) for the river basins within the LRWPA. The WAMs use the Water Rights Analysis Package (WRAP), developed at Texas A&M University, to simulate authorized diversions under current and future conditions using historical rainfall and evaporation data. Despite the more recent drought, the Drought of Record (DOR) for this region of Texas occurred in the 1950s and is reflected in the historical dataset. Water diversions are modeled according to the parameters of each particular water right and taken in priority order, so that the most senior water rights are satisfied before junior rights are allowed to divert water. Output files are compared by reviewing the statistical frequency of meeting diversion amounts or target instream flow levels. The reliable yield of a water right is the least amount of water diverted among all of the calendar years modeled. For reservoirs, an additional step is required to determine firm yield. Water stored in reservoirs allows diversions to continue during periods of drought; however, diverting at high rates rapidly depletes storage. To find the optimal target for a reservoir, an iterative process is used, modeling the permit first at its full-authorized diversion, and then at reduced target diversions until a yield is identified that is met throughout the simulation period.

There were originally eight WAM scenarios (referred to as model runs) simulated under the TCEQ program. The Guidelines for Regional Water Planning require the use of WAM Run 3, the full-authorized diversion of current water rights with no return flows, when determining the supply available to the region. This is a very conservative approach, since diversions for municipal and manufacturing use typically return up to 60 percent of that water to streams as treated wastewater effluent. However, the majority of water rights do not address return flows to source streams, implying a right to full consumptive use.

In previous planning cycles, the LRWPG has used the TCEQ Lavaca River WAM Run 3 to determine the firm yield of Lake Texana. This cycle, the LRWPG requested TWDB approval to use a modified version of the TCEQ Lavaca River WAM Run 3. The modified model was based on a review of the TCEQ Lavaca River WAM Run 3 performed by Freese & Nichols, Inc. (FNI) in 2016. The review discovered a few issues with the model related to the SB3 pulse flows, consistency with standard Run 3 assumptions, and consistency with water right permit terms. FNI proposed revisions to address the issues, and prepared a memo to TCEQ detailing the revisions. The LRWPG agreed that the revisions create a more accurate model. TWDB approved the LRWPG's request to use the modified model for determining surface water availability in the Lavaca Region. *Appendix 3B* contains the LRWPG hydrologic variance request to TWDB, which includes a description of the modified TCEQ Lavaca WAM Run 3. Appendix 3B also includes the approval letter from TWDB at the front of the appendix.

Run-of-river water from the Lavaca and Navidad Rivers is used primarily for irrigation purposes. No surface water is currently being used within the region for municipal purposes, and only a small amount is used for industrial purposes. *Table 3-3* shows the permitted diversions within the LRWPA. However, these permitted diversion rights in the LRWPA have 0 ac-ft/yr of firm yield under DOR conditions, so there is no supply shown for these diversions in the 2021 Lavaca RWP. Individual water right appropriations of rivers and creeks in the LRWPA are included in *Appendix 3C*.

Table 3-3 Permitted Diversions from LRWPA Rivers and Streams

Stream	Permitted Authorization (ac-ft/yr)
Lavaca River	4,547.5
Navidad River	2,050.0
West Mustang	3,155.0
East Mustang	3,313.0
Sandy Creek	3,023.0
Pinoak Creek	5,007.0
Goldenrod Creek	2,950.0
Sutherland Branch	400.0
Arenosa Creek	10.0
Rocky Creek	33.0
Stage Stand Creek	640.0
Lunis Creek	100.0
Porters Creek	3,306.0
Total	**33,534.5**

Lake Texana is the only reservoir in the LRWPA. It was developed as part of the Palmetto Bend Reclamation Project in 1968. Lake Texana had an original firm yield of 79,000 ac-ft. Of this amount, 4,500 ac-ft of water was reserved for required releases for the bays and estuaries. This brings the available firm yield to 74,500 ac-ft. Projected sedimentation was incorporated into the model runs for 2020-2070, in determining the firm yield of Lake Texana.

The surface water availability for the Colorado River water rights in Region K was determined using the Region K Cutoff Model, which is an approved, modified version of the TCEQ Colorado River WAM. The total availability for the irrigation portion of the Garwood Irrigation Division water right is 100,000 ac-ft. Sixteen percent of the Garwood Irrigation Division is within the Lavaca Region. Therefore, the amount of available surface water from the Colorado River for the Lavaca Region during the DOR is 16,000 ac-ft. The Arbuckle Reservoir, a new source in the 2021 Region K Water Plan, provides additional reliability for the Colorado River during DOR conditions.

3.5 Major Water Providers

The only MWP in the LRWPA is the Lavaca-Navidad River Authority (LNRA), which holds rights to the firm yield of Lake Texana. 31,440 ac-ft of this water is contracted for use by Corpus Christi and its surrounding service area. Another 41,200 ac-ft is contracted for industrial use to Formosa Plastic Corporation, 1,032 ac-ft to Inteplast Corporation, and 594 ac-ft to Calhoun County Navigational District, and 178 ac-ft to the City of Point Comfort. The Inteplast Corporation contract and an expected 10,400 ac-ft of the Formosa Plastic Corporation contract are the only uses of water from Lake Texana that are used within the LRWPA. As additional existing and potential customers develop plans to establish facilities within the LRWPA, LNRA will look at options for creating additional water supplies to meet those new demands. *Chapter 5* discusses the potential water management strategies that could create additional water supplies for LNRA.

A volume of water equal to 4,500 ac-ft is set aside from the firm yield of Lake Texana for environmental flows. Additionally, LNRA releases water from reservoir storage to meet pass through requirements as set forth in an agreement with Texas Parks and Wildlife Department (TPWD). This agreement stipulates freshwater release rates for bay and estuary inflows that are based on historical mean and median monthly streamflows in the Lavaca Basin.

In addition to the firm yield rights listed above, LNRA has a total of 12,000 ac-ft/yr of interruptible water supply from Lake Texana. The majority of this supply is contracted to the City of Corpus Christi. Although this amount is not reliable in DOR conditions, these supplies are available for typical conditions.

3.6 Inter-Regional Coordination

The LRWPG understands that continued coordination with neighboring regional water planning groups is essential to maintaining consistency among the different regions and insuring that supplies and management strategies are properly developed. Based on the coordination that has occurred to date, implementation of water management strategies currently planned for Regions L and N are not expected to impact supplies in the LRWPA.

3.7 Water Supply Allocations

Water supply allocations by WUG, county, and basin are shown in *Appendix 3A*. Existing water supplies determined for WUGs and the major water provider, LNRA, are legally and physically available under DOR conditions. The methodology used for allocating existing water supplies in the 2021 Lavaca RWP involved making minor updates to the existing supply allocation from the 2016 Lavaca RWP, based on the limited growth in the region and the limited impacts on water supplies the recent drought has had. No shortages are projected for Jackson County or Lavaca County. For the Lavaca Region portion of Wharton County, shortages are projected for irrigation in the Lavaca Basin (8,067 ac-ft/yr shortage.) These projected shortages remain constant across the planning horizon

APPENDIX 3A

TWDB DB22 Reports

Region P Source Availability

GROUNDWATERSOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
GULF COAST AQUIFER SYSTEM	JACKSON	COLORADO-LAVACA	FRESH	28,025	28,025	28,025	28,025	28,025	28,025
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA	FRESH/ BRACKISH	49,582	49,582	49,582	49,582	49,582	49,582
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA-GUADALUPE	FRESH	12,875	12,875	12,875	12,875	12,875	12,875
GULF COAST AQUIFER SYSTEM	LAVACA	GUADALUPE	FRESH	41	41	41	41	41	41
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA	FRESH	19,811	19,811	19,811	19,811	19,811	19,811
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA-GUADALUPE	FRESH	401	401	401	401	401	401
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO	FRESH	873	873	873	873	873	873
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO-LAVACA	FRESH	14,091	14,091	14,091	14,091	14,091	14,091
GULF COAST AQUIFER SYSTEM	WHARTON	LAVACA	FRESH	62,992	62,992	62,992	62,992	62,992	62,992
GROUNDWATERSOURCE AVAILABILITY TOTAI				**188,691**	**188,691**	**188,691**	**188,691**	**188,691**	**188,691**

SURFACE WATER SOURCE TYPE				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY ***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
TEXANA LAKE/RESERVOIR	RESERVOIR**	LAVACA	FRESH	74,500	74,500	74,500	74,500	74,500	74,500
SURFACE WATER SOURCE AVAILABILITY TOTAI				**74,500**	**74,500**	**74,500**	**74,500**	**74,500**	**74,500**

REGION P SOURCE AVAILABILITY TOTAI	**263,191**	**263,191**	**263,191**	**263,191**	**263,191**	**263,191**

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

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

Region P Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	331	331	331	331	331	331
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	10,549	10,627	10,627	10,627	10,627	10,627
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	10	10	10	10	10	10
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	415	415	415	415	415	415
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	22,372	22,372	22,372	22,372	22,372	22,372
		COLORADO-LAVACA BASIN TOTAL	**33,677**	**33,755**	**33,755**	**33,755**	**33,755**	**33,755**
EDNA	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	1,281	1,281	1,281	1,281	1,281	1,281
GANADO	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	340	340	340	340	340	340
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	602	602	602	602	602	602
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	146	147	147	147	147	147
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	41	41	41	41	41	41
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	1,289	1,289	1,289	1,289	1,289	1,289
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	45,136	45,136	45,136	45,136	45,136	45,136
		LAVACA BASIN TOTAL	**48,835**	**48,836**	**48,836**	**48,836**	**48,836**	**48,836**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	71	71	71	71	71	71
MANUFACTURING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	50	50	50	50	50	50
MANUFACTURING	P	TEXANA LAKE/RESERVOIR	179	181	181	181	181	181
MINING	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	22	22	22	22	22	22
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	178	178	178	178	178	178
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	10,990	10,990	10,990	10,990	10,990	10,990
		LAVACA-GUADALUPE BASIN TOTAL	**11,490**	**11,492**	**11,492**	**11,492**	**11,492**	**11,492**
		JACKSON COUNTY TOTAL	**94,002**	**94,083**	**94,083**	**94,083**	**94,083**	**94,083**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	4	4	4	4	4	4
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	37	37	37	37	37	37
		GUADALUPE BASIN TOTAL	**41**	**41**	**41**	**41**	**41**	**41**
HALLETTSVILLE	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	846	846	846	846	846	846
MOULTON	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	234	234	234	234	234	234
SHINER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	641	641	641	641	641	641
YOAKUM*	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	860	860	860	860	860	860
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	1,611	1,611	1,611	1,611	1,611	1,611
MANUFACTURING	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	625	625	625	625	625	625
MINING	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	2,544	2,544	2,544	2,544	2,544	2,544
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	3,650	3,650	3,650	3,650	3,650	3,650
IRRIGATION	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	8,692	8,692	8,692	8,692	8,692	8,692
		LAVACA BASIN TOTAL	**19,703**	**19,703**	**19,703**	**19,703**	**19,703**	**19,703**
COUNTY-OTHER	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	1	1	1	1	1	1
LIVESTOCK	P	GULF COAST AQUIFER SYSTEM | LAVACA COUNTY	76	76	76	76	76	76
		LAVACA-GUADALUPE BASIN TOTAL	**77**	**77**	**77**	**77**	**77**	**77**
		LAVACA COUNTY TOTAL	**19,821**	**19,821**	**19,821**	**19,821**	**19,821**	**19,821**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	347	347	347	347	347	347
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	31	31	31	31	31	31
		COLORADO BASIN TOTAL	**378**	**378**	**378**	**378**	**378**	**378**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	2,125	2,125	2,125	2,125	2,125	2,125
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	134	134	134	134	134	134
MANUFACTURING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	34	34	34	34	34	34
MINING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	6	6	6	6	6	6
LIVESTOCK*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	184	184	184	184	184	184
IRRIGATION*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	4,858	4,858	4,858	4,858	4,858	4,858

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

Region P Water User Group (WUG) Existing Water Supply

WUG NAME	SOURCE REGION	SOURCE DESCRIPTION	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
		COLORADO-LAVACA BASIN TOTAL	**7,341**	**7,341**	**7,341**	**7,341**	**7,341**	**7,341**
EL CAMPO*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	61	61	61	61	61	61
WHARTON COUNTY WCID 1	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	213	213	213	213	213	213
COUNTY-OTHER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	452	452	452	452	452	452
MINING*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	13	13	13	13	13	13
STEAM ELECTRIC POWER*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	2,060	2,060	2,060	2,060	2,060	2,060
LIVESTOCK*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	650	650	650	650	650	650
IRRIGATION*	K	COLORADO RUN-OF-RIVER	16,000	16,000	16,000	16,000	16,000	16,000
IRRIGATION*	P	GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	59,521	59,521	59,521	59,521	59,521	59,521
		LAVACA BASIN TOTAL	**78,970**	**78,970**	**78,970**	**78,970**	**78,970**	**78,970**
		WHARTON COUNTY TOTAL	**86,689**	**86,689**	**86,689**	**86,689**	**86,689**	**86,689**
		REGION P EXISTING WATER SUPPLY TOTAL	**200,512**	**200,593**	**200,593**	**200,593**	**200,593**	**200,593**

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

Region P Source Water Balance (Availability - WUG Supply)

GROUNDWATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
GULF COAST AQUIFER SYSTEM	JACKSON	COLORADO-LAVACA	FRESH	4,897	4,897	4,897	4,897	4,897	4,897
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA	FRESH/ BRACKISH	893	893	893	893	893	893
GULF COAST AQUIFER SYSTEM	JACKSON	LAVACA-GUADALUPE	FRESH	1,564	1,564	1,564	1,564	1,564	1,564
GULF COAST AQUIFER SYSTEM	LAVACA	GUADALUPE	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA	FRESH	108	108	108	108	108	108
GULF COAST AQUIFER SYSTEM	LAVACA	LAVACA-GUADALUPE	FRESH	324	324	324	324	324	324
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO	FRESH	842	842	842	842	842	842
GULF COAST AQUIFER SYSTEM	WHARTON	COLORADO-LAVACA	FRESH	6,279	6,279	6,279	6,279	6,279	6,279
GULF COAST AQUIFER SYSTEM	WHARTON	LAVACA	FRESH	83	83	83	83	83	83
GROUNDWATER SOURCE WATER BALANCE TOTAL				**14,990**	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**

SURFACE WATER SOURCE TYPE				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SOURCE NAME	**COUNTY**	**BASIN**	**SALINITY***	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
TEXANA LAKE/RESERVOIR	RESERVOIR**	LAVACA	FRESH	0	0	0	0	0	0
SURFACE WATER SOURCE WATER BALANCE TOTAL				**0**	**0**	**0**	**0**	**0**	**0**

REGION P SOURCE WATER BALANCE TOTAL	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**	**14,990**

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

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

APPENDIX 3B

Modified TCEQ Lavaca River WAM Run 3

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

July 20, 2018

The Honorable Phillip Spenrath
Region P RWPG Chair
c/o Lavaca-Navidad River Authority
P.O. Box 429
Edna, TX 77957

RE: Region P Regional Water Planning Group (RWPG) request for approval to modify surface water availability hydrologic assumptions for development of the 2021 Region P Regional Water Plan (RWP)

Dear Judge Spenrath:

The Texas Water Development Board (TWDB) has reviewed your request dated June 21, 2018 for approval of alternative water supply assumptions to be used in determining surface water availability. This letter confirms that the TWDB approves the use of the proposed Freese & Nichols, Inc modified version of the Texas Commission on Environmental Quality (TCEQ) Lavaca Water Availability Model (WAM) RUN3 for existing supply analysis.

Region P also requested to use the modified Lavaca WAM RUN3 for water management strategy evaluations. While the use of these modified conditions may be reasonable for planning purposes, WAM RUN3 would be utilized by the TCEQ for analyzing permit applications. It is acceptable to use modified conditions for water management strategy supply evaluations only if the yield produced is more conservative for surface water appropriations than WAM RUN3. However, TWDB is of the understanding that the modified conditions would result in greater yields than WAM RUN3. Strategy evaluations involving new surface water appropriations must be based on WAM RUN3.

While the TWDB authorizes this modification to evaluate existing water supplies for development of the 2021 Region P RWP, it is the responsibility of the RWPG to ensure that the resulting estimates of water availability are reasonable for drought planning purposes and will reflect conditions expected in the event of actual drought conditions; and in all other regards will be evaluated in accordance with the contract Exhibit C, *Second Amended General Guidelines for Fifth Cycle of Regional Water Plan Development.*

If you have any questions, please do not hesitate to contact Elizabeth McCoy, project manager for Region P, at 512-475-1852 or via email at elizabeth.mccoy@twdb.texas.gov.

Sincerely,

Jeff Walker
Executive Administrator

c: Mr. Patrick Brzozowski, Lavaca-Navidad River Authority
Ms. Karen Gregory, Lavaca-Navidad River Authority
Ms. Jaime Burke, AECOM, Inc.
Ms. Elizabeth McCoy, TWDB

LAVACA REGIONAL WATER PLANNING GROUP

P.O. Box 429 Edna, Texas 77957
Phone: 361-782-5229 Fax: 361-782-5310

June 21, 2018

Mr. Jeff Walker
Executive Administrator
Texas Water Development Board
P.O. Box 13231
1700 North Congress Avenue
Austin, Texas 78711-3231

Subject: Request by the Lavaca Regional Water Planning Group (Region P) to use a modified TCEQ WAM Run 3 for surface water availability modeling in the 2021 Lavaca Regional Water Plan development (Hydrologic Variance Request)

Dear Mr. Walker:

On June 18, 2018, the Lavaca Regional Water Planning Group (Region P) authorized submitting this request to you for approval to use a modified version of the TCEQ Lavaca WAM Run 3 Model (version date of 9/2/2014) in determining availability of surface water resources for development of the 2021 Lavaca Regional Water Plan (RWP). This request to use the modified model is for both surface water supply availability and for evaluating water management strategies. For water management strategies requiring a new water right appropriation, if the modified model is not accepted by TCEQ during the current planning cycle, the unmodified TCEQ Lavaca WAM Run 3 model will be used per TWDB requirements.

This request is based on a review of the Lavaca River WAM Run 3 model, version date of 9/2/2014, which Freese & Nichols, Inc. (FNI) performed in 2016. The WAM had been updated by TCEQ in 2014 to include new code for modeling the Senate Bill 3 (SB3) environmental flows. During the review, FNI observed a few issues with the model related to the SB3 pulse flows, consistency with standard Run 3 assumptions, and consistency with water right permit terms. FNI proposed revisions to address the issues and prepared a memo to TCEQ detailing the revisions. The FNI memo is included as Attachment A to the request. Region P agrees that these revisions create a more accurate model.

TCEQ has reviewed the proposed revisions from FNI, but they have not yet made the revisions to the TCEQ model and adopted it. A summary of the proposed revisions to the TCEQ Lavaca WAM Run 3 includes:

1. Several changes to the existing code used to model SB3 pulse flow requirements in the Lavaca WAM.
2. Addition of missing SB3 pulse flow code for the Navidad River at Strane Park near Edna.

3. Revisions to Lake Texana SV SA records

    - These records will also then update for 2020-2070 sedimentation for regional water planning analysis, as required by TWDB guidelines.

4. Addition of a synthetic primary control point to correct a naturalized flow calculation.

5. Revisions to modeling of Lake Texana interruptible diversions

    - 3 authorizations split out rather than lumped under one diversion
    - Include annual diversion limit (simplifies the coding)
    - Pattern change to allow more water to be diverted in the last three months of the year (if available)

6. Revisions to Stage 2 of the Palmetto Bend Project location and SV SA records to model it as described in COA 16-2095.

The FNI modified model and the TCEQ WAM Run 3 were both adjusted for 2020-2070 sedimentation and run to see how the surface water available supply results compared for the two model versions.

There was no change to the firm availability of the interruptible water rights – they remained at 0 acre-feet/ year for both model versions for all decades.

In the FNI modified model, the firm yield of Lake Texana was 74,500 acre-feet/year for all decades. In the TCEQ WAM Run 3, the firm yield of Lake Texana was 74,500 acre-feet/year for the 2020 decade but decreases each decade down to 73,290 acre-feet/year by 2070, due to sedimentation.
Overall, the use of the modified model increases the firm yield availability of Lake Texana in the 2030-2070 decades.

Region P believes the modifications to the TCEQ Lavaca WAM Run 3 listed above create a more accurate model for use in analyzing surface water availabilities. We respectfully request to use this modified version of the TCEQ Lavaca WAM Run 3 Model (version date of 9/2/2014) in determining availability of surface water resources for development of the 2021 Lavaca Regional Water Plan (RWP). We appreciate your consideration of this request. Should you have any questions regarding this submittal, please contact our Consultant, Jaime Burke, via phone at (512) 457-7798 or via email at jaime.burke@aecom.com.

Sincerely,

Phillip Spenrath, Chairman
Lavaca Regional Water Planning Group

Enclosures: Attachment A – FNI Memo to TCEQ

C: Ms. Elizabeth McCoy, TWDB (electronically)

Region P Hydrologic Variance Request
Attachment A

MEMORANDUM

FREESE AND NICHOLS

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TO: Kathy Alexander, TCEQ

CC: Patrick Brzozowski, Bill Dugat, Doug Caroom

FROM: Philip Taucer, Jon Albright

SUBJECT: Proposed Revisions to Lavaca and Lavaca-Guadalupe WAMs

DATE: March 29, 2016

PROJECT: LVA15590

Freese and Nichols, Inc. (FNI) has performed a review of the most recent available Run 3 Water Availability Models (WAMs) for the Lavaca River Basin and Lavaca-Guadalupe Coastal Basin. The Lavaca WAM, with a version date of 9/2/2014, was obtained from the TCEQ website and includes new code for modeling of Senate Bill 3 (SB3) environmental flows. TCEQ provided FNI with a draft WAM Run 3 for the Lavaca-Guadalupe Coastal Basin, with a version date of 7/30/2015. The results of the model review indicated a number of opportunities to enhance the model. The identified issues are related primarily to SB3 pulse flows, consistency with standard Run 3 assumptions, and consistency with water right permit terms. Proposed revisions to address these issues are discussed in greater detail in the sections below.

Revisions of Existing Senate Bill 3 WRAP Code

FNI proposes several changes to the existing code used to model SB3 pulse flow requirements in the Lavaca WAM. During a review of model results, it was observed that the target volume of small pulses for the Lavaca River near Edna occasionally differed from expected values. It was determined that the CI record which sets the duration for this pulse differed from the values specified in *Title 30, Texas Administrative Code, Chapter 298 (30 TAC §298)* for the Fall season. The following revision is proposed:

```
CILESPND       6         6         7         7         7         7
CI             4         4         6         6         6         6
```

A similar issue was identified with the CI record setting the large pulse duration for Sandy Creek near Ganado. The following revision is proposed:

```
CISGLPND       8         8        10        10        10        10
CI             7         7         7         7         7         8
```

It was also observed that the target volume of the annual pulse for all SB3 locations in the model intermittently differed from expected values. It was determined that a TO record within the annual pulse calculation for each SB3 location was referencing records for the large pulse. The proposed revision for the Lavaca River near Edna is shown below. Similar charges are also recommended for the other three SB3 locations.

```
WRFKLE03          XMONTH20110301                                    BF-LEB-AP1
TO      2            ADD                  DAYSPY                          CONT
TO      2            SUB                  LEAPND
```

Additions to Senate Bill 3 WRAP Code: Lavaca WAM

The existing Lavaca WAM does not include SB3 pulse flow code for the Navidad River at Strane Park near Edna (USGS Gage 08164390) as described by *30 TAC §298.330(e)(16)*. While the exclusion of SB3 code for this point does not appear to impact regulated flows in the existing model due to the junior priority of the SB3 code, there is the potential for impacts to future appropriations with a more junior priority date. FNI has generated additional code to model the SB3 pulse flow requirements at this location. The proposed code closely follows the approach applied by the existing Lavaca WAM for the other SB3 locations. The following changes were made to the model code:

1. Control point connectivity in the DAT file was modified to add a new control point (GSNE1) at the SB3 location as well as associated dummy control points for pulse flow calculations.

```
**CP RF502   DV501                          7            GS500      -1
CP RF502   GSNE1                          7            GS500      -1
CP GSNE1  NESUBS                          7            GS500      -1
CPNESUBS  NEBASE                          7            GS500      -1
CPNEBASE  NESPUL                          7            GS500      -1
CPNESPUL  NELPUL                          7            GS500      -1
CPNELPUL  NEAPUL                          7            GS500      -1
CPNEAPUL   DV501                          7            GS500      -1
```

2. FD and WP records for these additional control points were also added to the DIS file. The drainage area reflected on the WP records was set to match the contributing area listed for USGS Gage 08164390. Remaining properties listed on the WP records were copied from control point RF502.

```
FD GSNE1   GS500       1   GS550  GS1000
FDNESUBS   GS500       1   GS550  GS1000
FDNEBASE   GS500       1   GS550  GS1000
FDNESPUL   GS500       1   GS550  GS1000
FDNELPUL   GS500       1   GS550  GS1000
FDNEAPUL   GS500       1   GS550  GS1000

WP GSNE1  579.00   70.73   39.69     1.0
WPNESUBS  579.00   70.73   39.69     1.0
WPNEBASE  579.00   70.73   39.69     1.0
WPNESPUL  579.00   70.73   39.69     1.0
WPNELPUL  579.00   70.73   39.69     1.0
WPNEAPUL  579.00   70.73   39.69     1.0
```

3. UC records for pulse volumes were also added.

```
** NE UCs
UC NESUB      61      56     172     167     172     167     =     1401
UC            74      74     131     135     131      61
UC NEDRY     861     784    1107    1071    1107    1071     =    12883
UC          1476    1476    1012    1045    1012     861
UC NEAVG    2152    1961    2152    2083    2152    2083     =    26833
UC          2890    2890    2083    2152    2083    2152
UC NEWET    4366    3978    4366    4225    4366    4225     =    53038
UC          5165    5165    4225    4366    4225    4366
```

4. Other changes associated with the addition of this SB3 location included addition of dummy CP and CI records to facilitate calculations as well as the WR and IF records used to set pulse targets. These changes are not included in this section due to their length, but are included in ***Attachment A***.

5. Hydrologic conditions for SB3 pulse flow modeling are determined through the HIS file included with the existing Lavaca WAM. Per *30 TAC §298.320(d)*, the seasonal hydrologic conditions in the Lavaca River Basin are a function of reservoir elevation in Lake Texana at the end of the preceding season. However, an estimate of hydrologic condition based on the SV and SA records and modeled storage from the existing WAM results in hydrologic conditions which differ from the HIS file in approximately 40 percent of seasons. Because the SB3 code is currently the most junior in the model, this assumption does not appear to impact regulated flows in the existing model. However, modeled hydrologic conditions could impact future appropriations with a more junior priority date. TCEQ may wish to consider use of an updated HIS file generated from modeled reservoir storage from the WAM, inclusive of any other model revisions incorporated by TCEQ. Alternately, the model code could be modified to dynamically calculate hydrologic condition without the need for an HIS file.

Additions to Senate Bill 3 WRAP Code: Lavaca-Guadalupe WAM

The existing Lavaca-Guadalupe WAM does not include SB3 pulse flow code for Garcitas Creek near Inez (USGS Gage 08164600) as described by *30 TAC §298.330(e)(20)*. While the exclusion of SB3 code for this point does not appear to impact regulated flows in the existing model due to the junior priority of the SB3 code, there is the potential for impacts to future appropriations with a more junior priority date. FNI has generated additional code to model the SB3 pulse flow requirements at this location. The proposed code closely follows the approach applied by the existing Lavaca WAM for SB3 locations. The following changes were made to the model code:

1. Control point connectivity in the DAT file was modified to add dummy control points for pulse flow calculations.

```
**CPGS1200  CB1190                         1
CPGS1200   GSGC1                         1
CP GSGC1  GCSUBS                         7           GS1200      -1
CPGCSUBS  GCBASE                         7           GS1200      -1
CPGCBASE  GCSPUL                         7           GS1200      -1
CPGCSPUL  GCLPUL                         7           GS1200      -1
CPGCLPUL  GCAPUL                         7           GS1200      -1
CPGCAPUL  CB1190                         7           GS1200      -1
CPDAYSPY     OUT                         2    ZERO    ZERO
```

2. FD and WP records for these additional control points were also added to the DIS file. The parameters on the WP records were set to match the contributing area listed for control point GS1200, the primary control point which represents USGS Gage 08164600.

```
FD GSGC1  GS1200
FDGCSUBS  GS1200
FDGCBASE  GS1200
FDGCSPUL  GS1200
FDGCLPUL  GS1200
FDGCAPUL  GS1200

WP GSGC1   97.36   63.90   38.35     1.0
WPGCSUBS   97.36   63.90   38.35     1.0
WPGCBASE   97.36   63.90   38.35     1.0
WPGCSPUL   97.36   63.90   38.35     1.0
WPGCLPUL   97.36   63.90   38.35     1.0
WPGCAPUL   97.36   63.90   38.35     1.0
```

3. UC records for pulse volumes were also added.

```
** GC UCs
UC GCSUB      61      56      61      60      61      60      =      723
UC            61      61      60      61      60      61
UC GCDRY     123     112     123     119     123     119      =     1145
UC            61      61      60      61      60     123
UC GCAVG     246     224     246     238     246     238      =     2291
UC           123     123     119     123     119     246
UC GCWET     430     392     430     417     430     417      =     3856
UC           184     184     179     184     179     430
```

4. Because a HIS file is not included as part of the existing Lavaca-Guadalupe WAM, hydrologic conditions were assumed to mirror the Lavaca River Basin; therefore, the HIS file for the Lavaca WAM was applied for the Lavaca-Guadalupe WAM as well. Because the SB3 code is currently the most junior in the model, this assumption does not appear to impact regulated flows in the existing model. However, modeled hydrologic conditions could impact future appropriations with a more junior priority date. Potential alternative approaches which TCEQ may wish to consider include using a basin-specific HIS file generated from modeled naturalized flows or modification of model code to dynamically calculate hydrologic condition without the need for an HIS file.

5. Other changes associated with the addition of this SB3 location included addition of dummy CP and CI records to facilitate calculations as well as the WR and IF records used to set pulse targets. These changes are not included in this section due to their length, but are included in ***Attachment B***.

Revisions to Lake Texana SVSA Records

The SV and SA records included in the Lavaca WAM for Lake Texana do not follow the standard Run 3 assumption of original surveyed area and capacity. While the reservoir began impounding flows in 1980, the SVSA records primarily reflect measurements from a year 2000 survey of the lake by the Texas Water Development Board (TWDB). TWDB data is used up to the conservation elevation of 44 feet above mean sea level (ft msl), with an additional pair of area and capacity values corresponding to the authorized storage of 170,300 ac-ft at an assumed elevation of 45 ft msl. In addition to departing from Run 3 assumptions, this potentially introduces inconsistencies into a) the modeling of reservoir operation, as bay and estuary release requirements for the lake as specified in Certificate of Adjudication (COA) 16-2095B are contingent on a percentage of storage capacity, b) the frequency and reliability of interruptible diversions from Lake Texana and c) with the operation of upstream junior irrigators that can only divert when Texana is above 43 feet.

FNI recommends use of the authorized area and capacity dataset from the Texas Department of Water Resources (TWDR) year 1984 operational analysis of Lake Texana to improve consistency with standard Run 3 assumptions. In order to confirm the reasonableness of the TDWR dataset as a representation of original reservoir conditions, the survey data and calculated sedimentation rate from TWDB's year 2010 *Volumetric and Sedimentation Survey of Lake Texana* report were used to estimate year 1980 reservoir storage. The calculated original storage based on the sedimentation in the 2010 survey is approximately 171,100 ac-ft at elevation 44 ft msl, which is very close to the authorized storage capacity of 170,300 ac-ft.

Updated model code was developed to implement this revised storage data. The following changes were made to the model code:

1. The SV and SA records from the existing WAM were replaced with values representing TDWR data.

```
SVTEXANA       0     480    2950    9190   21420   40060   64210   94790  132820  170300  180840
SATEXANA       0     190     790    1700    3190    4270    5390    6840    8370   10370   10880
```

2. A minor adjustment was made to the WS record for the non-interruptible diversion from Lake Texana to reflect updated storage parameters. The TDWR storage-area tables did not have the corresponding elevations. By back-calculating the incremental elevation between storage/area values for the 9th and 10th entries in the SV/SA records, it was determined that the elevation corresponding with storage 132,820 ac-ft was 4 feet lower than the elevation at 170,300 ac-ft. Assuming that the maximum storage is at elevation 44 feet, then the elevation at 132,820 ac-ft was at 40 feet. With these two points, the storage at elevation 43 feet could be calculated (160,930 acre-feet).

```
WRDV221A   74500      TA19720515   1   1                                 C2095_1 TEXANA1
WSTEXANA  160930
```

3. Adjustments were made to DI records to reflect updated storage parameters.

```
** DROUGHT INDEX RECORDS for B&E when below 78.18% conservation
DI     1   0   1  TEXANA
IS     6       0   10000  100000  133140  133141  170301
IP           100     100     100     100       0       0
**
** DROUGHT INDEX RECORDS for B&E when above 78.18% conservation
DI     2   0   1  TEXANA
IS     6       0   10000  100000  133140  133141  170301
IP             0       0       0       0     100     100
**
** DROUGHT INDEX RECORDS water rights that have the 43 ft msl restriction.
DI     3   0   1  TEXANA
IS     6       0   10000  100000  160930  160931  170300
IP             0       0       0       0     100     100
```

Addition of Synthetic Primary Control Point

The original Lavaca WAM uses flows at control point GS500 (USGS Gage 08164500, Navidad River near Ganado) to estimate flows at control point EP000, the mouth of the Lavaca River. As a result, in approximately 26 percent of the months the naturalized flow at the mouth was less than the combined naturalized flow from the upstream primary control points GS500, GS300 (USGS Gage 08164000, Lavaca River near Edna) and WGS800 (USGS Gage 08164503, West Mustang Creek near Ganado). A summary of naturalized flows for these points from the existing Lavaca WAM is included in ***Attachment C***. Because the naturalized flow calculation for EP000 is solely based on GS500, whenever flow at GS500 is zero, flow at EP000 is also modeled as zero even though there are flows shown from the Lavaca River and West Mustang Creek. It does not seem reasonable to assume that these flows are lost prior to entering the bay. These observations indicate that the naturalized flow methodology applied for EP000 in the existing model is not a reliable approach.

WRAP is unable to directly calculate incremental flows below multiple primary control points. Therefore, FNI recommends addressing this issue by treating EP000 as a primary model control point with naturalized flows synthesized externally from naturalized flows at the other primary control points. FNI calculated new naturalized flows at EP000 using the total flow at GS500, GS300, and WGS800 multiplied by the ratio of the drainage areas found in the DIS file (2,322.46 divided by 822.05 + 1058.52+ 167.53 equals 1.134). This is consistent with the method used by WRAP to calculate naturalized flows at secondary control points between primary control points. This is also consistent with a number of other WAMs which have synthetic flows at the outlet point of the model.

The following proposed code changes implement the new naturalized flows at the mouth.

1. A modified CP record changes EP000 from a secondary to a primary control point.

```
CP EP000     OUT                         1           GS300       0
```

2. The following IN records were added to the INF file.

```
IN EP000    1940  2090.7 26948.5  5332.9  3707.4  7929.7 23720.6639742.9  7358.4  4238.2 41153.7728331.6347518.9
IN EP000    1941119749.2 72502.6221902.4269463.5438255.8291206.0139189.6 51369.0 18366.7 67584.4 65360.1 25033.9
IN EP000    1942 10873.5 14823.0 15068.6174049.1 15590.5 13164.0221570.7 14218.5 43974.3 15073.0 25871.1 15765.1
IN EP000    1943 30324.2 10251.7 59369.1  9478.6 30296.5 16451.4 24444.6  9659.1  7135.7  5978.3 50465.5 76706.4
IN EP000    1944192479.2 43633.8307243.9 19213.7178756.1 20630.3 11070.0  7742.1 36672.3  7857.2 33994.9 81711.6
IN EP000    1945 82422.6 27362.0 20095.6210268.9 11194.8 15455.9  9637.9 43345.7 12651.5 16381.5  5450.9 17978.3
IN EP000    1946 48893.2115426.4 69399.5 28169.3 71036.8234881.2 34622.0 88200.0226323.3184951.0145143.6 32193.2
IN EP000    1947154774.4 16801.3 38700.4 26285.7110784.0  8516.0  9493.2  8734.9  7708.8  3264.7  8773.4 19871.8
IN EP000    1948 24928.4 55144.5 45498.8  9122.1151905.6  6450.6 12879.7   803.1  9609.7  2468.3  4834.1  2689.3
IN EP000    1949  5213.7 53345.4 28429.2218539.8 29374.6  6545.3 17822.1 15598.8 11826.1191600.5 11652.3105499.5
IN EP000    1950 45526.4 34829.1  7269.0 27761.3 11201.0 75919.3  6830.1   342.3  8421.1  2466.8  2947.3  2123.8
IN EP000    1951  1693.2  2992.1  6635.2  4229.2  3836.5 86156.3  2251.9     0.0 36705.4  9784.6  4859.0  2814.3
IN EP000    1952  1272.4 10829.9  5277.3 88717.3219581.3 33196.6  4978.0  1466.3  7287.6  1879.6 52075.0 87359.8
IN EP000    1953 12117.8 13125.6  5145.4  6476.6161518.8  2339.5  6572.5 53183.7 75035.9  5872.3  5267.8  7810.6
IN EP000    1954  1952.6  2317.7  1726.7  7664.9 12569.4   261.3  1796.8   206.7  1351.5  2709.7  2318.0   696.7
IN EP000    1955  1514.7103160.7  1690.8  5037.7 99206.5 19019.4  2756.9 15006.1 20370.2 14653.6  2335.8   887.7
IN EP000    1956   872.8  8022.8   640.3  2882.3  2916.2     0.0  3186.9     0.0    73.4   765.9  2341.3  6614.9
IN EP000    1957     0.9 14443.7122317.2250494.9140918.8126944.7  3055.9   171.3 45338.0358842.1207530.9 19566.8
IN EP000    1958135682.4188849.9 23429.6 12069.5 68970.9  2500.0 20515.6  1000.7 70343.1 38097.8 21122.1 42542.4
IN EP000    1959 22238.7238171.0 17788.6305689.5 61885.7 76755.8 11524.5 22639.8 18217.5 92510.7 66779.8 65386.0
IN EP000    1960 59319.2 65915.7 16462.4 27904.0 38350.7349034.7 60992.7138141.0 22064.1482953.4181637.3132192.7
IN EP000    1961198123.5292766.8 27028.5 18377.4 15580.0285187.3126135.2 11538.7464724.2 21677.3160588.1 17203.4
IN EP000    1962 15002.3 16393.5 11177.0 90558.7 21379.0 43665.1 18479.3  1535.0 27730.0  8287.5  5637.8 19793.0
IN EP000    1963 26036.7 43530.2  6719.4  4849.4  8537.3  6686.5 27990.2   402.1  1914.7  2698.9 11397.9 20413.1
IN EP000    1964  5777.1 26369.1 18700.1  8928.6  5252.2 53428.0  6460.8  2753.1 48196.4 13189.9  6901.4  2766.0
IN EP000    1965 90378.1123659.3 10040.4 11646.4315458.4 98309.8 11985.0  2479.3 11670.5 26637.4171274.1 61713.6
IN EP000    1966 37240.7 72822.2 38400.9111372.3193786.9 43374.0 23390.3 17586.8 13956.1  8786.1  4237.3  3521.2
IN EP000    1967  4355.9  3486.5  3476.6 14801.6 11547.7  1248.3  4021.8 19288.6394597.4143305.0 13450.2  6288.0
IN EP000    1968305217.7 29962.2 29329.6 36123.0255916.9518567.1 59057.9  8982.4 29754.6 22864.0 18104.6 54656.8
IN EP000    1969 31532.4222380.2146490.6224752.8269762.7 17396.5  6318.4  2849.1 17209.1 26800.1 16911.4 58847.9
IN EP000    1970 58130.4 10424.1109639.7 18254.2246297.4 70845.1 19730.1  4315.2107681.7126512.2 10030.1  5474.8
IN EP000    1971  4215.4  6386.1  4739.3  7928.5  8050.4  6141.6  4443.0 93715.6243004.1103831.3 11636.5116313.2
IN EP000    1972 65627.5107044.4 36413.9 11194.7546948.0 79854.1 32928.9 19686.1 15013.3 10059.1 10215.5  5319.6
IN EP000    1973 19070.7 40148.1209229.9478659.4 92606.4965679.3 72542.7 41403.8130105.4300523.6 51277.0 23646.9
IN EP000    1974245445.4 36674.6 22707.2 34417.9110405.7126901.7 14974.3 23001.3407122.6 34066.7169927.2 65183.6
IN EP000    1975 36303.3 28911.2 13747.2 90101.3326517.0124750.9 80591.8 26107.5 26662.0 17822.1  9016.7 61034.4
IN EP000    1976  7298.4  6679.1  7103.1 81499.4128432.6 76227.6 66206.3  3237.2  9048.0113943.6 61646.5409538.6
IN EP000    1977 58199.4179226.4 22486.5197443.5 33108.4 74756.9 17937.5  2904.3  6001.7  6004.2 38806.0  5296.4
IN EP000    1978 73279.9 46725.7 12182.9 37054.7  2787.8 39600.0 15851.0  1189.7504590.6 22795.3 33865.3 16854.2
IN EP000    1979328344.8154065.5 78472.6222374.2379935.2155362.5 36208.6  8068.9270814.4  6017.8  8093.1 11959.2
IN EP000    1980214429.4 37071.7 11002.6 10382.5154725.0  7463.9 13796.8  2121.1  9100.2 33266.1  5917.1  8184.3
IN EP000    1981  9053.4  6998.0 11409.7 35901.3 68242.0416622.0 76587.9 58141.3476075.5 81384.2347454.1 26581.1
IN EP000    1982  9603.4 82802.1 25832.0 27558.2520352.9 19251.3 20748.4  1958.7  7943.3 12730.0192815.5 16414.4
IN EP000    1983 73316.0205624.4185353.8 34821.1 62308.9 16195.3111186.2 13388.4130033.5179570.7116676.8  7270.5
IN EP000    1984 73694.9 28969.0 22098.1 16338.4 13780.0 14631.0 20879.0  4491.0  1289.5209596.7 20092.9 15504.7
IN EP000    1985 97135.0 62613.3199652.5311015.9 43615.0 22521.4 38716.4 11019.5 16835.8 34831.3234181.9 53999.4
IN EP000    1986  5231.9  7476.6  2692.6 11351.7 13537.6222155.7 18822.5  6647.8 20944.3 46198.1 35759.8205256.1
IN EP000    1987 62688.7147733.4 46920.7 16782.0 70739.9641075.9 54200.7  9430.1  5010.2  1650.7 92411.3 88231.4
IN EP000    1988 10869.3  2616.8 23180.7 24584.8 18234.0 13524.9 23770.9  7784.3    95.3 14043.5  1834.1 12217.9
IN EP000    1989111586.8 17773.5 12246.6  5264.7130619.7 14957.8  7438.9  2644.6     0.0  4063.1  5210.9   361.1
IN EP000    1990  3278.0 31669.1 65935.9 51452.6 33591.2    26.9 25582.4  3156.9 13740.7 11035.7  1594.6    22.5
IN EP000    1991171119.6 61208.7 16555.0302089.4 34939.3 37368.7 48253.2  8537.6 33876.8  2490.7  6802.8376359.2
IN EP000    1992334581.3883200.3133695.2419298.4456711.8246171.7 31863.9  9491.1  9644.1  8018.2 68756.1 61189.6
IN EP000    1993 80669.9124668.1125973.9110964.4451581.3674427.7 44156.1 21405.6  2708.0 29939.2  6379.5 43800.5
IN EP000    1994  9577.9  2141.5 38242.6 40219.6237854.3 73967.3 12097.1 27520.4 20486.4 1147303 14445.0116565.0
IN EP000    1995129152.6  9865.1202807.3 46508.2124490.0 27104.2 48545.2 18165.1 10761.5   686.2 17050.8 66300.2
IN EP000    1996  8009.8  3691.9 10633.4  9639.6 13425.4 68185.9 17246.4 15949.2 99096.7  1835.9 15087.5 19054.0
```

3. The following records were changed in the DIS file.

On Lavaca:
```
FD 20955   EP000       1   GS300  WGS800   GS500
FD CB220   EP000       1   GS300  WGS800   GS500
FD DV211   EP000       1   GS300  WGS800   GS500
FD DV212   EP000       1   GS300  WGS800   GS500
FD DV213   EP000       1   GS300  WGS800   GS500
FD DV214   EP000       1   GS300  WGS800   GS500
FD DV215   EP000       1   GS300  WGS800   GS500
FD DV216   EP000       1   GS300  WGS800   GS500
FD WQ002   EP000       1   GS300  WGS800   GS500
```

On Navidad:
```
FD CB230   EP000       2  WGS800   GS500   GS300
FDDV221A   EP000       2  WGS800   GS500   GS300
FDDV221B   EP000       2  WGS800   GS500   GS300
FDRSRTRN   EP000       2  WGS800   GS500   GS300
FD WQ004   EP000       2  WGS800   GS500   GS300
```

Below confluence of Lavaca and Navidad:
```
FD CB210   EP000       3   GS300  WGS800   GS500
FD DV201   EP000       3   GS300  WGS800   GS500
FD GS100   EP000       3   GS300  WGS800   GS500
FD GS200   EP000       3   GS300  WGS800   GS500
FD WQ001   EP000       3   GS300  WGS800   GS500
FD WQ003   EP000       3   GS300  WGS800   GS500
```

Revisions to Modeling of Lake Texana Interruptible Diversions

The 12,000 acre-feet per year of interruptible supply from Lake Texana consists of three separate authorizations:

- *500 acre-feet per year from the original 75,000 acre-feet per year authorized from Lake Texana in the unamended certificate with a priority date of May 15, 1972.* Amendment D changed this supply to interruptible because the implementation of bay and estuary pass-through requirements in Amendment B reduced the firm yield of the reservoir from 79,000 acre-feet per year to 74,500 acre-feet per year. So 500 acre-feet per year of the original authorization was changed to interruptible. It appears that the priority date of this authorization was not changed.
- *4,000 acre-feet per year authorized in Amendment B with a priority date of May 15, 1982*. This is the remaining 4,000 acre-feet per year of the 4,500 acre-foot total reduction in firm yield mentioned in the previous bullet. Amendment D makes this interruptible without changing the priority date.
- *7,500 acre-feet per year authorized in Amendment D with a priority date of July 1, 2002.*

According to Special Condition 5.B. of Amendment D, the 12,000 acre-feet of the interruptible water can only be diverted when the lake level is above 43 feet. The upper tier of the bay and estuary pass-through requirements must be met at all times for interruptible water to be diverted, as specified in Bay and Estuary Release Schedule 4.A.1 of Amendment B, and repeated in Special Condition 5.A. of Amendment D.

In the current TCEQ WAM, the interruptible authorization is modeled as a single 12,000 acre-feet per year diverted at a July 2, 2002 priority date. The reason for the change in the priority date of the authorization is not documented, but it may be due to the implementation of the LNRA Water Management Plan and the 1996 *Compromise Settlement Agreement* between LNRA and upstream water right holders, which is included in the

Water Management Plan. The compromise agreement allows upstream diverters to take water when Lake Texana is above 43 feet. Changing the priority date allows the upstream diverters to take water when Texana is above 43 feet but below 170,300 acre-feet. The proposed modifications to the interruptible code split out the three authorizations so that their origin can be clearly linked to the water rights. The junior priority date of all authorizations has been maintained, but it has been changed to the July 1, 2002 date found in Amendment D.

Two other revisions have been proposed for the interruptible modeling. The first uses the annual diversion limit in Field 10 of the SO Record to limit annual diversions rather than diverting more water than needed to a dummy control point and returning unused water to the reservoir. The annual diversion limit option was not available when the Lavaca WAM was developed. The proposed technique is simpler and more robust than the previous version. The second change uses a pattern that allows more water to be diverted in the last three months of the year if interruptible targets have not been met earlier in the year. The annual limits on the SO record prevent over-use of water.

Like the previous modeling, the 43-foot limit is established by making storage below 43 feet inactive (Field 7 of the WS Record) and bay and estuary limits are implemented using a drought index tied to 78.18 percent of the storage in Lake Texana.

The following changes were made to the model code:

1. A new UC record was added to set monthly interruptible diversion targets. A monthly limit of 2,880 ac-ft has been retained from the old model for the first nine months of the year. This has been increased for the last three months so that the full amount of interruptible water may be diverted if it was not available earlier in the year.

```
UC  INTW      288     288     288     288     288     288
UC            288     288     288     480     480     480
```

2. The 500 ac-ft/yr of interruptible water originating from firm authorization in the original permit is modeled using the following code. Please note that a separate water right record that fills Lake Texana at the 2002 priority date has been commented out because the proposed revisions no longer rely on diverting more water from the reservoir than is needed to meet interruptible targets. The annual diversion target is set to divert 120 ac-ft/month during the first nine months of the year and 200 ac-ft/month in the last three months of the year. Field 10 of the SO record limits annual diversions to 500 ac-ft/yr. The 160,930 ac-ft limit in the WS record prevents the reservoir from dropping below 43 ft msl because of this diversion. If Lake Texana is below 78.18 percent, the reference to Drought Index 2 on the WR record sets the diversion target to zero target to zero.

```
**   500 ac-ft at from original authorization, set to 2002 priority to reflect subordination
**
WRDV221A    1680    INTW20020701   1   1     1.0    NOUT       2      72_INTERUP          TEXANA
WSTEXANA  170300                          160930
SO                                                                   500
```

3. The 4,000 ac-ft/yr of interruptible water authorized by Amendment B is modeled using the following code. The annual diversion target is set to divert 960 ac-ft/month during the first nine months of the year and 1,600 ac-ft/month in the last three months of the year. Field 10 of the SO record limits annual diversions to 4,000 ac-ft/yr. The 160,930 ac-ft limit in the WS record prevents the reservoir from dropping below 43 ft msl because of this diversion. If Lake Texana is below 78.18 percent, the reference to Drought Index 2 on the WR record sets

the diversion target to zero.

```
**  4,000 ac-ft from 1982 authorization, set to 2002 priority to reflect subordination
**
WRDV221A   13440    INTW20020701   1   1     1.0    NOUT       2      82_INTERUP          TEXANA
WSTEXANA  170300                          160930
SO                                                                  4000
```

4. The following code models the 7,500 ac-ft/yr of interruptible water authorized in Amendment D. The annual diversion target is set to divert 1,920 ac-ft/month during the first nine months of the year and 3,200 ac-ft/month in the last three months of the year. Field 10 of the SO record limits annual diversions to 7,500 ac-ft/yr. The 160,930 ac-ft limit in the WS record prevents the reservoir from dropping below 43 ft msl because of this diversion. If Lake Texana is below 78.18 percent, the reference to Drought Index 2 on the WR record sets the diversion target to zero.

```
**  7,500 ac-ft from Amendment D.
**
WRDV221A   26880    INTW20020701   1   1     1.0    NOUT       2      02_INTERUP          TEXANA
WSTEXANA  170300                          160930
SO                                                                 7500
```

Revisions to Stage 2 Location and SVSA Records

In the existing Lavaca WAM, Stage 2 of the Palmetto Bend project does not appear to be modeled at the location or capacity authorized in COA 16-2095, as amended. The location description in the permit states that "Station 129+60 on the centerline, being a point common to the Stage 1 and Stage 2 Dams, bears N 71°27'W, 3333 feet from the northwest corner of the Stephen F. Austin Survey, Abstract No. 5, Jackson Co. Texas." This point is at the tip of the blue arrow in ***Figure 1***, approximately where the proposed Stage 2 dam intersects the existing Stage 1 dam. ***Figure 1*** also shows the proposed location of the Stage 2 dam from the 1963 report *Plan of Development for Palmetto Bend Project Texas (1963 Report)*. The existing WAM has Stage 2 modeled at control point WQ002, also shown on ***Figure 1***, which is upstream of the location described in the permit. COA 16-2095A authorizes the storage of 93,340 ac-ft in Stage 2. In the existing WAM, the storage for the project is 62,454 ac-ft. The storage in the existing WAM appears to be the location and storage for an alternative version of Stage 2 described in the 1991 report *Cost Update for Palmetto Bend Stage 2 and Yield Enhancement Alternative for Lake Texana and Palmetto Bend Stage 2*. FNI was unable to find any indication that the permit was amended to reflect either the upstream location or the reduced storage.

FREESE NICHOLS

Figure 1. Model Stage 2 Reservoir Location

In order to model Stage 2 as described and authorized in COA 16-2095, FNI proposes:

a) Adding a new control point STG_II where the dam described in the 1963 Report intersects the Lavaca River
b) Moving the location of the dam to the new control point
c) Using the storage-area relationship found in the 1963 Report.

The Stage 2 dam, as proposed in the 1963 Report, would also impound water flowing down Dry Creek, a tributary located between the Lavaca and Navidad Rivers. The dam is upstream of the confluence of Dry Creek and the Navidad River, cutting off a portion of the Dry Creek drainage area. The drainage area for the new control point STG_II includes the portion of the Dry Creek drainage area above the dam.

FNI estimated the drainage area of control point STG_II to be 865 square miles based on the incremental drainage area between control point DV211 and the dam (including the Dry Creek drainage area above the dam). This is less than the 929 square miles in the 1963 Report. The 1963 Report also has a drainage area of 887 square miles for the Lavaca River near Edna, TX (USGS Gage 08164000). This was the gage drainage area reported by the USGS at the time. The USGS subsequently revised the gage drainage area to 817 square miles. The Lavaca WAM has a drainage area of 822.0499 square miles for the Edna gage (control point GS300). Applying the delta between the Lavaca WAM drainage area for GS300 (822 square miles) and the Edna gage drainage area in the 1963 Report (887 square miles) to the Stage 2 drainage area in the 1963 Report (929 square miles) results in a drainage area of 864 square miles; this is very close to the recommended drainage area of 865 square miles.

In order to implement the proposed changes, the following revisions were made to the model:

1. A new control point (STG_II) was added to the DAT file.

```
**  FNI change - add new control point for Stage 2 authorized location
**CP DV211   CB220                       7           GS300      -2
CP DV211  STG_II                       7           GS300      -2
CPSTG_II   CB220                       7           GS300      -2
**  FNI change - this control point is above Stage 2 authorized location
**CPTWW217   CB220                       7           GS300      -1
CPTWW217  STG_II                       7           GS300      -1
**  end FNI change
```

2. Associated revisions were also made to the DIS file. Note that this code assumes a primary control point at EP000.

```
** new control point STG_II for authorized location
FDSTG_II   EP000       1   GS300  WGS800   GS500

**  FNI change - new control point at authorized location for Stage 2
WPSTG_II  865.00                     1.0
```

3. Modeling of diversion and storage was revised. The only changes to the existing code for these records are the control point and the storage amount.

```
**  FNI change - move to authorized location at new control point STG_II and store full amount
authorized in water right
**
WRSTG_II    7150       119720515   1   1    0.00                     61602095_3 TEXANA2
WSSTAGE2   93340
```

```
**
WRSTG_II   22850       219720515   1   1    0.00                      61602095_4 TEXANA2
WSSTAGE2   93340
**
WRSTG_II   18122  BAYES119931006   1   1     1.0   20955                    2095_5
**
```

4. New SV and SA records for the downstream location from the 1963 Report were added.

```
**  FNI change
**  Stage 2 SVSA from 1963 Definite Plan Report Palmetto Bend Project Texas
**  elev       0       5      10      15      20      25      30      35      40      44      47      50
SVSTAGE2       0     133     563    1388    4168   11301   24320   43358   68338   93344  116279  147046
SASTAGE2       0      53     119     211     901    1952    3256    4359    5633    6870    8420   11234
**
```

References

HDR Engineering, Inc. 1991. *Regional Planning Water Study Cost Update for Palmetto Bend Stage 2 and Yield Enhancement Alternative for Lake Texana and Palmetto Bend Stage 2*, prepared for the Lavaca Navidad River Authority.

Texas Department of Water Resources. 1984. *Lavaca Navidad River Authority Bay and Estuary Releases*.

Texas Water Development Board. 2011. *Volumetric and Sedimentation Survey of Lake Texana: January – March 2010 Survey.*

Unites States Department of the Interior Bureau of Reclamation, Region 5. 1963. *Plan of Development for Palmetto Bend Project, Texas*, revised October 1963.

ATTACHMENT A
PROPOSED SB3 CODE FOR THE NAVIDAD RIVER AT STRANE PARK NEAR EDNA

DAT File Revisions

UC Records

```
**  FNI change - add UCs for Navidad Rv at Strane Pk nr Edna
** NE UCs
UC NESUB      61      56     172     167     172     167      =     1401
UC            74      74     131     135     131      61
UC NEDRY     861     784    1107    1071    1107    1071      =    12883
UC          1476    1476    1012    1045    1012     861
UC NEAVG    2152    1961    2152    2083    2152    2083      =    26833
UC          2890    2890    2083    2152    2083    2152
UC NEWET    4366    3978    4366    4225    4366    4225      =    53038
UC          5165    5165    4225    4366    4225    4366
**  FNI change end
```

CP Records

```
**  FNI change - edit connectivity for Navidad Rv at Strane Pk nr Edna
**CP RF502   DV501                       7           GS500      -1
CP RF502   GSNE1                       7           GS500      -1
CP GSNE1  NESUBS                       7           GS500      -1
CPNESUBS  NEBASE                       7           GS500      -1
CPNEBASE  NESPUL                       7           GS500      -1
CPNESPUL  NELPUL                       7           GS500      -1
CPNELPUL  NEAPUL                       7           GS500      -1
CPNEAPUL   DV501                       7           GS500      -1
**  FNI change end
```

```
** FNI change - add points for Navidad Rv at Strane Pk nr Edna
**** NE Base Flows CPS
CPNESEVT    OUT                       2    NONE    NONE
CPNESVD1    OUT                       2    NONE    NONE
CPNESVT2    OUT                       2    NONE    NONE
CPNESVT3    OUT                       2    NONE    NONE
CPNEBDRY    OUT                       2    NONE    NONE
CPNEBAVG    OUT                       2    NONE    NONE
CPNEBWET    OUT                       2    NONE    NONE
**
** NE Pulse CPS
CPNESPND     OUT                       2    ZERO    ZERO
CPNELPND     OUT                       2    ZERO    ZERO
CPNEAPND     OUT                       2    ZERO    ZERO
**
CPFKNE01     OUT                       2    NONE    NONE
CPFKNE02     OUT                       2    NONE    NONE
CPFKNE03     OUT                       2    NONE    NONE
CPFKNE04     OUT                       2    NONE    NONE
CPFKNE05     OUT                       2    NONE    NONE
CPFKNE06     OUT                       2    NONE    NONE
CPFKNE07     OUT                       2    NONE    NONE
CPFKNE08     OUT                       2    NONE    NONE
CPFKNE09     OUT                       2    NONE    NONE
CPFKNE10     OUT                       2    NONE    NONE
CPFKNE11     OUT                       2    NONE    NONE
CPFKNE12     OUT                       2    NONE    NONE
CPFKNE13     OUT                       2    NONE    NONE
CPFKNE14     OUT                       2    NONE    NONE
CPFKNE15     OUT                       2    NONE    NONE
CPFKNE16     OUT                       2    NONE    NONE
CPFKNE17     OUT                       2    NONE    NONE
CPFKNE18     OUT                       2    NONE    NONE
CPFKNE19     OUT                       2    NONE    NONE
CPFKNE20     OUT                       2    NONE    NONE
```

```
CPFKNE21     OUT                         2    NONE    NONE
CPFKNE22     OUT                         2    NONE    NONE
CPNEAPFA     OUT                         2    NONE    NONE
CPNEAPFB     OUT                         2    NONE    NONE
** FNI change end
```

CI Records

```
**  FNI change - add data for Navidad Rv at Strane Pk nr Edna
**** Navidad Rv at Strane Pk nr Edna BASE CIs
CINESEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINESVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINESVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINESVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINEBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINEBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINEBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** NE PULSE CIs
*** NE Pulse Duration
CINESPND       6       6       7       7       7       7
CI             5       5       6       6       6       6
CINELPND       7       7       7       7       7       7
CI             6       6       7       7       7       7
CINEAPND       7       7       7       7       7       7
CI             7       7       7       7       7       7
*** NE Pulse Calculation
CIFKNE01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
```

```
CIFKNE20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKNE22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINEAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CINEAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**  FNI change end
```

WR/IF Records for Pulse Flows

```
**  FNI Change - add code for Navidad Rv at Strane Park nr Edna
*************START E-Flows Navidad Rv at Strane Park nr Edna
**Start Base NE
** During Severe Conditions set Sub or Base trigger
WRNESVD1   12883   NEDRY20110301                                      FKNESEVD1
WRNESEVT          XMONTH20110301                                     SEVTRIGGER
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                   FKNESEVD1
**** Severe Condition Subsistence or Base
WRNESVT2   12883   NEDRY20110301                                      FKNESEVD2
TO    16            LIM       1       1  DV221A
FS     5  NESEVT      1       0       1 9999999   1
WRNESVT3    1401   NESUB20110301                                     FKNESEVSUB
TO    16            LIM       1       1  DV221A
FS     5  NESVT2      1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS file for Hydrologic conditions
WRNEBDRY   12883   NEDRY20110301                                       FKNEBASD
TO    16            LIM       2       2  DV221A
WRNEBAVG   26833   NEAVG20110301                                       FKNEBASM
TO    16            LIM       3       3  DV221A
WRNEBWET   53038   NEWET20110301                                       FKNEBASW
TO    16            LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFNEBASE                20110301   2                 NEBASEFIN
TO    13            ADD                                   FKNESEVSUB    CONT
TO    13            ADD                                    FKNESEVD2    CONT
TO    13            ADD                                     FKNEBASD    CONT
TO    13            ADD                                     FKNEBASM    CONT
TO    13            ADD                                     FKNEBASW
***
********** NE SMALL PULSE ***************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKNE01          XMONTH20110301                                     BF-NEB-SP1
TO     2            ADD                DAYSPY                              CONT
TO     2            SUB                NESPND
WRFKNE01          XMONTH20110301                                     BF-NEB-SP2
TO     6            ADD                                   BF-NEB-SP1    CONT
TO     2            DIV                DAYSPY
WRFKNE01          XMONTH20110301                                     BF-NEB-SP3
TO    13            ADD                                    NEBASEFIN    CONT
TO     6            MUL                                   BF-NEB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSNE1 exceeded target
WRFKNE04    9000  XMONTH20110301                                      FKNESPULW
TO     6            ADD                                   BF-NEB-SP3
WRFKNE05          XMONTH20110301                                     NEWINONOFF
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                    FKNESPULW
**
WRFKNE06   11250  XMONTH20110301                                      FKNESPUSP
TO     6            ADD                                   BF-NEB-SP3
WRFKNE07          XMONTH20110301                                     NESPRONOFF
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                    FKNESPUSP
```

```
**
WRFKNE08    1000  XMONTH20110301                                            FKNESPULS
TO     6            ADD                                            BF-NEB-SP3
WRFKNE09          XMONTH20110301                                           NESUMONOFF
TO     2            ADD                   GSNE1                                  CONT
TO     6            DIV                                              FKNESPULS
**
WRFKNE10    8700  XMONTH20110301                                            FKNESPULF
TO     6            ADD                                            BF-NEB-SP3
WRFKNE11          XMONTH20110301                                           NEFALONOFF
TO     2            ADD                   GSNE1                                  CONT
TO     6            DIV                                              FKNESPULF
** ENGAGING  PULSE
IFNESPUL    9000  XMONTH20110301                             NESPULW1
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE05       1       0       1 9999999   2   1   2   2  12   2
IFNESPUL    9000  XMONTH20110301   3                         NESPULW2
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE05       1       0       1 9999999   2   1   2   0  12   2
IFNESPUL   11250  XMONTH20110301                             NESPUSP1
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE07       1       0       1 9999999   2   1   2   3   3   6
IFNESPUL   11250  XMONTH20110301   3                         NESPUSP2
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE07       1       0       1 9999999   2   1   2   0   3   6
IFNESPUL    1000  XMONTH20110301                             NESPULS1
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE09       1       0       1 9999999   2   1   2   1   7   8
IFNESPUL    1000  XMONTH20110301   3                         NESPULS2
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE09       1       0       1 9999999   2   1   2   0   7   8
IFNESPUL    8700  XMONTH20110301                             NESPULF1
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE11       1       0       1 9999999   2   1   2   2   9  11
IFNESPUL    8700  XMONTH20110301   3                         NESPULF2
TO     6            ADD                                            BF-NEB-SP3
FS     5  FKNE11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFNESPUL                20110301                              NESPFIN
TO    13            ADD                                               NESPULW2    CONT
TO    13            ADD                                               NESPUSP2    CONT
TO    13            ADD                                               NESPULS2    CONT
TO    13            ADD                                               NESPULF2
**
***********NE LARGE PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKNE02          XMONTH20110301                                           BF-NEB-LP1
TO     2            ADD                  DAYSPY                                  CONT
TO     2            SUB                  NELPND
WRFKNE02          XMONTH20110301                                           BF-NEB-LP2
TO     6            ADD                                            BF-NEB-LP1    CONT
TO     2            DIV                  DAYSPY
WRFKNE02          XMONTH20110301                                           BF-NEB-LP3
TO    13            ADD                                              NEBASEFIN    CONT
TO     6            MUL                                            BF-NEB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSNE1 exceeded target
WRFKNE12   11250  XMONTH20110301                                            FKNELPULW
TO     6            ADD                                            BF-NEB-LP3
WRFKNE13          XMONTH20110301                                          NELWINONOFF
TO     2            ADD                   GSNE1                                  CONT
TO     6            DIV                                              FKNELPULW
**
WRFKNE14   11250  XMONTH20110301                                            FKNELPUSP
TO     6            ADD                                            BF-NEB-LP3
WRFKNE15          XMONTH20110301                                          NELSPRONOFF
TO     2            ADD                   GSNE1                                  CONT
TO     6            DIV                                              FKNELPUSP
**
WRFKNE16    3400  XMONTH20110301                                            FKNELPULS
```

```
TO     6            ADD                                        BF-NEB-LP3
WRFKNE17           XMONTH20110301                                     NELSUMONOFF
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                          FKNELPULS
**
WRFKNE18   11250  XMONTH20110301                                        FKNELPULF
TO     6            ADD                                        BF-NEB-LP3
WRFKNE19           XMONTH20110301                                     NELFALONOFF
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                          FKNELPULF
** ENGAGING  PULSE
IFNELPUL   11250  XMONTH20110301                         NELPULW1
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE13       1       0       1 9999999   2   1   1   2  12   2
IFNELPUL   11250  XMONTH20110301   3                     NELPULW2
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE13       1       0       1 9999999   2   1   1   0  12   2
IFNELPUL   11250  XMONTH20110301                         NELPUSP1
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE15       1       0       1 9999999   2   1   1   3   3   6
IFNELPUL   11250  XMONTH20110301   3                     NELPUSP2
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE15       1       0       1 9999999   2   1   1   0   3   6
IFNELPUL    3400  XMONTH20110301                         NELPULS1
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE17       1       0       1 9999999   2   1   1   1   7   8
IFNELPUL    3400  XMONTH20110301   3                     NELPULS2
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE17       1       0       1 9999999   2   1   1   0   7   8
IFNELPUL   11250  XMONTH20110301                         NELPULF1
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE19       1       0       1 9999999   2   1   1   2   9  11
IFNELPUL   11250  XMONTH20110301   3                     NELPULF2
TO     6            ADD                                        BF-NEB-LP3
FS     5  FKNE19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFNELPUL                20110301                          NELPFIN
TO    13            ADD                                          NELPULW2    CONT
TO    13            ADD                                          NELPUSP2    CONT
TO    13            ADD                                          NELPULS2    CONT
TO    13            ADD                                          NELPULF2
***********************
***********NE Annual PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKNE03           XMONTH20110301                                      BF-NEB-AP1
TO     2            ADD                DAYSPY                                  CONT
TO     2            SUB                NEAPND
WRFKNE03           XMONTH20110301                                      BF-NEB-AP2
TO     6            ADD                                        BF-NEB-AP1    CONT
TO     2            DIV                DAYSPY
WRFKNE03           XMONTH20110301                                      BF-NEB-AP3
TO    13            ADD                                         NEBASEFIN    CONT
TO     6            MUL                                        BF-NEB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSNE1 exceeded target
WRFKNE20   11250  XMONTH20110301                                        FKNEAPUL
TO     6            ADD                                        BF-NEB-AP3
WRFKNE21           XMONTH20110301                                      NEANNONOFF
TO     2            ADD                 GSNE1                              CONT
TO     6            DIV                                           FKNEAPUL
** ENGAGING  PULSE
IFNEAPFA   11250  XMONTH20110301                          NEAPLA1
TO     6            ADD                                        BF-NEB-AP3
FS     5  FKNE21       1       0       1 9999999   2   1   1   5  1    6       1
IFNEAPFA   11250  XMONTH20110301   3                      NEAPLA2
TO     6            ADD                                        BF-NEB-AP3
FS     5  FKNE21       1       0       1 9999999   2   1   1   0  1    6       1
IFNEAPFB   11250  XMONTH20110301                          NEAPLB1
TO     6            ADD                                        BF-NEB-AP3
FS     5  FKNE21       1       0       1 9999999   2   1   1   5  7   12       1
```

```
IFNEAPFB   11250  XMONTH20110301   3                     NEAPLB2
TO     6             ADD                                      BF-NEB-AP3
FS     5  FKNE21       1       0       1 9999999   2   1   1   0  7   12       1
WRFKNE22                20110301                                        NEFRSTHALF
TO    13                                                          NEAPLA2
IFNEAPFB                20110301   3                     NEAPLB3
TO    13                                                          NEAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6       1      NEFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFNEAPUL                20110301                         NEAPFIN
TO    13             ADD                                          NEAPLA2    CONT
TO    13             ADD                                          NEAPLB3
***********************
******************* End E-FLOWS FOR Navidad Rv at Strane Park nr Edna
**  FNI change end
```

DIS File Revisions

FD Records

```
**  FNI change - add FD cards for Navidad Rv at Strane Park nr Edna
FD GSNE1   GS500       1   GS550  GS1000
FDNESUBS   GS500       1   GS550  GS1000
FDNEBASE   GS500       1   GS550  GS1000
FDNESPUL   GS500       1   GS550  GS1000
FDNELPUL   GS500       1   GS550  GS1000
FDNEAPUL   GS500       1   GS550  GS1000
** FNI Change End
```

WP Records

```
**  FNI change - add WP cards for Navidad Rv at Strane Park nr Edna
WP GSNE1  579.00   70.73   39.69     1.0
WPNESUBS  579.00   70.73   39.69     1.0
WPNEBASE  579.00   70.73   39.69     1.0
WPNESPUL  579.00   70.73   39.69     1.0
WPNELPUL  579.00   70.73   39.69     1.0
WPNEAPUL  579.00   70.73   39.69     1.0
**  FNI change End
```

ATTACHMENT B
PROPOSED SB3 CODE FOR GARCITAS CREEK NEAR INEZ

DAT File Revisions

UC Records

```
**  FNI change - add UCs for Carcitas Creek near Inez
** GC UCs
UC GCSUB      61      56      61      60      61      60     =      723
UC            61      61      60      61      60      61
UC GCDRY     123     112     123     119     123     119     =     1145
UC            61      61      60      61      60     123
UC GCAVG     246     224     246     238     246     238     =     2291
UC           123     123     119     123     119     246
UC GCWET     430     392     430     417     430     417     =     3856
UC           184     184     179     184     179     430
**  FNI change end
```

CP Records

```
**  FNI change - edit connectivity for Garcitas Creek near Inez
**CPGS1200  CB1190                      1
CPGS1200   GSGC1                       1
CP GSGC1  GCSUBS                       7           GS1200      -1
CPGCSUBS  GCBASE                       7           GS1200      -1
CPGCBASE  GCSPUL                       7           GS1200      -1
CPGCSPUL  GCLPUL                       7           GS1200      -1
CPGCLPUL  GCAPUL                       7           GS1200      -1
CPGCAPUL  CB1190                       7           GS1200      -1
CPDAYSPY     OUT                       2    ZERO    ZERO
**  FNI change end

** FNI change - add points for Garcitas Creek near Inez
**** GC Base Flows CPS
CPGCSEVT    OUT                       2    NONE    NONE
CPGCSVD1    OUT                       2    NONE    NONE
CPGCSVT2    OUT                       2    NONE    NONE
CPGCSVT3    OUT                       2    NONE    NONE
CPGCBDRY    OUT                       2    NONE    NONE
CPGCBAVG    OUT                       2    NONE    NONE
CPGCBWET    OUT                       2    NONE    NONE
**
** GC Pulse CPS
CPGCSPND     OUT                       2    ZERO    ZERO
CPGCLPND     OUT                       2    ZERO    ZERO
CPGCAPND     OUT                       2    ZERO    ZERO
**
CPFKGC01     OUT                       2    NONE    NONE
CPFKGC02     OUT                       2    NONE    NONE
CPFKGC03     OUT                       2    NONE    NONE
CPFKGC04     OUT                       2    NONE    NONE
CPFKGC05     OUT                       2    NONE    NONE
CPFKGC06     OUT                       2    NONE    NONE
CPFKGC07     OUT                       2    NONE    NONE
CPFKGC08     OUT                       2    NONE    NONE
CPFKGC09     OUT                       2    NONE    NONE
CPFKGC10     OUT                       2    NONE    NONE
CPFKGC11     OUT                       2    NONE    NONE
CPFKGC12     OUT                       2    NONE    NONE
CPFKGC13     OUT                       2    NONE    NONE
CPFKGC14     OUT                       2    NONE    NONE
CPFKGC15     OUT                       2    NONE    NONE
CPFKGC16     OUT                       2    NONE    NONE
CPFKGC17     OUT                       2    NONE    NONE
CPFKGC18     OUT                       2    NONE    NONE
CPFKGC19     OUT                       2    NONE    NONE
CPFKGC20     OUT                       2    NONE    NONE
CPFKGC21     OUT                       2    NONE    NONE
CPFKGC22     OUT                       2    NONE    NONE
CPGCAPFA     OUT                       2    NONE    NONE
```

```
CPGCAPFB     OUT                       2    NONE    NONE
** FNI change end
```

CI Records

```
**  FNI change - add data for Garcitas Creek near Inez
CIDAYSPY      31   28.25      31      30      31      30
CI            31      31      30      31      30      31
**** Garcitas Creek near Inez BASE CIs
CIGCSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** GC PULSE CIs
*** GC Pulse Duration
CIGCSPND       8       8      10      10      10      10
CI             4       4       8       8       8       8
CIGCLPND      10      10      10      10      10      10
CI             8       8      10      10      10      10
CIGCAPND      10      10      10      10      10      10
CI            10      10      10      10      10      10
*** GC Pulse Calculation
CIFKGC01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC20 9999999 9999999 9999999 9999999 9999999 9999999
```

```
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKGC22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIGCAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**  FNI change end
```

WR/IF Records for Pulse Flows

```
**  FNI Change - add code for Garcitas Creek near Inez
*************START E-Flows Garcitas Creek near Inez
**Start Base GC
** During Severe Conditions set Sub or Base trigger
WRGCSVD1    1145   GCDRY20110301                                            FKGCSEVD1
WRGCSEVT          XMONTH20110301                                           SEVTRIGGER
TO     2             ADD                  GSGC1                                  CONT
TO     6             DIV                                           FKGCSEVD1
**** Severe Condition Subsistence or Base
WRGCSVT2    1145   GCDRY20110301                                            FKGCSEVD2
TO    16             LIM       1       1  GS1200
FS     5  GCSEVT       1       0       1 9999999   1
WRGCSVT3     723   GCSUB20110301                                           FKGCSEVSUB
TO    16             LIM       1       1  GS1200
FS     5  GCSVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS file for Hydrologic conditions
WRGCBDRY    1145   GCDRY20110301                                             FKGCBASD
TO    16             LIM       2       2  GS1200
WRGCBAVG    2291   GCAVG20110301                                             FKGCBASM
TO    16             LIM       3       3  GS1200
WRGCBWET    3856   GCWET20110301                                             FKGCBASW
TO    16             LIM       4       4  GS1200
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFGCBASE                20110301   2                  GCBASEFIN
TO    13             ADD                                           FKGCSEVSUB    CONT
TO    13             ADD                                            FKGCSEVD2    CONT
TO    13             ADD                                             FKGCBASD    CONT
TO    13             ADD                                             FKGCBASM    CONT
TO    13             ADD                                             FKGCBASW
***
********** GC SMALL PULSE **********************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKGC01          XMONTH20110301                                           BF-GCB-SP1
TO     2             ADD                 DAYSPY                                  CONT
TO     2             SUB                 GCSPND
WRFKGC01          XMONTH20110301                                           BF-GCB-SP2
TO     6             ADD                                           BF-GCB-SP1    CONT
TO     2             DIV                 DAYSPY
WRFKGC01          XMONTH20110301                                           BF-GCB-SP3
TO    13             ADD                                            GCBASEFIN    CONT
TO     6             MUL                                           BF-GCB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSGC1 exceeded target
WRFKGC04     520  XMONTH20110301                                            FKGCSPULW
TO     6             ADD                                           BF-GCB-SP3
WRFKGC05          XMONTH20110301                                           GCWINONOFF
TO     2             ADD                  GSGC1                                  CONT
TO     6             DIV                                            FKGCSPULW
**
WRFKGC06    1500  XMONTH20110301                                            FKGCSPUSP
TO     6             ADD                                           BF-GCB-SP3
WRFKGC07          XMONTH20110301                                           GCSPRONOFF
TO     2             ADD                  GSGC1                                  CONT
TO     6             DIV                                            FKGCSPUSP
**
```

```
WRFKGC08      28  XMONTH20110301                                    FKGCSPULS
TO     6           ADD                                     BF-GCB-SP3
WRFKGC09          XMONTH20110301                                   GCSUMONOFF
TO     2           ADD                GSGC1                              CONT
TO     6           DIV                                       FKGCSPULS
**
WRFKGC10     420  XMONTH20110301                                    FKGCSPULF
TO     6           ADD                                     BF-GCB-SP3
WRFKGC11          XMONTH20110301                                   GCFALONOFF
TO     2           ADD                GSGC1                              CONT
TO     6           DIV                                       FKGCSPULF
** ENGAGING  PULSE
IFGCSPUL     520  XMONTH20110301                          GCSPULW1
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC05       1       0       1 9999999   2   1   2   2  12   2
IFGCSPUL     520  XMONTH20110301   3                      GCSPULW2
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC05       1       0       1 9999999   2   1   2   0  12   2
IFGCSPUL    1500  XMONTH20110301                          GCSPUSP1
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC07       1       0       1 9999999   2   1   2   3   3   6
IFGCSPUL    1500  XMONTH20110301   3                      GCSPUSP2
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC07       1       0       1 9999999   2   1   2   0   3   6
IFGCSPUL      28  XMONTH20110301                          GCSPULS1
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC09       1       0       1 9999999   2   1   2   1   7   8
IFGCSPUL      28  XMONTH20110301   3                      GCSPULS2
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC09       1       0       1 9999999   2   1   2   0   7   8
IFGCSPUL     420  XMONTH20110301                          GCSPULF1
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC11       1       0       1 9999999   2   1   2   2   9  11
IFGCSPUL     420  XMONTH20110301   3                      GCSPULF2
TO     6           ADD                                     BF-GCB-SP3
FS     5  FKGC11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFGCSPUL                20110301                           GCSPFIN
TO    13           ADD                                        GCSPULW2    CONT
TO    13           ADD                                        GCSPUSP2    CONT
TO    13           ADD                                        GCSPULS2    CONT
TO    13           ADD                                        GCSPULF2
**
***********GC LARGE PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKGC02          XMONTH20110301                                   BF-GCB-LP1
TO     2           ADD               DAYSPY                                CONT
TO     2           SUB               GCLPND
WRFKGC02          XMONTH20110301                                   BF-GCB-LP2
TO     6           ADD                                     BF-GCB-LP1    CONT
TO     2           DIV               DAYSPY
WRFKGC02          XMONTH20110301                                   BF-GCB-LP3
TO    13           ADD                                       GCBASEFIN    CONT
TO     6           MUL                                     BF-GCB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSGC1 exceeded target
WRFKGC12    1500  XMONTH20110301                                    FKGCLPULW
TO     6           ADD                                     BF-GCB-LP3
WRFKGC13          XMONTH20110301                                  GCLWINONOFF
TO     2           ADD                GSGC1                              CONT
TO     6           DIV                                       FKGCLPULW
**
WRFKGC14    1500  XMONTH20110301                                    FKGCLPUSP
TO     6           ADD                                     BF-GCB-LP3
WRFKGC15          XMONTH20110301                                  GCLSPRONOFF
TO     2           ADD                GSGC1                              CONT
TO     6           DIV                                       FKGCLPUSP
**
WRFKGC16     150  XMONTH20110301                                    FKGCLPULS
TO     6           ADD                                     BF-GCB-LP3
```

```
WRFKGC17          XMONTH20110301                                              GCLSUMONOFF
TO     2            ADD                  GSGC1                                       CONT
TO     6            DIV                                             FKGCLPULS
**
WRFKGC18    1500  XMONTH20110301                                                FKGCLPULF
TO     6            ADD                                            BF-GCB-LP3
WRFKGC19          XMONTH20110301                                              GCLFALONOFF
TO     2            ADD                  GSGC1                                       CONT
TO     6            DIV                                             FKGCLPULF
** ENGAGING  PULSE
IFGCLPUL    1500  XMONTH20110301                             GCLPULW1
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC13       1       0       1 9999999   2   1   1   2  12   2
IFGCLPUL    1500  XMONTH20110301   3                         GCLPULW2
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC13       1       0       1 9999999   2   1   1   0  12   2
IFGCLPUL    1500  XMONTH20110301                             GCLPUSP1
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC15       1       0       1 9999999   2   1   1   3   3   6
IFGCLPUL    1500  XMONTH20110301   3                         GCLPUSP2
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC15       1       0       1 9999999   2   1   1   0   3   6
IFGCLPUL     150  XMONTH20110301                             GCLPULS1
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC17       1       0       1 9999999   2   1   1   1   7   8
IFGCLPUL     150  XMONTH20110301   3                         GCLPULS2
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC17       1       0       1 9999999   2   1   1   0   7   8
IFGCLPUL    1500  XMONTH20110301                             GCLPULF1
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC19       1       0       1 9999999   2   1   1   2   9  11
IFGCLPUL    1500  XMONTH20110301   3                         GCLPULF2
TO     6            ADD                                            BF-GCB-LP3
FS     5  FKGC19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFGCLPUL                20110301                              GCLPFIN
TO    13            ADD                                               GCLPULW2    CONT
TO    13            ADD                                               GCLPUSP2    CONT
TO    13            ADD                                               GCLPULS2    CONT
TO    13            ADD                                               GCLPULF2
***********************
***********GC Annual PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKGC03          XMONTH20110301                                               BF-GCB-AP1
TO     2            ADD                 DAYSPY                                       CONT
TO     2            SUB                 GCAPND
WRFKGC03          XMONTH20110301                                               BF-GCB-AP2
TO     6            ADD                                            BF-GCB-AP1    CONT
TO     2            DIV                 DAYSPY
WRFKGC03          XMONTH20110301                                               BF-GCB-AP3
TO    13            ADD                                             GCBASEFIN    CONT
TO     6            MUL                                            BF-GCB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GSGC1 exceeded target
WRFKGC20    1500  XMONTH20110301                                                 FKGCAPUL
TO     6            ADD                                            BF-GCB-AP3
WRFKGC21          XMONTH20110301                                               GCANNONOFF
TO     2            ADD                  GSGC1                                       CONT
TO     6            DIV                                              FKGCAPUL
** ENGAGING  PULSE
IFGCAPFA    1500  XMONTH20110301                              GCAPLA1
TO     6            ADD                                            BF-GCB-AP3
FS     5  FKGC21       1       0       1 9999999   2   1   1   5  1    6       1
IFGCAPFA    1500  XMONTH20110301   3                          GCAPLA2
TO     6            ADD                                            BF-GCB-AP3
FS     5  FKGC21       1       0       1 9999999   2   1   1   0  1    6       1
IFGCAPFB    1500  XMONTH20110301                              GCAPLB1
TO     6            ADD                                            BF-GCB-AP3
FS     5  FKGC21       1       0       1 9999999   2   1   1   5  7   12       1
IFGCAPFB    1500  XMONTH20110301   3                          GCAPLB2
```

```
TO     6             ADD                                        BF-GCB-AP3
FS     5  FKGC21       1       0       1 9999999   2   1   1   0  7   12       1
WRFKGC22                20110301                                        GCFRSTHALF
TO    13                                                           GCAPLA2
IFGCAPFB                20110301   3                         GCAPLB3
TO    13                                                           GCAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6       1      GCFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFGCAPUL                20110301                         GCAPFIN
TO    13             ADD                                           GCAPLA2    CONT
TO    13             ADD                                           GCAPLB3
***********************
****************** End E-FLOWS FOR Garcitas Creek near Inez
**  FNI change end
```

DIS File Revisions

FD Records

```
**  FNI change - Add for SB3 Garcitas Creek near Inez
FD GSGC1  GS1200
FDGCSUBS  GS1200
FDGCBASE  GS1200
FDGCSPUL  GS1200
FDGCLPUL  GS1200
FDGCAPUL  GS1200
**  FNI change end
```

WP Records

```
**  FNI change - Add for SB3 Garcitas Creek near Inez
WP GSGC1   97.36   63.90   38.35     1.0
WPGCSUBS   97.36   63.90   38.35     1.0
WPGCBASE   97.36   63.90   38.35     1.0
WPGCSPUL   97.36   63.90   38.35     1.0
WPGCLPUL   97.36   63.90   38.35     1.0
WPGCAPUL   97.36   63.90   38.35     1.0
**  FNI change end
```

ATTACHMENT C
LAVACA WAM NATURALIZED FLOWS

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Jan-40	1,023	820	-	1,844	1,800	Y
Feb-40	11,381	9,858	2,527	23,765	21,628	Y
Mar-40	1,988	2,182	534	4,703	4,787	
Apr-40	1,350	1,223	697	3,269	2,682	Y
May-40	2,420	1,958	2,615	6,993	4,297	Y
Jun-40	5,807	13,502	1,610	20,918	29,624	
Jul-40	245,847	215,046	103,275	564,168	471,825	Y
Aug-40	3,507	2,218	764	6,489	4,866	Y
Sep-40	1,760	1,594	384	3,738	3,497	Y
Oct-40	11,987	19,276	5,030	36,292	42,292	
Nov-40	204,146	383,786	54,360	642,291	842,051	
Dec-40	102,495	166,547	37,424	306,465	365,414	
Jan-41	37,314	55,143	13,146	105,603	120,988	
Feb-41	25,339	32,144	6,455	63,938	70,525	
Mar-41	82,410	100,927	12,352	195,688	221,440	
Apr-41	75,382	137,787	24,462	237,631	302,313	
May-41	171,088	186,190	29,205	386,483	408,514	
Jun-41	120,647	116,008	20,150	256,805	254,529	Y
Jul-41	25,608	84,954	12,185	122,747	186,394	
Aug-41	12,066	30,606	2,629	45,301	67,151	
Sep-41	5,246	9,808	1,143	16,197	21,519	
Oct-41	9,748	40,102	9,750	59,600	87,987	
Nov-41	14,584	36,096	6,959	57,639	79,196	
Dec-41	5,884	12,769	3,424	22,077	28,015	
Jan-42	4,424	4,420	745	9,589	9,698	
Feb-42	4,358	6,738	1,977	13,072	14,783	
Mar-42	4,673	7,452	1,164	13,289	16,350	
Apr-42	54,692	83,739	15,057	153,488	183,729	
May-42	5,335	5,315	3,099	13,749	11,661	Y
Jun-42	3,132	7,883	594	11,609	17,296	
Jul-42	66,036	100,455	28,906	195,396	220,404	
Aug-42	3,555	8,210	775	12,539	18,012	
Sep-42	16,648	18,504	3,627	38,780	40,599	
Oct-42	5,045	6,184	2,063	13,292	13,568	
Nov-42	5,188	13,719	3,908	22,815	30,100	
Dec-42	4,258	7,407	2,238	13,903	16,251	
Jan-43	5,938	16,987	3,817	26,742	37,271	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Feb-43	3,327	4,187	1,527	9,041	9,185	
Mar-43	12,775	35,107	4,474	52,356	77,026	
Apr-43	3,482	3,742	1,135	8,359	8,211	Y
May-43	6,836	15,336	4,546	26,718	33,647	
Jun-43	8,016	6,202	290	14,508	13,608	Y
Jul-43	8,061	8,568	4,927	21,557	18,800	Y
Aug-43	3,306	4,491	720	8,518	9,854	
Sep-43	2,099	3,737	457	6,293	8,199	
Oct-43	1,638	2,424	1,211	5,272	5,318	
Nov-43	7,917	30,404	6,183	44,504	66,707	
Dec-43	20,037	38,496	9,112	67,645	84,462	
Jan-44	41,891	103,003	24,847	169,741	225,995	
Feb-44	11,204	22,518	4,758	38,479	49,405	
Mar-44	80,078	170,225	20,645	270,948	373,484	
Apr-44	7,716	7,448	1,780	16,944	16,341	Y
May-44	50,325	91,741	15,573	157,639	201,286	
Jun-44	7,987	9,347	858	18,193	20,509	
Jul-44	3,122	3,756	2,885	9,762	8,241	Y
Aug-44	2,957	3,226	644	6,828	7,078	
Sep-44	12,285	17,379	2,677	32,340	38,130	
Oct-44	2,130	3,373	1,426	6,929	7,401	
Nov-44	6,045	19,269	4,665	29,979	42,278	
Dec-44	9,890	50,421	11,749	72,059	110,626	
Jan-45	22,557	40,551	9,578	72,686	88,971	
Feb-45	6,270	14,512	3,347	24,130	31,841	
Mar-45	7,796	8,622	1,304	17,722	18,916	
Apr-45	36,707	126,265	22,457	185,429	277,033	
May-45	3,373	3,642	2,858	9,872	7,990	Y
Jun-45	7,801	5,641	188	13,630	12,377	Y
Jul-45	1,922	4,189	2,388	8,499	9,191	
Aug-45	2,568	35,098	560	38,225	77,007	
Sep-45	933	10,021	203	11,157	21,986	
Oct-45	2,567	9,146	2,734	14,446	20,066	
Nov-45	1,180	1,398	2,229	4,807	3,068	Y
Dec-45	1,964	10,884	3,007	15,855	23,879	
Jan-46	5,061	30,850	7,206	43,117	67,687	
Feb-46	27,765	62,262	11,764	101,791	136,608	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Mar-46	14,891	41,117	5,193	61,201	90,212	
Apr-46	6,355	15,334	3,153	24,842	33,644	
May-46	10,090	43,888	8,667	62,645	96,294	
Jun-46	49,179	134,467	23,489	207,134	295,028	
Jul-46	6,498	19,754	4,281	30,532	43,341	
Aug-46	43,771	24,474	9,536	77,781	53,697	Y
Sep-46	96,539	82,015	21,033	199,587	179,946	Y
Oct-46	86,823	61,646	14,633	163,102	135,255	Y
Nov-46	39,359	76,211	12,428	127,997	167,211	
Dec-46	10,782	13,929	3,680	28,390	30,560	
Jan-47	39,027	78,586	18,877	136,490	172,422	
Feb-47	6,747	6,189	1,880	14,817	13,580	Y
Mar-47	12,619	18,967	2,542	34,129	41,616	
Apr-47	10,121	10,711	2,348	23,181	23,501	
May-47	35,898	51,967	9,832	97,697	114,018	
Jun-47	4,050	3,460	-	7,510	7,591	
Jul-47	1,944	4,030	2,397	8,372	8,843	
Aug-47	1,532	5,837	334	7,703	12,806	
Sep-47	941	5,652	205	6,798	12,401	
Oct-47	1,024	973	882	2,879	2,134	Y
Nov-47	2,048	3,213	2,476	7,737	7,049	Y
Dec-47	2,701	11,648	3,176	17,524	25,556	
Jan-48	3,655	14,998	3,331	21,984	32,906	
Feb-48	10,195	32,004	6,430	48,630	70,219	
Mar-48	9,471	27,133	3,520	40,124	59,532	
Apr-48	2,443	4,359	1,243	8,045	9,564	
May-48	73,030	51,208	9,723	133,961	112,353	Y
Jun-48	4,182	1,507	-	5,689	3,306	Y
Jul-48	2,854	5,730	2,774	11,358	12,573	
Aug-48	582	-	127	708	-	Y
Sep-48	1,050	7,196	229	8,475	15,789	
Oct-48	607	741	829	2,177	1,625	Y
Nov-48	728	1,318	2,218	4,263	2,891	Y
Dec-48	899	715	759	2,372	1,568	Y
Jan-49	2,185	2,209	204	4,598	4,846	
Feb-49	9,829	30,967	6,248	47,044	67,944	
Mar-49	4,308	18,300	2,463	25,071	40,152	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Apr-49	62,058	110,884	19,781	192,723	243,287	
May-49	9,353	12,426	4,126	25,905	27,262	
Jun-49	3,554	2,219	-	5,772	4,868	Y
Jul-49	3,955	8,532	3,229	15,717	18,720	
Aug-49	5,163	7,468	1,125	13,756	16,386	
Sep-49	1,979	8,018	431	10,429	17,593	
Oct-49	23,632	117,942	27,392	168,966	258,771	
Nov-49	2,196	5,317	2,763	10,276	11,666	
Dec-49	27,051	53,546	12,440	93,037	117,484	
Jan-50	7,022	26,889	6,238	40,148	58,996	
Feb-50	5,847	20,470	4,397	30,715	44,913	
Mar-50	2,579	3,178	653	6,410	6,973	
Apr-50	6,557	14,855	3,069	24,482	32,594	
May-50	4,738	2,454	2,686	9,878	5,384	Y
Jun-50	7,888	50,721	8,342	66,951	111,285	
Jul-50	1,628	2,128	2,267	6,023	4,669	Y
Aug-50	248	-	54	302	-	Y
Sep-50	289	7,075	63	7,426	15,522	
Oct-50	218	1,057	901	2,175	2,318	
Nov-50	242	281	2,076	2,599	617	Y
Dec-50	570	575	728	1,873	1,262	Y
Jan-51	808	686	-	1,493	1,504	
Feb-51	901	806	931	2,639	1,768	Y
Mar-51	1,102	3,998	751	5,851	8,772	
Apr-51	842	2,047	840	3,730	4,491	
May-51	577	415	2,392	3,383	909	Y
Jun-51	19,043	55,144	1,792	75,978	120,989	
Jul-51	278	-	1,708	1,986	-	Y
Aug-51	-	-	-	-	-	
Sep-51	8,287	22,277	1,805	32,369	48,878	
Oct-51	1,677	5,128	1,824	8,629	11,251	
Nov-51	736	1,330	2,219	4,285	2,917	Y
Dec-51	759	919	804	2,482	2,017	Y
Jan-52	570	552	-	1,122	1,212	
Feb-52	2,029	5,724	1,798	9,551	12,558	
Mar-52	1,378	2,683	594	4,654	5,886	
Apr-52	14,204	54,129	9,904	78,237	118,763	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
May-52	79,510	97,699	16,433	193,641	214,357	
Jun-52	11,867	15,447	1,962	29,275	33,891	
Jul-52	1,663	446	2,281	4,390	978	Y
Aug-52	1,062	-	231	1,293	-	Y
Sep-52	896	5,336	195	6,427	11,708	
Oct-52	153	688	817	1,658	1,509	Y
Nov-52	17,004	23,656	5,263	45,923	51,903	
Dec-52	23,611	43,263	10,166	77,040	94,921	
Jan-53	2,958	6,480	1,248	10,686	14,217	
Feb-53	3,149	6,492	1,934	11,575	14,245	
Mar-53	1,900	2,113	525	4,538	4,635	
Apr-53	2,875	2,004	833	5,712	4,397	Y
May-53	41,820	85,890	14,728	142,438	188,447	
Jun-53	1,484	580	-	2,063	1,272	Y
Jul-53	988	2,806	2,002	5,796	6,156	
Aug-53	14,099	29,730	3,072	46,901	65,229	
Sep-53	6,522	58,228	1,421	66,172	127,757	
Oct-53	1,480	2,476	1,223	5,179	5,433	
Nov-53	972	1,440	2,234	4,646	3,159	Y
Dec-53	910	4,404	1,574	6,888	9,662	
Jan-54	885	837	-	1,722	1,836	
Feb-54	645	518	881	2,044	1,137	Y
Mar-54	643	542	337	1,523	1,190	Y
Apr-54	4,962	1,119	679	6,759	2,455	Y
May-54	4,117	4,050	2,917	11,085	8,887	Y
Jun-54	230	-	-	230	-	Y
Jul-54	-	-	1,585	1,585	-	Y
Aug-54	150	-	33	182	-	Y
Sep-54	311	813	68	1,192	1,783	
Oct-54	-	1,409	981	2,390	3,091	
Nov-54	-	6	2,039	2,044	12	Y
Dec-54	-	11	603	614	25	Y
Jan-55	486	849	-	1,336	1,864	
Feb-55	35,929	46,126	8,920	90,974	101,203	
Mar-55	859	321	311	1,491	704	Y
Apr-55	1,791	1,846	805	4,443	4,050	Y
May-55	42,574	37,211	7,703	87,487	81,642	Y

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Jun-55	6,388	9,499	886	16,773	20,841	
Jul-55	593	-	1,839	2,431	-	Y
Aug-55	9,107	2,142	1,984	13,233	4,700	Y
Sep-55	2,461	14,967	536	17,964	32,837	
Oct-55	198	9,834	2,890	12,923	21,577	
Nov-55	24	-	2,036	2,060	-	Y
Dec-55	185	-	598	783	-	Y
Jan-56	229	541	-	770	1,187	
Feb-56	946	4,540	1,589	7,075	9,960	
Mar-56	294	-	271	565	-	Y
Apr-56	150	1,625	767	2,542	3,565	
May-56	363	-	2,209	2,572	-	Y
Jun-56	-	-	-	-	-	
Jul-56	861	-	1,950	2,810	-	Y
Aug-56	-	-	-	-	-	
Sep-56	-	65	-	65	142	
Oct-56	-	12	664	675	25	Y
Nov-56	-	24	2,041	2,065	52	Y
Dec-56	1,890	2,738	1,206	5,834	6,007	
Jan-57	-	1	-	1	2	
Feb-57	4,497	6,334	1,906	12,737	13,898	
Mar-57	27,353	71,665	8,849	107,868	157,238	
Apr-57	84,645	115,649	20,610	220,903	253,741	
May-57	28,155	81,956	14,161	124,272	179,816	
Jun-57	18,294	80,014	13,640	111,948	175,557	
Jul-57	779	-	1,916	2,695	-	Y
Aug-57	124	-	27	151	-	Y
Sep-57	9,911	27,912	2,159	39,982	61,240	
Oct-57	116,984	191,114	8,353	316,451	419,316	
Nov-57	68,782	98,735	15,499	183,015	216,630	
Dec-57	7,252	7,700	2,303	17,255	16,895	Y
Jan-58	40,968	63,498	15,188	119,654	139,318	
Feb-58	65,782	84,989	15,770	166,540	186,471	
Mar-58	10,106	9,184	1,372	20,662	20,151	Y
Apr-58	4,390	4,915	1,339	10,644	10,783	
May-58	23,639	30,456	6,728	60,823	66,822	
Jun-58	1,687	518	-	2,205	1,136	Y

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Jul-58	7,286	6,200	4,607	18,092	13,603	Y
Aug-58	725	-	158	883	-	Y
Sep-58	22,898	34,147	4,989	62,033	74,920	
Oct-58	13,962	15,468	4,167	33,597	33,937	
Nov-58	3,856	11,205	3,566	18,627	24,585	
Dec-58	7,038	24,468	6,010	37,517	53,684	
Jan-59	3,584	13,149	2,879	19,612	28,850	
Feb-59	64,801	122,800	22,434	210,035	269,431	
Mar-59	6,330	8,114	1,244	15,687	17,802	
Apr-59	78,903	161,998	28,676	269,577	355,435	
May-59	20,885	27,402	6,287	54,575	60,122	
Jun-59	8,204	51,079	8,406	67,688	112,069	
Jul-59	3,444	3,701	3,018	10,163	8,121	Y
Aug-59	4,174	14,882	909	19,965	32,651	
Sep-59	4,311	10,815	939	16,065	23,728	
Oct-59	16,152	52,801	12,629	81,582	115,849	
Nov-59	13,800	37,888	7,203	58,891	83,128	
Dec-59	10,328	38,271	9,062	57,662	83,970	
Jan-60	11,350	33,184	7,777	52,312	72,808	
Feb-60	12,683	37,965	7,481	58,129	83,298	
Mar-60	4,944	8,307	1,267	14,518	18,227	
Apr-60	6,757	14,792	3,058	24,608	32,455	
May-60	5,097	23,062	5,661	33,820	50,600	
Jun-60	64,335	206,881	36,586	307,802	453,910	
Jul-60	11,082	36,529	6,177	53,787	80,147	
Aug-60	39,104	74,198	8,520	121,822	162,795	
Sep-60	4,537	13,932	989	19,458	30,568	
Oct-60	223,165	164,737	37,999	425,901	361,443	Y
Nov-60	50,570	94,666	14,944	160,180	207,703	
Dec-60	36,385	65,180	15,012	116,576	143,008	
Jan-61	58,368	93,763	22,588	174,719	205,721	
Feb-61	63,650	164,710	29,822	258,181	361,383	
Mar-61	9,911	12,193	1,732	23,836	26,753	
Apr-61	6,769	7,626	1,811	16,206	16,733	
May-61	5,591	5,083	3,066	13,740	11,152	Y
Jun-61	80,999	145,089	25,410	251,497	318,334	
Jul-61	34,490	60,886	15,858	111,234	133,587	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Aug-61	4,873	4,241	1,062	10,176	9,304	Y
Sep-61	123,171	259,819	26,835	409,825	570,060	
Oct-61	9,552	7,258	2,306	19,117	15,925	Y
Nov-61	65,144	65,505	10,968	141,617	143,722	
Dec-61	7,593	5,714	1,864	15,171	12,537	Y
Jan-62	5,773	6,262	1,195	13,230	13,739	
Feb-62	5,239	7,166	2,052	14,457	15,722	
Mar-62	4,354	4,671	832	9,857	10,249	
Apr-62	37,031	39,736	3,094	79,861	87,183	
May-62	5,796	9,373	3,685	18,853	20,564	
Jun-62	14,054	21,413	3,041	38,507	46,980	
Jul-62	3,200	10,179	2,917	16,296	22,334	
Aug-62	1,112	-	242	1,354	-	Y
Sep-62	8,997	13,497	1,960	24,454	29,613	
Oct-62	3,496	2,569	1,244	7,309	5,636	Y
Nov-62	2,006	816	2,149	4,972	1,791	Y
Dec-62	3,579	10,872	3,004	17,455	23,853	
Jan-63	4,982	14,717	3,262	22,961	32,290	
Feb-63	17,552	17,043	3,793	38,388	37,392	Y
Mar-63	2,936	2,427	563	5,926	5,324	Y
Apr-63	1,679	1,801	797	4,277	3,950	Y
May-63	1,701	3,054	2,773	7,529	6,702	Y
Jun-63	1,573	4,324	-	5,897	9,487	
Jul-63	4,304	17,006	3,373	24,684	37,313	
Aug-63	291	-	63	355	-	Y
Sep-63	256	1,377	56	1,689	3,021	
Oct-63	210	1,230	940	2,380	2,698	
Nov-63	1,054	6,125	2,873	10,051	13,438	
Dec-63	2,268	12,393	3,341	18,002	27,192	
Jan-64	2,116	2,664	315	5,095	5,844	
Feb-64	4,095	15,617	3,542	23,254	34,265	
Mar-64	5,360	9,698	1,433	16,491	21,278	
Apr-64	4,313	2,620	940	7,874	5,749	Y
May-64	1,718	509	2,406	4,632	1,116	Y
Jun-64	17,407	25,864	3,846	47,116	56,747	
Jul-64	943	2,771	1,984	5,698	6,080	
Aug-64	1,434	681	313	2,428	1,495	Y

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Sep-64	11,332	28,702	2,469	42,503	62,974	
Oct-64	2,410	6,979	2,243	11,632	15,311	
Nov-64	523	3,103	2,461	6,086	6,807	
Dec-64	794	856	790	2,439	1,878	Y
Jan-65	36,461	35,016	8,225	79,701	76,826	Y
Feb-65	55,753	44,640	8,658	109,051	97,943	Y
Mar-65	4,978	3,218	658	8,854	7,061	Y
Apr-65	4,129	4,819	1,323	10,271	10,573	
May-65	99,470	154,143	24,579	278,192	338,199	
Jun-65	40,640	39,706	6,349	86,696	87,118	
Jul-65	2,882	4,901	2,786	10,569	10,754	
Aug-65	1,795	-	391	2,186	-	Y
Sep-65	1,107	8,943	241	10,292	19,622	
Oct-65	5,254	14,328	3,909	23,491	31,436	
Nov-65	48,575	88,379	14,087	151,041	193,909	
Dec-65	17,005	33,720	3,698	54,423	73,984	
Jan-66	7,453	20,671	4,718	32,841	45,353	
Feb-66	15,971	40,347	7,901	64,220	88,525	
Mar-66	9,130	21,847	2,887	33,865	47,934	
Apr-66	34,763	53,635	9,818	98,216	117,677	
May-66	44,984	107,992	17,919	170,894	236,942	
Jun-66	8,299	26,069	3,883	38,250	57,196	
Jul-66	5,189	11,699	3,739	20,627	25,669	
Aug-66	2,572	12,377	560	15,509	27,155	
Sep-66	1,994	9,879	434	12,307	21,675	
Oct-66	1,056	4,917	1,776	7,748	10,787	
Nov-66	1,008	608	2,121	3,737	1,334	Y
Dec-66	1,225	1,048	832	3,105	2,299	Y
Jan-67	1,395	2,236	211	3,841	4,905	
Feb-67	1,090	1,016	968	3,075	2,229	Y
Mar-67	1,553	1,108	405	3,066	2,431	Y
Apr-67	4,342	7,007	1,703	13,053	15,374	
May-67	2,176	4,960	3,048	10,184	10,882	
Jun-67	540	561	-	1,101	1,230	
Jul-67	126	1,775	1,646	3,547	3,895	
Aug-67	982	15,814	214	17,010	34,698	
Sep-67	111,966	211,623	24,394	347,982	464,314	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Oct-67	51,582	60,435	14,359	126,376	132,598	
Nov-67	4,887	4,344	2,630	11,861	9,530	Y
Dec-67	2,723	1,819	1,003	5,545	3,992	Y
Jan-68	61,217	167,362	40,582	269,161	367,203	
Feb-68	8,727	14,373	3,323	26,423	31,535	
Mar-68	10,017	13,911	1,937	25,865	30,521	
Apr-68	13,108	15,556	3,191	31,856	34,131	
May-68	83,488	122,224	19,973	225,685	268,168	
Jun-68	114,656	290,873	51,778	457,307	638,194	
Jul-68	12,628	32,637	6,816	52,081	71,607	
Aug-68	3,621	3,512	789	7,921	7,704	Y
Sep-68	6,407	18,437	1,396	26,240	40,451	
Oct-68	2,654	13,734	3,774	20,163	30,134	
Nov-68	2,757	9,831	3,378	15,966	21,569	
Dec-68	12,305	28,904	6,991	48,200	63,417	
Jan-69	6,820	17,134	3,853	27,807	37,593	
Feb-69	62,639	112,799	20,672	196,110	247,489	
Mar-69	44,111	75,738	9,337	129,185	166,173	
Apr-69	83,346	97,419	17,437	198,202	213,743	
May-69	87,432	129,448	21,015	237,895	284,017	
Jun-69	6,580	8,124	637	15,341	17,825	
Jul-69	2,815	-	2,758	5,572	-	Y
Aug-69	2,063	-	450	2,513	-	Y
Sep-69	2,974	11,554	648	15,176	25,350	
Oct-69	7,455	12,651	3,529	23,634	27,756	
Nov-69	3,713	8,063	3,137	14,914	17,691	
Dec-69	18,140	27,152	6,604	51,896	59,574	
Jan-70	16,469	28,229	6,566	51,263	61,936	
Feb-70	3,938	3,797	1,458	9,193	8,330	Y
Mar-70	22,337	66,160	8,191	96,688	145,159	
Apr-70	4,698	9,298	2,102	16,098	20,400	
May-70	76,769	120,683	19,750	217,202	264,786	
Jun-70	26,067	31,538	4,872	62,476	69,195	
Jul-70	3,575	10,753	3,072	17,399	23,592	
Aug-70	2,545	706	555	3,805	1,549	Y
Sep-70	21,676	68,563	4,723	94,961	150,431	
Oct-70	16,111	77,280	18,177	111,567	169,556	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Nov-70	2,351	3,922	2,573	8,845	8,605	Y
Dec-70	2,014	1,813	1,001	4,828	3,978	Y
Jan-71	1,893	1,736	89	3,717	3,810	
Feb-71	1,954	2,456	1,222	5,632	5,388	Y
Mar-71	2,177	1,545	457	4,179	3,389	Y
Apr-71	1,677	4,115	1,200	6,992	9,028	
May-71	1,344	2,991	2,764	7,099	6,562	Y
Jun-71	5,208	209	-	5,416	458	Y
Jul-71	979	941	1,998	3,918	2,065	Y
Aug-71	39,396	34,665	8,583	82,645	76,057	Y
Sep-71	83,037	113,170	18,091	214,297	248,301	
Oct-71	22,025	56,153	13,388	91,565	123,203	
Nov-71	4,689	3,111	2,462	10,262	6,825	Y
Dec-71	33,969	55,690	12,914	102,573	122,188	
Jan-72	21,834	29,230	6,810	57,875	64,132	
Feb-72	26,465	57,083	10,851	94,399	125,244	
Mar-72	13,857	16,061	2,195	32,112	35,238	
Apr-72	3,703	4,842	1,327	9,872	10,624	
May-72	190,906	252,635	38,794	482,335	554,297	
Jun-72	23,518	40,423	6,479	70,421	88,692	
Jul-72	6,396	18,404	4,239	29,039	40,380	
Aug-72	6,351	9,626	1,384	17,361	21,121	
Sep-72	2,719	9,928	593	13,240	21,782	
Oct-72	2,286	4,829	1,756	8,871	10,595	
Nov-72	2,287	4,122	2,600	9,009	9,043	
Dec-72	2,034	1,684	973	4,691	3,696	Y
Jan-73	4,241	10,376	2,201	16,818	22,765	
Feb-73	9,384	21,451	4,570	35,405	47,066	
Mar-73	65,214	106,304	12,995	184,513	233,238	
Apr-73	153,465	228,415	40,234	422,114	501,157	
May-73	34,011	39,607	8,049	81,667	86,899	
Jun-73	297,620	547,560	6,421	851,600	1,201,381	
Jul-73	23,547	29,094	11,332	63,973	63,834	Y
Aug-73	9,731	24,662	2,120	36,513	54,110	
Sep-73	14,272	97,355	3,109	114,736	213,602	
Oct-73	110,068	125,784	29,170	265,022	275,978	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Nov-73	12,780	26,754	5,685	45,220	58,700	
Dec-73	7,737	10,250	2,867	20,853	22,489	
Jan-74	67,993	119,562	28,895	216,450	262,327	
Feb-74	13,186	15,615	3,542	32,342	34,260	
Mar-74	7,434	11,002	1,589	20,025	24,139	
Apr-74	5,793	20,507	4,053	30,352	44,993	
May-74	30,763	56,163	10,438	97,363	123,224	
Jun-74	50,672	52,564	8,675	111,910	115,328	
Jul-74	3,711	6,367	3,128	13,205	13,969	
Aug-74	6,331	12,574	1,379	20,284	27,588	
Sep-74	90,222	249,150	19,657	359,028	546,650	
Oct-74	8,809	16,771	4,463	30,042	36,797	
Nov-74	37,728	96,880	15,246	149,853	212,560	
Dec-74	17,133	32,552	7,798	57,483	71,421	
Jan-75	10,307	17,713	3,995	32,015	38,864	
Feb-75	9,521	12,910	3,065	25,496	28,326	
Mar-75	5,815	5,391	918	12,123	11,828	Y
Apr-75	34,849	37,584	7,025	79,457	82,462	
May-75	105,958	156,996	24,991	287,944	344,459	
Jun-75	28,735	69,535	11,744	110,014	152,564	
Jul-75	27,225	30,993	12,854	71,071	68,000	Y
Aug-75	5,837	15,915	1,272	23,023	34,918	
Sep-75	4,420	18,129	963	23,512	39,776	
Oct-75	3,397	9,505	2,816	15,717	20,853	
Nov-75	2,709	2,820	2,422	7,952	6,187	Y
Dec-75	12,620	33,252	7,953	53,824	72,957	
Jan-76	2,945	3,076	416	6,436	6,748	
Feb-76	2,351	2,338	1,201	5,890	5,129	Y
Mar-76	3,163	2,526	575	6,264	5,543	Y
Apr-76	31,366	34,089	6,416	71,872	74,794	
May-76	50,594	52,725	9,942	113,260	115,682	
Jun-76	16,888	43,330	7,005	67,223	95,069	
Jul-76	17,906	31,480	8,999	58,385	69,069	
Aug-76	2,344	-	511	2,855	-	Y
Sep-76	3,963	3,153	863	7,979	6,917	Y
Oct-76	54,965	36,569	8,950	100,483	80,234	Y
Nov-76	22,417	26,321	5,626	54,364	57,750	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Dec-76	147,442	209,574	4,142	361,158	459,820	
Jan-77	21,105	24,552	5,667	51,324	53,869	
Feb-77	60,594	82,184	15,275	158,054	180,317	
Mar-77	11,261	7,410	1,159	19,830	16,258	Y
Apr-77	55,437	100,678	18,004	174,119	220,893	
May-77	12,822	12,272	4,103	29,197	26,925	Y
Jun-77	17,450	41,755	6,720	65,926	91,614	
Jul-77	3,834	8,805	3,179	15,819	19,319	
Aug-77	2,103	-	458	2,561	-	Y
Sep-77	3,881	567	846	5,293	1,243	Y
Oct-77	1,537	2,824	935	5,295	6,195	
Nov-77	9,400	16,397	8,425	34,222	35,976	
Dec-77	2,788	1,750	134	4,671	3,839	Y
Jan-78	9,178	42,076	13,369	64,623	92,318	
Feb-78	9,177	24,466	7,563	41,206	53,679	
Mar-78	6,383	4,302	60	10,744	9,438	Y
Apr-78	15,092	14,144	3,441	32,677	31,033	Y
May-78	2,459	-	-	2,459	-	Y
Jun-78	8,217	21,767	4,939	34,922	47,757	
Jul-78	2,497	5,618	5,864	13,979	12,326	Y
Aug-78	1,049	-	-	1,049	-	Y
Sep-78	168,898	232,001	44,083	444,982	509,025	
Oct-78	7,571	9,387	3,144	20,102	20,596	
Nov-78	7,800	15,154	6,911	29,865	33,248	
Dec-78	4,372	6,312	4,179	14,863	13,850	Y
Jan-79	96,003	162,030	31,523	289,556	355,504	
Feb-79	44,823	74,721	16,322	135,865	163,942	
Mar-79	23,964	38,152	7,086	69,202	83,707	
Apr-79	63,800	104,768	27,537	196,104	229,867	
May-79	151,064	168,474	15,514	335,052	369,643	
Jun-79	89,903	42,014	5,093	137,009	92,180	Y
Jul-79	10,076	14,955	6,900	31,931	32,812	
Aug-79	4,334	652	2,130	7,116	1,430	Y
Sep-79	49,278	128,628	60,917	238,822	282,217	
Oct-79	3,916	1,231	160	5,307	2,701	Y
Nov-79	2,806	3,272	1,059	7,137	7,178	
Dec-79	3,489	2,974	4,083	10,546	6,526	Y

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Jan-80	31,759	103,236	54,103	189,098	226,507	
Feb-80	13,598	15,034	4,061	32,692	32,984	
Mar-80	4,750	4,412	541	9,703	9,680	Y
Apr-80	4,019	4,068	1,069	9,156	8,926	Y
May-80	52,619	69,045	14,784	136,447	151,488	
Jun-80	3,414	3,168	-	6,582	6,951	
Jul-80	1,635	9,876	656	12,167	21,669	
Aug-80	1,043	828	-	1,871	1,816	Y
Sep-80	2,070	1,228	4,728	8,025	2,694	Y
Oct-80	1,899	20,945	6,493	29,336	45,954	
Nov-80	1,252	3,513	453	5,218	7,707	
Dec-80	1,552	4,780	886	7,218	10,487	
Jan-81	2,257	4,707	1,020	7,984	10,328	
Feb-81	1,507	4,322	343	6,171	9,482	
Mar-81	1,988	7,859	214	10,062	17,244	
Apr-81	9,672	18,932	3,056	31,660	41,539	
May-81	14,212	26,752	19,217	60,180	58,696	Y
Jun-81	137,738	187,303	42,364	367,405	410,955	
Jul-81	22,820	29,811	14,909	67,540	65,407	Y
Aug-81	4,350	44,652	2,271	51,273	97,970	
Sep-81	141,120	268,255	10,460	419,835	588,569	
Oct-81	16,447	42,492	12,831	71,770	93,230	
Nov-81	103,563	182,641	20,204	306,408	400,727	
Dec-81	8,562	14,589	290	23,441	32,010	
Jan-82	5,997	2,421	50	8,469	5,312	Y
Feb-82	32,877	32,131	8,013	73,020	70,497	Y
Mar-82	10,033	11,965	783	22,780	26,251	
Apr-82	6,295	14,189	3,819	24,303	31,132	
May-82	198,967	217,862	42,052	458,882	478,004	
Jun-82	9,155	7,822	-	16,977	17,162	
Jul-82	3,775	13,697	825	18,297	30,052	
Aug-82	1,727	-	-	1,727	-	Y
Sep-82	3,433	3,202	370	7,005	7,026	
Oct-82	2,987	6,381	1,859	11,226	13,999	
Nov-82	64,093	83,009	22,935	170,038	182,127	
Dec-82	11,112	-	3,363	14,475	-	Y
Jan-83	12,829	46,077	5,750	64,655	101,095	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Feb-83	46,769	113,035	21,530	181,333	248,005	
Mar-83	50,939	97,569	14,949	163,457	214,073	
Apr-83	7,101	22,906	700	30,708	50,257	
May-83	21,867	30,901	2,180	54,948	67,798	
Jun-83	5,499	8,783	-	14,282	19,271	
Jul-83	54,135	20,609	23,308	98,051	45,217	Y
Aug-83	8,224	-	3,583	11,807	-	Y
Sep-83	8,796	81,517	24,359	114,672	178,853	
Oct-83	12,716	113,014	32,627	158,357	247,960	
Nov-83	28,025	68,104	6,764	102,893	149,424	
Dec-83	3,857	745	1,810	6,412	1,635	Y
Jan-84	19,804	39,842	5,343	64,989	87,416	
Feb-84	5,813	18,051	1,683	25,547	39,605	
Mar-84	6,873	12,423	191	19,488	27,258	
Apr-84	3,200	10,003	1,206	14,408	21,947	
May-84	4,350	-	7,802	12,152	-	Y
Jun-84	4,006	8,896	-	12,903	19,519	
Jul-84	1,063	14,272	3,078	18,413	31,313	
Aug-84	804	3,087	69	3,961	6,774	
Sep-84	526	581	30	1,137	1,275	
Oct-84	20,707	134,262	29,868	184,836	294,579	
Nov-84	3,594	11,262	2,863	17,719	24,710	
Dec-84	3,485	8,906	1,283	13,673	19,541	
Jan-85	21,703	56,254	7,704	85,660	123,425	
Feb-85	20,283	29,602	5,332	55,217	64,949	
Mar-85	40,571	113,626	21,870	176,067	249,302	
Apr-85	112,956	134,281	27,037	274,275	294,622	
May-85	13,127	23,851	1,485	38,463	52,330	
Jun-85	5,543	13,221	1,097	19,861	29,008	
Jul-85	11,073	19,427	3,642	34,143	42,624	
Aug-85	918	8,649	151	9,718	18,976	
Sep-85	2,556	9,883	2,408	14,847	21,684	
Oct-85	3,455	19,368	7,893	30,717	42,495	
Nov-85	49,337	133,474	23,707	206,517	292,850	
Dec-85	7,270	33,690	6,661	47,620	73,917	
Jan-86	3,032	1,428	154	4,614	3,133	Y
Feb-86	3,500	3,020	74	6,593	6,626	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Mar-86	2,280	-	94	2,375	-	Y
Apr-86	1,457	7,610	943	10,011	16,697	
May-86	2,398	7,776	1,765	11,938	17,060	
Jun-86	62,335	111,005	22,573	195,912	243,551	
Jul-86	1,775	13,230	1,594	16,599	29,027	
Aug-86	594	5,269	-	5,863	11,559	
Sep-86	2,572	13,743	2,156	18,470	30,153	
Oct-86	6,732	26,802	7,207	40,741	58,806	
Nov-86	1,908	26,877	2,751	31,535	58,969	
Dec-86	64,214	94,937	21,858	181,009	208,297	
Jan-87	18,126	30,113	7,044	55,283	66,071	
Feb-87	53,338	64,122	12,821	130,281	140,688	
Mar-87	16,814	21,759	2,805	41,378	47,740	
Apr-87	3,434	10,222	1,143	14,800	22,428	
May-87	7,726	40,335	14,322	62,383	88,497	
Jun-87	287,605	242,684	35,054	565,343	532,465	Y
Jul-87	11,639	30,692	5,467	47,798	67,341	
Aug-87	3,187	4,556	574	8,316	9,996	
Sep-87	2,105	2,314	-	4,418	5,076	
Oct-87	1,456	-	-	1,456	-	Y
Nov-87	13,067	55,879	12,549	81,494	122,602	
Dec-87	16,332	50,404	11,072	77,808	110,590	
Jan-88	2,975	6,034	577	9,585	13,238	
Feb-88	2,184	-	124	2,308	-	Y
Mar-88	3,084	15,363	1,995	20,442	33,708	
Apr-88	2,082	16,952	2,647	21,681	37,194	
May-88	5,178	9,920	982	16,080	21,766	
Jun-88	4,922	7,005	-	11,927	15,369	
Jul-88	3,533	16,048	1,381	20,963	35,211	
Aug-88	361	5,700	803	6,865	12,507	
Sep-88	84	-	-	84	-	Y
Oct-88	105	10,589	1,690	12,385	23,234	
Nov-88	205	809	604	1,617	1,776	
Dec-88	530	8,037	2,208	10,775	17,634	
Jan-89	10,120	70,647	17,638	98,405	155,004	
Feb-89	3,871	10,118	1,685	15,674	22,200	
Mar-89	2,062	8,592	146	10,800	18,850	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
Apr-89	1,053	2,832	758	4,643	6,212	
May-89	9,733	86,835	18,621	115,189	190,522	
Jun-89	2,283	10,115	793	13,191	22,193	
Jul-89	213	4,945	1,403	6,560	10,849	
Aug-89	-	2,332	-	2,332	5,117	
Sep-89	-	-	-	-	-	
Oct-89	18	3,565	-	3,583	7,822	
Nov-89	66	4,143	386	4,595	9,091	
Dec-89	193	-	125	318	-	Y
Jan-90	512	2,132	247	2,891	4,679	
Feb-90	1,190	23,189	3,549	27,928	50,879	
Mar-90	5,868	47,176	5,102	58,147	103,508	
Apr-90	8,726	31,388	5,261	45,374	68,867	
May-90	3,989	17,466	8,168	29,623	38,322	
Jun-90	24	-	-	24	-	Y
Jul-90	1,446	19,552	1,562	22,560	42,898	
Aug-90	-	2,507	277	2,784	5,501	
Sep-90	1,374	10,740	3	12,118	23,564	
Oct-90	-	8,275	1,457	9,732	18,155	
Nov-90	17	946	444	1,406	2,075	
Dec-90	-	-	20	20	-	Y
Jan-91	34,505	92,023	24,377	150,905	201,904	
Feb-91	11,496	36,576	5,906	53,978	80,249	
Mar-91	1,971	10,447	2,182	14,599	22,920	
Apr-91	82,404	151,111	32,887	266,403	331,548	
May-91	9,763	18,979	2,070	30,812	41,641	
Jun-91	4,161	24,216	4,578	32,954	53,130	
Jul-91	9,770	25,671	7,112	42,553	56,324	
Aug-91	94	6,981	455	7,529	15,316	
Sep-91	2,636	20,429	6,810	29,875	44,822	
Oct-91	655	663	879	2,197	1,455	Y
Nov-91	4,420	788	791	5,999	1,729	Y
Dec-91	133,097	162,661	36,141	331,899	356,887	
Jan-92	92,413	168,751	33,892	295,056	370,251	
Feb-92	299,673	407,807	71,385	778,865	894,754	
Mar-92	42,029	70,346	5,526	117,901	154,344	
Apr-92	164,461	183,690	21,615	369,765	403,027	

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
May-92	151,256	221,930	29,573	402,759	486,929	
Jun-92	104,544	103,212	9,334	217,091	226,454	
Jul-92	6,599	18,257	3,244	28,100	40,057	
Aug-92	2,707	5,631	32	8,370	12,356	
Sep-92	1,824	4,500	2,181	8,505	9,873	
Oct-92	1,865	5,207	-	7,071	11,423	
Nov-92	6,655	43,046	10,933	60,634	94,446	
Dec-92	17,435	29,479	7,047	53,961	64,678	
Jan-93	16,995	46,255	7,890	71,140	101,487	
Feb-93	20,673	72,294	16,974	109,941	158,617	
Mar-93	43,394	59,380	8,318	111,092	130,283	
Apr-93	28,742	59,160	9,954	97,856	129,801	
May-93	138,379	216,965	42,891	398,234	476,035	
Jun-93	236,335	302,170	56,251	594,755	662,979	
Jul-93	10,624	25,934	2,382	38,940	56,901	
Aug-93	3,330	14,541	1,006	18,877	31,904	
Sep-93	1,801	587	-	2,388	1,287	Y
Oct-93	2,082	20,610	3,710	26,402	45,220	
Nov-93	1,732	289	3,605	5,626	635	Y
Dec-93	2,635	34,901	1,090	38,626	76,575	
Jan-94	2,454	5,773	219	8,446	12,666	
Feb-94	1,747	-	141	1,889	-	Y
Mar-94	6,738	21,142	5,845	33,725	46,387	
Apr-94	2,937	29,919	2,612	35,468	65,645	
May-94	95,673	102,981	11,102	209,756	225,947	
Jun-94	6,177	50,608	8,444	65,229	111,037	
Jul-94	1,271	8,469	928	10,668	18,581	
Aug-94	1,335	21,192	1,743	24,269	46,496	
Sep-94	5,268	10,211	2,587	18,066	22,404	
Oct-94	437,500	468,800	105,469	1,011,768	1,028,576	
Nov-94	8,182	4,132	425	12,739	9,066	Y
Dec-94	18,432	62,939	21,424	102,795	138,091	
Jan-95	35,600	64,397	13,898	113,895	141,292	
Feb-95	5,987	2,317	396	8,700	5,084	Y
Mar-95	37,653	133,214	7,982	178,849	292,280	
Apr-95	35,491	393	5,130	41,014	862	Y

Date	Modeled Naturalized Flow (ac-ft)					EP000 < Sum of Upstream Primary CPs?
	GS300	GS500	WGS800	Sum of Upstream Primary CPs	EP000	
May-95	10,051	94,707	5,026	109,784	207,793	
Jun-95	17,997	1,127	4,779	23,902	2,472	Y
Jul-95	2,881	30,833	9,096	42,810	67,650	
Aug-95	2,233	11,869	1,918	16,019	26,040	
Sep-95	961	6,543	1,987	9,490	14,355	
Oct-95	605	-	-	605	-	Y
Nov-95	3,306	8,376	3,354	15,037	18,378	
Dec-95	4,891	40,223	13,354	58,468	88,251	
Jan-96	1,200	5,397	467	7,064	11,842	
Feb-96	882	2,252	122	3,256	4,942	
Mar-96	1,162	8,030	186	9,377	17,618	
Apr-96	964	6,730	807	8,501	14,765	
May-96	506	11,317	17	11,839	24,830	
Jun-96	7,573	45,380	7,178	60,131	99,567	
Jul-96	1,723	10,988	2,499	15,209	24,107	
Aug-96	5,304	1,859	6,903	14,065	4,078	Y
Sep-96	39,311	32,443	15,636	87,390	71,182	Y
Oct-96	1,619	-	-	1,619	-	Y
Nov-96	1,849	5,784	5,672	13,305	12,691	Y
Dec-96	3,955	7,627	5,221	16,803	16,735	Y

APPENDIX 3C

TCEQ Active Water Rights

WRNo	WRType	Permit #	WR Issue Date	Amendment Letter	OwnerName	Diversion Amount (AFY)	UseCode	Priority Date	Consumptive Amt	Acreage	Basin Number	Water Master	County
2078	ADJ	2078	07/03/1981		DUPONT, NANIE MAE | FARQUHAR, FRANCES | GAYLE, A D JR | GAYLE, GEORGE S JR | LAWRENCE, VIRGINIA G | ORMAN, ELIZABETH L | SHOEMATE, CATHERINE L | SIMONS, A G | SIMONS, LILLIAN H | SIMONS, M T JR | SIMONS, W C | STELL, REGINA E | WRIGHT, ELEANOR	450.0000	AGRICULTURE - IRRIGATION	12/10/1938			16	SOUTH TEXAS	JACKSON
2078	ADJ	2078	07/03/1981		DUPONT, NANIE MAE | FARQUHAR, FRANCES | GAYLE, A D JR | GAYLE, GEORGE S JR | LAWRENCE, VIRGINIA G | ORMAN, ELIZABETH L | SHOEMATE, CATHERINE L | SIMONS, A G | SIMONS, LILLIAN H | SIMONS, M T JR | SIMONS, W C | STELL, REGINA E | WRIGHT, ELEANOR	1138.0000	AGRICULTURE - IRRIGATION	09/30/1903			16	SOUTH TEXAS	JACKSON
2084	ADJ	2084	07/03/1981		ESTATE OF ET ROSE DECEASED	400.0000	AGRICULTURE - IRRIGATION	11/10/1950			16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	18122.0000	OTHER	10/06/1993			16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	42518.0000	MUNICIPAL/DOMESTIC | NAVIGATION	05/15/1972		170300.0000	16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	32482.0000	INDUSTRIAL | NAVIGATION | RECREATION	05/15/1972			16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	7150.0000	MUNICIPAL/DOMESTIC	05/15/1972		93340.0000	16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	22850.0000	INDUSTRIAL | RECREATION	05/15/1972			16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	4000.0000	MUNICIPAL/DOMESTIC | NAVIGATION	05/24/1982			16	SOUTH TEXAS	JACKSON
2095	ADJ	2095	07/03/1981	E	LAVACA-NAVIDAD RIVER AUTHORITY	7500.0000	INDUSTRIAL | MUNICIPAL/DOMESTIC	07/01/2002			16	SOUTH TEXAS	JACKSON
2097	ADJ	2097	07/03/1981		GEBRUEDER VIEHOF FARMS OHG	95.0000	AGRICULTURE - IRRIGATION	11/17/1939			16	SOUTH TEXAS	JACKSON
2098	ADJ	2098	07/03/1981	A	STAFFORD, BURR JED | STAFFORD, HARRISON | STAFFORD, HARRISON II	452.5000	AGRICULTURE - IRRIGATION	11/17/1939			16	SOUTH TEXAS	JACKSON
2098	ADJ	2098	07/03/1981	A	STAFFORD, BURR JED | STAFFORD, HARRISON | STAFFORD, HARRISON II	747.5000	AGRICULTURE - IRRIGATION	11/22/1982			16	SOUTH TEXAS	JACKSON
2099	ADJ	2099	07/03/1981		STAFFORD, BURR JED | STAFFORD, HARRISON | STAFFORD, HARRISON II	226.2500	AGRICULTURE - IRRIGATION	11/17/1939			16	SOUTH TEXAS	JACKSON
2100	ADJ	2100	07/03/1981		STAFFORD, BURR JED | STAFFORD, HARRISON | STAFFORD, HARRISON II	226.2500	AGRICULTURE - IRRIGATION	11/17/1939			16	SOUTH TEXAS	JACKSON
2101	ADJ	2101	07/03/1981		KOOP, FRANCIS	1000.0000	AGRICULTURE - IRRIGATION	11/28/1939			16	SOUTH TEXAS	JACKSON
3827	WRPERM	4123	08/03/1981		SWENSON, ALBERT W | SWENSON, CLAUDIA P	100.0000	AGRICULTURE - IRRIGATION	05/11/1981			15	NOT IN WM AREA	JACKSON
3884	WRPERM	4192	06/18/1982	B	FORMOSA PLASTICS CORPORATION TEXAS	9000.0000	AGRICULTURE - IRRIGATION	03/01/1982		1120.0000	15	NOT IN WM AREA	JACKSON
3978	WRPERM	4296	05/19/1983		JAVELIN HOLDING LIMITED LIABILITY COMPANY	1200.0000	AGRICULTURE - IRRIGATION	01/03/1983		480.0000	16	SOUTH TEXAS	JACKSON
3978	WRPERM	4296	05/19/1983		2001 CAVALCADE INC | OWEN ENTERPRISES LLC	600.0000	AGRICULTURE - IRRIGATION	01/03/1983			16	SOUTH TEXAS	JACKSON
4085	WRPERM	4353	03/14/1984	B	ROLAND CARLSON LLC	500.0000	AGRICULTURE - IRRIGATION	04/18/1983			16	SOUTH TEXAS	JACKSON
4791	ADJ	4791	01/20/1987		FORMOSA PLASTICS CORPORATION TEXAS	11035.0000	AGRICULTURE - IRRIGATION	12/20/1976		900.0000	15	NOT IN WM AREA	JACKSON
5120	WRPERM	5120	06/10/1987		BABB, MURIEL | MARTIN, CHARLES D | MARTIN, DOROTHY MCCARTER | MARTIN, ROBERT | T J BABB HEIRS REVOCABLE TRUST | YATES, ELEANOR V	2500.0000	AGRICULTURE - IRRIGATION	02/19/1987			17	SOUTH TEXAS	JACKSON
5487	WRPERM	5487	08/08/1994		SWENSON, ALAN P | SWENSON, BRIAN M | SWENSON, SHARON	35.0000	AGRICULTURE - IRRIGATION	05/20/1994		8.0000	15	NOT IN WM AREA	JACKSON
5584	WRPERM	5584	10/27/1997		JACKSON COUNTY	1.5200	INDUSTRIAL	04/24/1997			16	SOUTH TEXAS	JACKSON
2077	ADJ	2077	07/03/1981		BOZKA, MATT J	4.0000	AGRICULTURE - IRRIGATION	12/31/1956			16	SOUTH TEXAS	LAVACA
2077	ADJ	2077	07/03/1981		BOZKA, MATT J	61.0000	AGRICULTURE - IRRIGATION	02/28/1949		10.0000	16	SOUTH TEXAS	LAVACA
2096	ADJ	2096	07/03/1981		MRAZ, VLASTA	33.0000	AGRICULTURE - IRRIGATION	02/28/1961		12.0000	16	SOUTH TEXAS	LAVACA
2096	ADJ	2096	07/03/1981		MRAZ, VLASTA		AGRICULTURE - IRRIGATION	02/28/1961		12.0000	16	SOUTH TEXAS	LAVACA
3912	WRPERM	4185	10/14/1982	A	JO ANN LEAVESLEY FAMILY TRUST | LEAVESLEY, JOHN E	340.0000	AGRICULTURE - IRRIGATION	02/08/1982		100.0000	16	SOUTH TEXAS	LAVACA
4102	WRPERM	4327	04/19/1984	A	T-BAR-D LLC	57.0000	AGRICULTURE - IRRIGATION	02/22/1983			16	SOUTH TEXAS	LAVACA
5130	WRPERM	5130	07/15/1987	A	CITY OF MOULTON		RECREATION	04/24/1987		6.0800	16	SOUTH TEXAS	LAVACA
5370	WRPERM	5370	10/15/1991	A	PAULA LOUISE ROBINSON TRUST	900.0000	AGRICULTURE - IRRIGATION	07/01/1991		356.0000	16	SOUTH TEXAS	LAVACA
2082	ADJ	2082	07/03/1981		EL RANCHO DE LOS PATOS INC	932.0000	AGRICULTURE - IRRIGATION	03/31/1929			16	SOUTH TEXAS	WHARTON
2083	ADJ	2083	07/03/1981		RAUN, NORRIS	2400.0000	AGRICULTURE - IRRIGATION	10/27/1969			16	SOUTH TEXAS	WHARTON
2083	ADJ	2083	07/03/1981		RAUN, NORRIS	623.2000	AGRICULTURE - IRRIGATION	05/10/1948			16	SOUTH TEXAS	WHARTON
2090	ADJ	2090	07/03/1981		ROD, KEN | ROD, MELISSA Z	527.0000	AGRICULTURE - IRRIGATION	03/31/1956			16	SOUTH TEXAS	WHARTON
2091	ADJ	2091	07/03/1981	B	BIRKNER, JACK | BIRKNER, MARY LOU	290.0000	AGRICULTURE - IRRIGATION	03/31/1953			16	SOUTH TEXAS	WHARTON
2092	ADJ	2092	07/03/1981		DEFRIEND, CHARLOTTE | DEFRIEND, MARK	990.0000	AGRICULTURE - IRRIGATION	03/30/1945			16	SOUTH TEXAS	WHARTON
2093	ADJ	2093	07/03/1981		TUCKER, EVA REIGH	1750.0000	AGRICULTURE - IRRIGATION	07/31/1964			16	SOUTH TEXAS	WHARTON
2094	ADJ	2094	07/03/1981		ALLEN, GRADY | ESTATE OF J K ALLEN	640.0000	AGRICULTURE - IRRIGATION	04/30/1952			16	SOUTH TEXAS	WHARTON
3665	WRPERM	3958	04/23/1979	A	BIRKNER, JACK | BIRKNER, MARY LOU	211.0000	AGRICULTURE - IRRIGATION	01/29/1979			16	SOUTH TEXAS	WHARTON
3725	WRPERM	4019	04/22/1980		BAIN, CARL B	420.0000	AGRICULTURE - IRRIGATION	01/21/1980			16	SOUTH TEXAS	WHARTON
3727	WRPERM	4021	04/23/1980		SCHMIDT, GREGORY PAUL | SCHMIDT, ROBERT JOHN	913.0000	AGRICULTURE - IRRIGATION	01/21/1980			16	SOUTH TEXAS	WHARTON
3836	WRPERM	4132	10/23/1981		VITERA, HARRY E	550.0000	AGRICULTURE - IRRIGATION	05/26/1981			16	SOUTH TEXAS	WHARTON
3876	WRPERM	4129	06/04/1982	A	MEEK, ALAN WAYNE	47.1200	AGRICULTURE - IRRIGATION	05/18/1981			16	SOUTH TEXAS	WHARTON
3876	WRPERM	4129	06/04/1982	A	MEEK, BRIAN NELSON	208.0500	AGRICULTURE - IRRIGATION	05/18/1981			16	SOUTH TEXAS	WHARTON
3876	WRPERM	4129	06/04/1982	A	MEEK, DALE CHARLES	208.0500	AGRICULTURE - IRRIGATION	05/18/1981			16	SOUTH TEXAS	WHARTON
3876	WRPERM	4129	06/04/1982	A	MEEK, GARY KENNETH	160.9300	AGRICULTURE - IRRIGATION	05/18/1981			16	SOUTH TEXAS	WHARTON
3876	WRPERM	4129	06/04/1982	A	MEEK, ALAN WAYNE	1.8500	AGRICULTURE - IRRIGATION	05/18/1981			16	SOUTH TEXAS	WHARTON
3903	WRPERM	4158	10/14/1982		MUSTANG EXPLORATION CO LTD	800.0000	AGRICULTURE - IRRIGATION	11/16/1981			16	SOUTH TEXAS	WHARTON
3905	WRPERM	4161	10/14/1982	A	EL RANCHO DE LOS PATOS INC	1332.0000	AGRICULTURE - IRRIGATION	11/16/1981			16	SOUTH TEXAS	WHARTON
3907	WRPERM	4163	10/14/1982		ESTATE OF J K ALLEN	640.0000	AGRICULTURE - IRRIGATION	11/16/1981		1.0000	16	SOUTH TEXAS	WHARTON
3907	WRPERM	4163	10/14/1982		ESTATE OF J K ALLEN	520.0000	AGRICULTURE - IRRIGATION	11/16/1981		1.0000	16	SOUTH TEXAS	WHARTON
3909	WRPERM	4165	10/14/1982		HALAMICEK, KATHLEEN	350.0000	AGRICULTURE - IRRIGATION	11/16/1981		45.0000	16	SOUTH TEXAS	WHARTON
3910	WRPERM	4166	10/14/1982		DERNEHL, WILBERT O	1000.0000	AGRICULTURE - IRRIGATION	11/16/1981		63.0000	16	SOUTH TEXAS	WHARTON
3911	WRPERM	4174	10/14/1982		WIGGINTON, ELAINE | WIGGINTON, GAYNARD	400.0000	AGRICULTURE - IRRIGATION	12/07/1981		2.0000	16	SOUTH TEXAS	WHARTON
4241	WRPERM	4560	08/01/1985	B	WEINHEIMER, EDMUND A JR	272.6300	AGRICULTURE - IRRIGATION	04/30/1985		25.2000	16	SOUTH TEXAS	WHARTON
4252	WRPERM	4559	10/03/1985	A	RAUN, NORRIS | RAUN, RICHARD T | RAUN, TRAVIS NORRIS	5500.0000	AGRICULTURE - IRRIGATION	04/16/1985		4.9000	16	SOUTH TEXAS	WHARTON
5168	WRPERM	5168	06/17/1988	A	RICHARDS BROTHERS COMPANY	1092.0000	AGRICULTURE - IRRIGATION	02/02/1988	1092.0000	2.0000	16	SOUTH TEXAS	WHARTON
5168	WRPERM	5168	06/17/1988	A	RICHARDS BROTHERS COMPANY	651.0000	AGRICULTURE - WILDLIFE MANAGEMENT | RECREATI	02/02/1988	651.0000	334.0000	16	SOUTH TEXAS	WHARTON
5263	WRPERM	5263	03/08/1990	A	WEINHEIMER, EDMUND A JR	90.0000	AGRICULTURE - IRRIGATION	11/21/1989			16	SOUTH TEXAS	WHARTON
5579	WRPERM	5579	03/18/2003		SEIFMAN, SARA A | SEIFMAN, WILLIAM R	200.0000	AGRICULTURE - IRRIGATION	03/07/1997			16	SOUTH TEXAS	WHARTON
5595	WRPERM	5595	09/27/2000		GOFF, E G | GOFF, JAN | GOFF, KENNETH	1550.0000	AGRICULTURE - IRRIGATION	09/27/2000			16	SOUTH TEXAS	WHARTON
5678	WRPERM	5678	11/14/2000		RICHARDS BROTHERS COMPANY	120.0000	AGRICULTURE - IRRIGATION	07/27/2000			16	SOUTH TEXAS	WHARTON
5706	WRPERM	5706	03/27/2002		BRANDL, ANTON JR | BRANDL, DOROTHY	104.4000	AGRICULTURE - IRRIGATION	10/01/2000			16	SOUTH TEXAS	WHARTON

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List of Appendices

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Chapter 4 – Identification of Water Needs

This chapter describes the analysis performed to identify water user groups (WUGs) with water shortages, also known as water needs. In *Chapter 5*, water management strategies have been defined for each of the identified future water shortages within LRWPA as required by the regional water planning process.

4.1 Identification of Water Needs

In *Chapter 2*, water demands were identified for all WUGs. In *Chapter 3*, water supplies available to the Lavaca Regional Water Planning Area (LRWPA) were identified and allocated to WUGs and Major Water Providers (MWPs) based on current usage and contracts. Projected surpluses and shortages were determined by matching the supplies and the demands. The *WUG Needs Report* in *Appendix 4A* lists all WUGs within the LRWPA with shortages.

Total water demands in the LRWPA were 206,304 ac-ft/yr in the year 2020 and are projected to decrease to 204,482 ac-ft/yr and 204,333 ac-ft/yr in years 2060 and 2070, respectively. Total water supplies allocated to WUGs in the region were estimated at 198,744 ac-ft/yr for 2020 and 198,825 ac-ft/yr for all planning periods between the years 2030 and 2070.

The sum of the projected shortages in the *WUG Needs Report* in *Appendix 4A* remains at 8,067 ac-ft/yr for the entire planning horizon from 2020 through 2070. As no WUGs are currently experiencing water shortages in LRWPA, it is assumed that the remaining demands have been made up by additional groundwater pumpage in excess of the supply numbers presented in *Chapter 3,* or with available interruptible surface water supplies.

LNRA, the Major Water Provider in the region, has 0 acre-feet of projected water needs through 2070 in the 2021 Lavaca RWP. Needs data for LNRA by category of use and by county/basin is provided in *Appendix 4A* in Tables 4A-1 and 4A-2. The WUGs in Lavaca County and Jackson County were found to experience no shortages through the year 2070. Irrigation in Wharton County within the Lavaca Basin will experience shortages in the planning area with a deficit of 8,067 ac-ft/yr from 2020 through 2070. There are no municipal shortages anticipated for LRWPA through the year 2070.

4.2 Socioeconomic Impact of Projected Water Shortages

For the 2021 Lavaca RWP, TWDB prepared the report *Socioeconomic Impacts of Projected Water Shortages for the Lavaca (Region P) Regional Water Planning Area*, along with corresponding reports for each of the other 15 regional water planning areas. The socioeconomic impacts within the Region P portion of Wharton County were summarized in this report. A copy of the report is included in *Appendix 4B*.

The socioeconomic impact reports for all 16 planning regions were divided into two components. The first of these is the economic impact module which addressed the potential impacts of unmet water demands on losses to regional economies resulting from reduced economic output caused by agricultural, industrial, or commercial water shortages. For the Lavaca Region, this portion of the report predicts what would occur if, in any given year, the Drought of Record recurs and the water demands anticipated in *Chapter 2* of this Plan cannot be met by the firm supplies shown in *Chapter 3*. Economic baseline data used in the analysis was generated from available year 2016 data using IMPLAN PRO™ distributed by the IMPLAN Group.

Additionally, methodology for socioeconomic impact analyses for the 2021 Regional Water Plans was provided by the TWDB as the second component of this analysis. The IMPLAN model estimates direct and indirect impacts to business, industry and agriculture, using output elasticities which were chosen to correlate the magnitude of the shortage as a percentage of the total demand to the resulting economic impact. Elasticities measure the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, shortages of 0 to 5 percent of the total demand were not expected to cause any reduction in output. Water shortages of between 5 and 50 percent were expected to see linear reductions in output for every 1 percent of unmet need, reaching the 100 percent negative impact level at 50 percent water shortage.

The socioeconomic impacts analysis examined multiple potential impacts of unmet water needs, including repercussions to tax revenues, income, employment, population, and school enrollment. The results of the study indicate income losses of $2 million for irrigated agriculture if needs are not met during a 1-year drought period. Unmet needs would result in the loss of an estimated 39 agricultural jobs, a population reduction of 7 people, and a decline in school enrollment of 1 student.

APPENDIX 4A

WUG Needs Report and MWP Needs Data

WUG NEEDS REPORT

REGION P			SPLIT WUG NEEDS (ACRE-FEET PER YEAR) *Surpluses Updated to Zero					
COUNTY	**BASIN**	**WUG**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
JACKSON	COLORADO-LAVACA	COUNTY-OTHER	0	0	0	0	0	0
JACKSON	COLORADO-LAVACA	IRRIGATION	0	0	0	0	0	0
JACKSON	COLORADO-LAVACA	LIVESTOCK	0	0	0	0	0	0
JACKSON	COLORADO-LAVACA	MANUFACTURING	0	0	0	0	0	0
JACKSON	COLORADO-LAVACA	MINING	0	0	0	0	0	0
JACKSON	LAVACA	COUNTY-OTHER	0	0	0	0	0	0
JACKSON	LAVACA	EDNA	0	0	0	0	0	0
JACKSON	LAVACA	GANADO	0	0	0	0	0	0
JACKSON	LAVACA	IRRIGATION	0	0	0	0	0	0
JACKSON	LAVACA	LIVESTOCK	0	0	0	0	0	0
JACKSON	LAVACA	MANUFACTURING	0	0	0	0	0	0
JACKSON	LAVACA	MINING	0	0	0	0	0	0
JACKSON	LAVACA-GUADALUPE	COUNTY-OTHER	0	0	0	0	0	0
JACKSON	LAVACA-GUADALUPE	IRRIGATION	0	0	0	0	0	0
JACKSON	LAVACA-GUADALUPE	LIVESTOCK	0	0	0	0	0	0
JACKSON	LAVACA-GUADALUPE	MANUFACTURING	0	0	0	0	0	0
JACKSON	LAVACA-GUADALUPE	MINING	0	0	0	0	0	0
LAVACA	GUADALUPE	COUNTY-OTHER	0	0	0	0	0	0
LAVACA	GUADALUPE	LIVESTOCK	0	0	0	0	0	0
LAVACA	LAVACA	COUNTY-OTHER	0	0	0	0	0	0
LAVACA	LAVACA	HALLETTSVILLE	0	0	0	0	0	0
LAVACA	LAVACA	IRRIGATION	0	0	0	0	0	0
LAVACA	LAVACA	LIVESTOCK	0	0	0	0	0	0
LAVACA	LAVACA	MANUFACTURING	0	0	0	0	0	0
LAVACA	LAVACA	MINING	0	0	0	0	0	0
LAVACA	LAVACA	MOULTON	0	0	0	0	0	0
LAVACA	LAVACA	SHINER	0	0	0	0	0	0
LAVACA	LAVACA	YOAKUM	0	0	0	0	0	0
LAVACA	LAVACA-GUADALUPE	COUNTY-OTHER	0	0	0	0	0	0
LAVACA	LAVACA-GUADALUPE	LIVESTOCK	0	0	0	0	0	0
WHARTON	COLORADO	COUNTY-OTHER	0	0	0	0	0	0
WHARTON	COLORADO	EL CAMPO	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	COUNTY-OTHER	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	EL CAMPO	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	IRRIGATION	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	LIVESTOCK	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	MANUFACTURING	0	0	0	0	0	0
WHARTON	COLORADO-LAVACA	MINING	0	0	0	0	0	0
WHARTON	LAVACA	COUNTY-OTHER	0	0	0	0	0	0
WHARTON	LAVACA	EL CAMPO	0	0	0	0	0	0
WHARTON	LAVACA	IRRIGATION	8,067	8,067	8,067	8,067	8,067	8,067
WHARTON	LAVACA	LIVESTOCK	0	0	0	0	0	0
REGION P TOTAL NEEDS			**8,067**	**8,067**	**8,067**	**8,067**	**8,067**	**8,067**

Table 4A-1 Major Water Provider Needs by Category of Use

				Contract Demand Needs/Surplus by Planning Decade (acre-feet/year)					
Region P Major Water Provider	**Buyer Entity**	**Buyer Entity Region**	**Buyer WUG Category**	**CNS 2020**	**CNS 2030**	**CNS 2040**	**CNS 2050**	**CNS 2060**	**CNS 2070**
LNRA	CORPUS CHRISTI	N	MUNICIPAL	0	0	0	0	0	0
LNRA	MANUFACTURING, CALHOUN	L	MANUFACTURING	0	0	0	0	0	0
LNRA	MANUFACTURING, JACKSON	P	MANUFACTURING	0	0	0	0	0	0
LNRA	POINT COMFORT	L	MUNICIPAL	0	0	0	0	0	0

Table 4A-2 Major Water Provider Needs by County and Basin

					Contract Demand Needs/Surplus by Planning Decade (acre-feet/year)					
Region P Major Water Provider	**Buyer Entity**	**Buyer Entity Region**	**Buyer Entity Split County**	**Buyer Entity Split Basin**	**CNS 2020**	**CNS 2030**	**CNS 2040**	**CNS 2050**	**CNS 2060**	**CNS 2070**
LNRA	CORPUS CHRISTI	N	NUECES	NUECES	0	0	0	0	0	0
LNRA	CORPUS CHRISTI	N	NUECES	NUECES-RIO GRANDE	0	0	0	0	0	0
LNRA	MANUFACTURING, CALHOUN	L	CALHOUN	COLORADO-LAVACA	0	0	0	0	0	0
LNRA	MANUFACTURING, CALHOUN	L	CALHOUN	LAVACA-GUADALUIPE	0	0	0	0	0	0
LNRA	MANUFACTURING, JACKSON	P	JACKSON	COLORADO-LAVACA	0	0	0	0	0	0
LNRA	POINT COMFORT	L	CALHOUN	COLORADO-LAVACA	0	0	0	0	0	0

APPENDIX 4B

Socioeconomic Impacts of Projected Water Shortages for the Lavaca (Region P) Regional Water Planning Area

Socioeconomic Impacts of Projected Water Shortages for the Lavaca (Region P) Regional Water Planning Area

Prepared in Support of the 2021 Region P Regional Water Plan

Texas Water Development Board

Dr. John R. Ellis
Water Use, Projections, & Planning Division
Texas Water Development Board

November 2019

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Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required analysis in the regional water planning process. The Texas Water Development Board (TWDB) estimates these impacts for regional water planning groups (RWPGs) and summarizes the impacts in the state water plan. The analysis presented is for the Lavaca Regional Water Planning Group (Region P).

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

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

For regional economic impacts, income losses and job losses are estimated within each planning decade (2020 through 2070). The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts are estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

IMPLAN data reported that Region P generated more than $1.3 billion in GDP (2018 dollars) and supported roughly 20,200 jobs in 2016. The Region P estimated total population was approximately 50,500 in 2016.

It is estimated that not meeting the identified water needs in Region P would result in an annually combined lost income impact of approximately $2 million in 2020 and $1 million in 2070 (Table ES-1). It is also estimated that the region would lose approximately 39 jobs in 2020 and 30 jobs in 2070.

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

Table ES-1 Region P socioeconomic impact summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$2	$2	$2	$2	$2	$1
Job losses	39	37	35	33	32	30
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$-	$-	$-	$-	$-	$-
Water trucking costs ($ millions)*	$-	$-	$-	$-	$-	$-
Utility revenue losses ($ millions)*	$-	$-	$-	$-	$-	$-
Utility tax revenue losses ($ millions)*	$-	$-	$-	$-	$-	$-
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$-	$-	$-	$-	$-	$-
Population losses	7	7	6	6	6	5
School enrollment losses	1	1	1	1	1	1

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

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on the regional economy in the short term, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government, and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

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

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

1.1 Regional Economic Summary

The Region P Regional Water Planning Area generated more than $1.3 billion in gross domestic product (2018 dollars) and supported roughly 20,200 jobs in 2016, according to the IMPLAN dataset utilized in this socioeconomic analysis. This activity accounted for 0.1 percent of the state's total gross domestic product of 1.73 trillion dollars for the year based on IMPLAN. Table 1-1 lists all economic sectors ranked by the total value-added to the economy in Region P. The manufacturing and mining sectors generated more than 26 percent of the region's total value-added and were also significant sources of tax revenue. The top employers in the region were in the agriculture, manufacturing, and public administration sectors. Region P's estimated total population was roughly 50,500 in 2016, approximately 0.2 percent of the state's total.

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

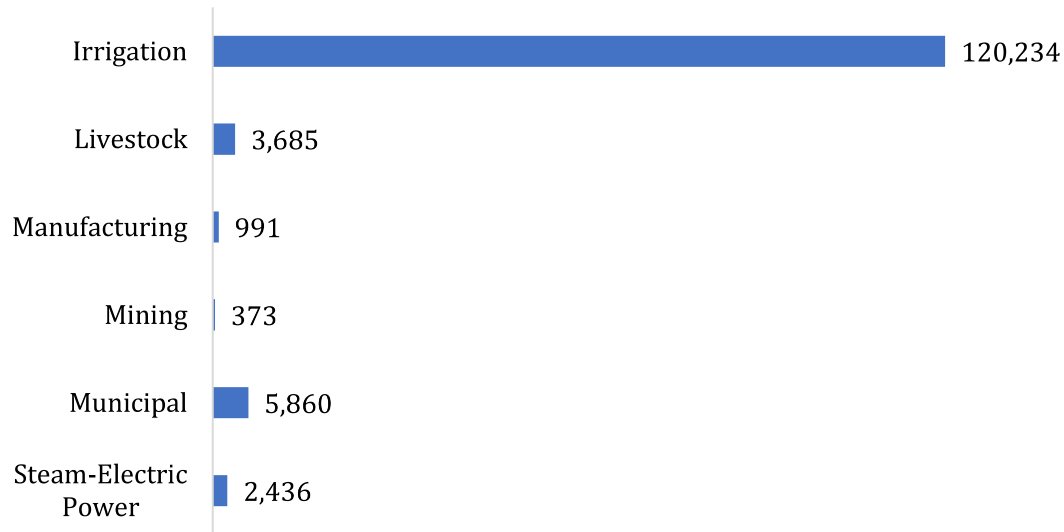
Table 1-1 Region P regional economy by economic sector*

Economic sector	Value-added ($ millions)	Tax ($ millions)	Jobs
Manufacturing	$255.0	$9.5	2,295
Construction	$157.8	$1.7	1,552
Public Administration	$136.8	$(0.6)	2,050
Real Estate and Rental and Leasing	$124.9	$22.6	454
Mining, Quarrying, and Oil and Gas Extraction	$100.3	$27.4	1,060
Wholesale Trade	$92.3	$20.3	690
Agriculture, Forestry, Fishing and Hunting	$88.4	$3.1	3,990
Retail Trade	$69.4	$22.4	1,709
Health Care and Social Assistance	$56.0	$1.9	1,333
Finance and Insurance	$43.2	$2.9	918
Transportation and Warehousing	$40.5	$2.8	760
Professional, Scientific, and Technical Services	$36.8	$1.3	703
Other Services (except Public Administration)	$36.5	$3.6	601
Management of Companies and Enterprises	$30.2	$0.8	301
Accommodation and Food Services	$25.7	$4.6	769
Utilities	$23.7	$5.6	58
Administrative and Support and Waste Management and Remediation Services	$17.4	$1.1	449
Information	$14.6	$3.7	142
Educational Services	$2.0	$0.2	166
Arts, Entertainment, and Recreation	$1.5	$0.4	177
Grand Total	$1,353.2	$135.5	20,179

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

While the manufacturing sector led the region in economic output, the majority (90 percent) of water use in 2016 occurred in irrigated agriculture. Figure 1-1 illustrates Region P's breakdown of the 2016 water use estimates by TWDB water use category.

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



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

1.2 Identified Regional Water Needs (Potential Shortages)

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

Table 1-2 summarizes the region's identified water needs in the event of a repeat of the drought of record. Demand management, such as conservation, or the development of new infrastructure to increase supplies, are water management strategies that may be recommended by the planning group to address those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are also presented in aggregate in Table 1-2. Projected needs for individual water user groups within the aggregate can vary greatly and may reach 100% for a given WUG and water use category. A detailed summary of water needs by WUG and county appears in Chapter 4 of the 2021 Region P Regional Water Plan.

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

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	water needs (acre-feet per year)	8,067	8,067	8,067	8,067	8,067	8,067
	% of the category's total water demand	5%	5%	5%	5%	5%	5%
Livestock	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Manufacturing	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Mining	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Municipal**	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Steam-electric power	water needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	0%	0%	0%	0%	0%	0%
Total water needs (acre-feet per year)		**8,067**	**8,067**	**8,067**	**8,067**	**8,067**	**8,067**

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

2 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic and social impacts of potential water shortages during a repeat of the drought of record. Consistent with previous water plans, ten impact measures were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic impact analysis measures

Regional economic impacts	Description
Income losses - value-added	The value of output less the value of intermediate consumption; it is a measure of the contribution to gross domestic product (GDP) made by an individual producer, industry, sector, or group of sectors within a year. Value-added measures used in this report have been adjusted to include the direct, indirect, and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage. These values have been adjusted to include the direct, indirect, and induced employment impacts on the region.
Financial transfer impacts	**Description**
Tax losses on production and imports	Sales and excise taxes not collected due to the shortage, in addition to customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. These values have been adjusted to include the direct, indirect and induced tax impacts on the region.
Water trucking costs	Estimated cost of shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying restricted water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1 Regional Economic Impacts

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

Income Losses - Value-added Losses

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

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur and are represented in this analysis by estimated additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employs additional power purchase costs as a proxy for the value-added impacts for the steam-electric power water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it is assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas that occurred during the recent drought period in 2011. This price is assumed to be comparable to those prices which would prevail in the event of another drought of record.

Job Losses

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

2.2 Financial Transfer Impacts

Several impact measures evaluated in this analysis are presented to provide additional detail concerning potential impacts on a portion of the economy or government. These financial transfer impact measures include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. These measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model is used to estimate reduced tax collections associated with the reduced output in the economy. Impact estimates for this measure include the direct, indirect, and induced impacts for the affected sectors.

Water Trucking Costs

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

Utility Revenue Losses

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

Utility Tax Losses

Foregone utility tax losses include estimates of forgone miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

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

2.3 Social Impacts

Consumer Surplus Losses for Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for a commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer's wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. Consumer surplus may also be viewed as an estimate of how much consumers would be willing to pay to keep the original quantity of water which they used prior to the drought. Lost consumer surplus estimates within this analysis only apply to the residential portion of municipal demand, with estimates being made for reduced outdoor and indoor residential use. Lost consumer surplus estimates varied widely by location and degree of water shortage.

Population and School Enrollment Losses

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

[2] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015, http://paa2015.princeton.edu/papers/150194. The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model the change in the population as the result of a job layoff event. The study found that layoffs impact both out-migration and in-migration into a region, and that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county.

3 Socioeconomic Impact Assessment Methodology

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate, and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts are based on the overall composition of the economy divided into many underlying economic sectors. Sectors in this analysis refer to one or more of the 536 specific production sectors of the economy designated within IMPLAN, the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 330 of these sectors, with the focus on the more water-intensive production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple, related IMPLAN economic sectors.

3.1 Analysis Context

The context of this socioeconomic impact analysis involves situations where there are physical shortages of groundwater or surface water due to a recurrence of drought of record conditions. Anticipated shortages for specific water users may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

3.2 IMPLAN Model and Data

Input-Output analysis using the IMPLAN software package was the primary means of estimating the value-added, jobs, and tax related impact measures. This analysis employed regional level models to determine key economic impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2016 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value-added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 536 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their appropriate planning water user categories (irrigation, livestock, manufacturing, mining, and municipal). Estimates of value-added for a water use category were obtained by summing value-added estimates across the relevant IMPLAN sectors associated with that water use category. These calculations were also performed for job losses as well as tax losses on production and imports.

The adjusted value-added estimates used as an income measure in this analysis, as well as the job and tax estimates from IMPLAN, include three components:

- ***Direct effects*** representing the initial change in the industry analyzed;
- ***Indirect effects*** that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- ***Induced effects*** that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

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

3.3 Elasticity of Economic Impacts

The economic impact of a water need is based on the size of the water need relative to the total water demand for each water user group. Smaller water shortages, for example, less than 5 percent, are generally anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage intensifies, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for these characteristics, an elasticity adjustment function is used to estimate impacts for the income, tax and job loss measures. Figure 3-1 illustrates this general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage reaches the lower bound ‘b1’ (5 percent in Figure 3-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound reaches the ‘b2’ level shortage (40 percent in Figure 3-1).

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

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

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

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

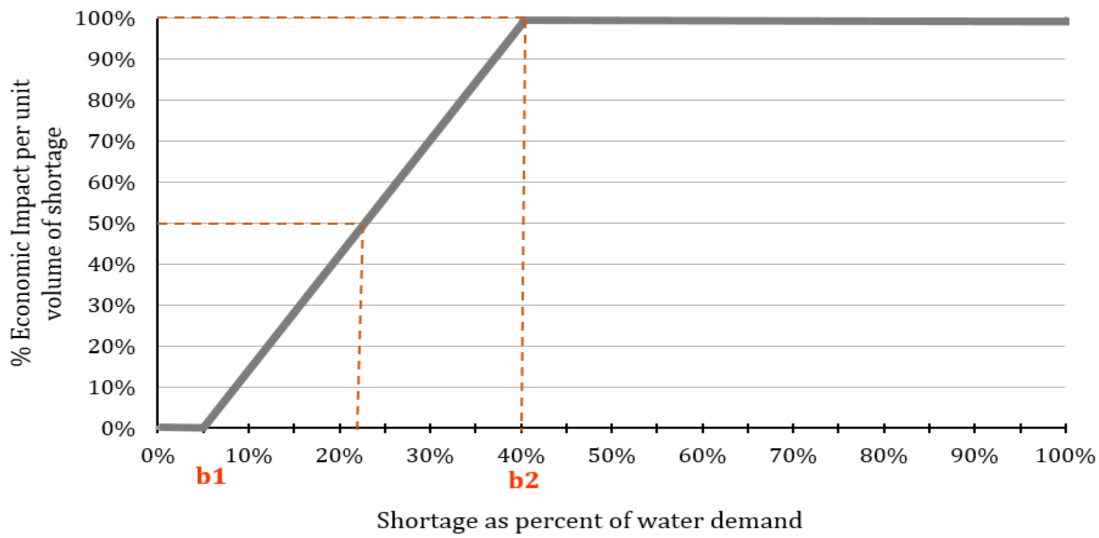


Table 3-1 Economic impact elasticity function lower and upper bounds

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

3.4 Analysis Assumptions and Limitations

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

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

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

2. All estimated socioeconomic impacts are snapshots for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from a single year recurrence of drought of record conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented are not cumulative (i.e., summing up expected impacts from today up to the decade noted), but are simply snapshots of the estimated annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated water supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, availability of limited resources, and other structural changes to the economy that may occur in the future. Changes in water use efficiency will undoubtedly take place in the future as supplies become more stressed. Use of the static IMPLAN structure was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This is not a form of cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting methods to weigh future costs differently through time.

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

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

7. Impacts are annual estimates. The socioeconomic analysis does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

8. Value-added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two measures (value-added and consumer surplus) are both valid impacts but ideally should not be summed.

9. The value-added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects to capture backward linkages in the economy described in Section 2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

10. The majority of impacts estimated in this analysis may be more conservative (i.e., smaller) than those that might actually occur under drought of record conditions due to not including impacts in the forward linkages in the economy. Input-output models such as IMPLAN only capture backward linkages on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in this type of economic modeling effort, it is important to note that forward linkages on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, resulting in conservative impact estimates.

11. The model does not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to some industries immediately following a drought, such as landscaping;
    b. The cost and time to rebuild liquidated livestock herds (a major capital investment in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not necessarily reflect what might occur on a statewide basis.

13. **The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers.** Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

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

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

4 Analysis Results

This section presents estimates of potential economic impacts that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented. Projected economic impacts for the six water use categories (irrigation, livestock, manufacturing, mining, municipal, and steam-electric power) are reported by decade.

4.1 Impacts for Irrigation Water Shortages

One of the three counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 4-1. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. However, it was not considered realistic to report increasing tax revenues during a drought of record.

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

Impact measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$2	$2	$2	$2	$2	$1
Job losses	39	37	35	33	32	30

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

4.2 Impacts for Livestock Water Shortages

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

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

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

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

4.3 Impacts of Manufacturing Water Shortages

None of the three counties in the region are projected to experience water shortages in the manufacturing water use category. Estimated impacts to this water use category appear in Table 4-3.

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

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

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

4.4 Impacts of Mining Water Shortages

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

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

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

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

4.5 Impacts for Municipal Water Shortages

None of the three counties in the region are projected to experience water shortages in the municipal water use category.

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

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

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

Impacts measure	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$-	$-	$-	$-	$-	$-
Job losses[1]	-	-	-	-	-	-
Tax losses on production and imports[1] ($ millions)*	$-	$-	$-	$-	$-	$-
Trucking costs ($ millions)*	$-	$-	$-	$-	$-	$-
Utility revenue losses ($ millions)*	$-	$-	$-	$-	$-	$-
Utility tax revenue losses ($ millions)*	$-	$-	$-	$-	$-	$-

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

4.6 Impacts of Steam-Electric Water Shortages

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

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

- Are reflected as an income loss proxy in the form of estimated additional purchasing costs for power from the electrical grid to replace power that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Do not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 4-6 Impacts of water shortages on steam-electric power in Region P

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

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

4.7 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 4-7.

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

Impacts measure	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$-	$-	$-	$-	$-	$-
Population losses	7	7	6	6	6	5
School enrollment losses	1	1	1	1	1	1

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

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

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2018 dollars, rounded). Values are presented only for counties with projected economic impacts for at least one decade.

(* Entries denoted by a dash (-) indicate no estimated economic impact)

		Income losses (Million $)*						Job losses					
County	**Water Use Category**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
WHARTON	IRRIGATION	$1.88	$1.79	$1.71	$1.62	$1.53	$1.44	39	37	35	33	32	30
WHARTON Total		**$1.88**	**$1.79**	**$1.71**	**$1.62**	**$1.53**	**$1.44**	**39**	**37**	**35**	**33**	**32**	**30**
REGION P Total		**$1.88**	**$1.79**	**$1.71**	**$1.62**	**$1.53**	**$1.44**	**39**	**37**	**35**	**33**	**32**	**30**

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Chapter 5 – Evaluation and Selection of Water Management Strategies

Chapter 4 identified the WUGs in the region with water needs. *Appendix 4A* lists all WUGs within the Lavaca Region with shortages. This chapter (*Chapter 5*) describes the analysis regarding the evaluation, and selection of appropriate water management strategies for the Lavaca Region. Water management strategies have been defined for each of the identified future water shortages within the Lavaca Region as required by the regional water planning process. Included within this chapter are:

- Description of the potentially feasible water management strategies
- Definition of the recommended and alternative water management strategies
- Allocation of selected strategies to specific WUGs

In addition to the above, this chapter has a sub-section specifically to address water conservation – including any recommended water conservation management strategies.

5.1 Selection and Application of Water Management Strategies

The Lavaca Regional Water Planning Area (LRWPA) obtains its surface water from Lake Texana and groundwater from the Gulf Coast aquifer. Because of the sensitivity of agricultural producers to the price of the water, attention was paid to the issue of sustainable use to prevent the drawdown of the water table to the point that the water would be unavailable to agriculture from a pumping cost standpoint.

Groundwater availabilities were determined based upon Desired Future Conditions (DFC) of each aquifer. This availability is known as the Modeled Available Groundwater (MAG), and the Texas Water Development Board restricted recommended strategies to those that use volumes of water that do not exceed the MAG, unless the Lavaca Regional Water Planning Group (LRWPG) requested to use a MAG Peak Factor. The LRWPG decided not to request a MAG Peak Factor.

Regions are required to consider emergency transfers of non-municipal use surface water per 31 TAC §357.34(c). Emergency transfers of surface water are granted by the Texas Commission on Environmental Quality on an interim basis during periods where an imminent threat to public health and safety exists, including multi-year droughts, spikes in demands, or failure of water supply systems where demands are unable to be met by available resources. As the regional water planning process considers supplies and demands over decadal periods, temporary emergency transfers of water were not considered. As all supplies allocated are considered available during drought of record (DOR) conditions, the need for additional supplies in the water planning process are due to unmet demands rather than temporary unavailability of supplies. If shortages are identified in a decade within the planning period, they are met with new supplies developed in a water management strategy (WMS).

Currently, non-municipal users in the Lavaca Region rely almost entirely on groundwater, and thus there is no infrastructure available to convey water from non-municipal users under emergency conditions. Furthermore, all needs within the Plan are assigned to irrigated agriculture.

Regions are required to consider regional water supply facilities and providing regional management of regional resources. However, due to the dependence of the Lavaca Region on groundwater supplies, regional-level supply infrastructure has not developed in the region, nor is it anticipated to develop or be needed in the foreseeable future. WUGs and individual agricultural irrigators predominantly are supplied by their own wells. Municipal WUGs are unlikely to display interest in regional water infrastructure development as they have access to adequate supplies and for a majority of municipal WUGs, limited or no growth is projected. At the same time, irrigated agriculture cannot financially support development of large-scale water infrastructure.

Per House Bill 807 (HB 807), if a Regional Water Planning Area (RWPA) has significant identified water needs, the Regional Water Planning Group (RWPG) shall provide a specific assessment of the potential for aquifer storage and recovery (ASR) projects to meet those needs. At the August 19, 2019 meeting, the LRWPG determined the threshold of significant water needs by evaluating existing needs for Irrigation in Wharton County. As the LRWPG did not believe the need in Irrigation was great enough to necessitate a consideration of ASR, significant identified water need was defined as 10,000 ac-ft/yr. Though the needs in the Lavaca Region did not reach the defined level of “significant,” an evaluation for ASR was conducted for LNRA, which may be found in *Section 5.1.5.3* as an alternative strategy.

Regional water planning groups are required to consider and report water loss estimates in the evaluation of water management strategies. A summary of current water loss for Region P is provided at the end of *Chapter 1.* Reported real losses for individual municipal WUGs from the 2015 audit submitted to TWDB range from 5.9 to 34.3 percent. These real losses are embedded in the water use survey data that the TWDB uses to project municipal water demands and determine water needs in the regional water planning process. Certain conservation strategies recommended in the 2021 Region P Water Plan are intended to decrease the water loss percentage for existing infrastructure, both for municipal and for irrigation water users. Drought management strategies recommended in this plan have no associated water losses.

5.1.1 Potential Water Management Strategies

The potential water management strategies considered in the 2021 RWP are as follows:

- Municipal Drought Management – Recommended (*Section 5.1.4.1*)
- Municipal Conservation – Recommended (*Sections 5.1.4.2 and 5.2.1*)
- Reuse (El Campo) – Recommended (*Section 5.1.4.3*)
- Manufacturing Drought Management – Alternative (*Section 5.1.5.5*)
- Conservation for Manufacturing – Recommended (*Section 5.2.2*)
- Irrigation Drought Management – Considered (*Section 5.1.6.1*)
- Irrigation Conservation – Recommended (*Sections 5.1.2.1 and 5.1.2.3*), Alternative (*Section 5.1.5.4*), Considered (*Section 5.1.6.2*)
- Lavaca Off-Channel Reservoir – Recommended (*Section 5.1.3.1*)
- LNRA Desalination – Recommended (*Section 5.1.3.2)*
- Lake Texana Dredging – Alternative (*Section 5.1.5.2*)
- LNRA Aquifer Storage and Recovery – Alternative (*Section 5.1.5.3*)
- Expand Use of Groundwater – Alternative (*Section 5.1.5.1*)

Several of the strategies mentioned above were considered and evaluated for meeting Irrigation water needs. *Appendix 5A* provides a table that lists which strategies are potentially feasible for meeting the Irrigation water needs. Several other strategies were considered and evaluated at the request of the project sponsor. If a project sponsor wishes to be considered for certain types of State funding, the project that the funding is requested for must be included in the Regional and State

Water Plan. The complete list and description of considered potential strategies is included in *Appendix 5B*.

5.1.2 Recommended Strategies to Meet Irrigation Water Needs

A major factor considered by LRWPG when selecting management strategies to meet Irrigation water needs is the cost of the proposed strategy. As farmers are the only users in the region with an anticipated shortage, they would bear the costs of any water management strategy. Irrigators would not be able to financially support strategies above a certain cost as higher rates for water would become economically prohibitive.

5.1.2.1 Irrigation Conservation

Several methods of conservation for agriculture were considered in the 2021 Lavaca Regional Water Plan to help meet irrigation needs. The recommended conservation measures for irrigation include On-Farm Conservation and Tail Water Recovery. Conservation is recommended as a water management strategy to meet irrigation water needs in Wharton County. Recommended conservation measures focus on Wharton County (within the Lavaca Basin), where irrigation needs are identified, but the Lavaca Regional Water Planning Group (LRWPG) supports conservation for irrigation in the whole region.

There are issues with irrigation conservation in the region; on the agricultural side, conservation savings would not result in a reduction of capital expenditures but a forced expenditure of funding to garner any savings. There is a finite upper limit to the amount of money that can be spent to conserve agricultural water and still be supported by on-farm income. The high cost of conservation and the lack of funds to pay for it make large scale conservation projects unlikely. Implementation largely depends on funding from the Natural Resources Conservation Service (NRCS). Programs such as the Environmental Quality Incentive Program (EQIP) have made the costs of improvements more reasonable for farmers with some success. However, the way in which agricultural operations in the Lavaca Region are managed prevent such programs from having substantial effects. A large portion of the irrigated acreage within the Lavaca Region is farmed by tenant farmers who have only year-to-year leases. These farmers have a limited incentive for investing in conservation measures without financial backing from the owner of the property.

Increased conservation in agricultural irrigation would have a potentially negative impact on streamflows in the area. During dry months, return flows from agricultural operations represent nearly all the streamflow seen in the region. Therefore, additional conservation during these times could have adverse effects on wildlife habitat. The more efficient usage of available supply may reduce habitat if canals with current plant growth and wildlife harborage are converted to pipelines or are lined to reduce seepage and plant growth.

Irrigation Conservation is also discussed in *Section 5.2.3*.

5.1.2.1.1 On-Farm Conservation

On-farm conservation measures include a combination of land leveling, multiple inlets, irrigation well meters, and replacement of canal ditches with pipeline. These measures increase water efficiency and reduce water loss. All measures focused on rice production, with the exception of irrigation well meters, which could also be applied for rice production, but focused on non-rice crops in this analysis.

Total water savings from on-farm conservation measures is 9,496 ac-ft/yr in Wharton County for all planning decades. These savings assume 50 percent of unimproved land will be improved with land-leveling and multiple inlets (6,780 acres), 25 percent of unimproved land will be improved with irrigation pipelines (3,390 acres), and that 25 percent of non-rice acreage will be improved with irrigation well meters (12,155 acres). It is assumed that 20 percent of the total rice acreage has already been improved and 25 percent of non-rice acreage has already been improved. For land with combined multiple inlets and land leveling, conservation savings would be 1.23 ac-ft/ac. For conversion from canal ditch to irrigation pipeline, the assumed conservation savings from Region H report by James Stansel "Potential Rice Irrigation Conservation Measures" was used for a water savings of 38 ac-ft per ditch mile. An assumed length of pipeline per acre of field of 25 feet was used, as recommended by L. G. Raun, Jr. Irrigation well meters were assumed to provide a water savings of 5 percent due to leak detection.

Unit costs for on-farm conservation measures are $54/ac-ft of water savings. Total facilities costs are $6.4 million, with total project costs of $7.2 million. Annual costs are approximately $509,000. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*. The capital costs shown are associated with the full demand reduction volume listed.

Local information on agricultural water conservation practices was provided by Dennis Mueck (USDA-NRCS, Ronald Gertson (Coastal Bend Groundwater Conservation District), and Glen Minzenmeyer (USDA-NRCS) for the 2011 Regional Water Plan. Costs have been updated to September 2018 dollars. *Table 5-1* lists a summary of current local conservation costs. In general, costs without grant funding or low-interest loans are prohibitive to implementation.

Table 5-1 Estimated Unit Cost of On-Farm Conservation Improvements

Improvement	Improvement Cost per Acre
Land Leveling	$538
Multiple Inlets	$101
Irrigation Pipeline	$241
Irrigation Well Meter	$100

5.1.2.1.2 Tail Water Recovery

Tail water recovery is also recommended as a water management strategy. Tail water recovery is defined by the Natural Resources Conservation Service as a planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tail water and/or rainfall runoff for reuse have been installed. The system allows for the capture of a portion of the irrigation field return flows, stores them until needed, and then conveys the water from the storage facility to a point of entry back into the irrigation system.

Total water savings from tail water recovery measures is 5,733 ac-ft/yr in Wharton County for all planning decades. These savings assume 5 percent of unimproved land, or 3,561 acres, will be improved with tail water recovery systems.

Unit costs for tail water recovery are $442/ac-ft of water savings. The costs were determined using the LCRA Water Supply for Agriculture report, a supplement to the LCRA Water Supply Resource Plan. The report’s 2010 construction cost was updated to September 2018 dollars and converted using the acreage amount of for the Lavaca Region. Total facilities costs are $16.8 million, with total project costs of $19.1 million. Annual costs are approximately $2.54 million. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*. The capital costs shown are associated with the full demand reduction volume listed.

5.1.2.1.3 Impacts of Irrigation Return Flows

An analysis was performed as part of the 2006 RWP to determine whether there is a significant impact upon in stream flows in the Lavaca Region from rice return flows. The analysis showed that there is an impact, and that the impact is positive in terms of the presence of additional flow that would otherwise not be in the stream during dry weather periods, although it may be minimal and of short duration. It should be noted further that the estimate of contribution is a very conservative estimate in that only the 2000 survey acreages were used, instead of the higher acreages that are likely during times of good price and demand for rice when acreages increase. It is further noted that the estimates of contribution are very conservative. Some additional flow from the rice fields can be expected from rainfall that would otherwise soak into the soil and produce no runoff during dry weather conditions. Where the rice fields are saturated, runoff will be produced even during dry times. Finally, all the water that will be applied to the land is produced from groundwater. There are no springs in the Lavaca Region, and there is no reduction of flow from the streams or from any springs as a result of the production of the groundwater. The additional water flowing in the streams as a result of rice return flow is a net increase. Additional conservation in the rice industry diminishes that additional flow as a consequence of more efficient water use and may reduce or impair existing aquatic and riparian habitat.

5.1.3 Recommended Strategies for Major Water Providers

The Lavaca-Navidad River Authority (LNRA) has existing and potential future customers that will require additional water beyond LNRA's existing supplies. LNRA is currently looking at different options for meeting those water demands. The water management strategies recommended by the LRWPG include the Lavaca Off-Channel Reservoir and LNRA Desalination, discussed in detail in this section.

5.1.3.1 Lavaca Off-Channel Reservoir

The Lavaca-Navidad River Authority (LNRA) has previously considered multiple scenarios for construction of new reservoir storage, including both on- and off-channel reservoirs. The *Lavaca River Water Supply Project Feasibility Study*, completed in 2011 by Freese & Nichols, Inc., compared a variety of these configuration options and recommended the most feasible scenarios. In the 2016 Lavaca Regional Water Plan, two of the scenarios were discussed. Since the 2016 Plan, LNRA has been moving forward with the project and narrowed down the general location to east of Lake Texana delivery system pipeline and determined that a two-phase implementation process may be the most feasible.

LNRA is still determining reservoir storage capacity configurations and pump station flow rates, but the minimum facility requirements would include a channel dam and associated pump station to deliver water from the river through a pipeline to Lake Texana in the first phase, and then to the proposed 50,000 ac-ft reservoir in the second phase. A second pump station would be required with the new off-channel reservoir to deliver raw water to the existing LNRA East Delivery System pipeline.

The associated pump station would turn on when there is sufficient storage in Lake Texana in the first phase and in the off-channel reservoir in the second phase, and when there is sufficient depth of water covering the inlet pipe. The amount of water pumped is limited primarily to flow conditions in the river and would likely be restricted to short-duration, high flow events. Thus, the associated river pump would be required to pump at significantly high rates in order to capture flood flows. For yield and costing purposes, the pump station is assumed to have a 200 MGD maximum flow rate, although the LNRA is considering flow rates up to 500 MGD. A diversion dam to increase the in-channel storage and optimize pumping opportunities is also considered in the scenarios in order to increase firm yield. A relatively small amount of in-channel storage could increase the project yield at minimal cost compared to the cost of increasing the size of the off-channel reservoir in order to store more water.

The two-phase project includes:

Phase One
- South Diversion Dam on the Lavaca River
- Raw water diversion pump station on the Lavaca River
- Pipeline from the diversion pump station to Lake Texana

Phase Two
- Pipeline from the diversion pump station to the off-channel reservoir
- Off-channel reservoir and associated intake pump station
- Pipeline from off-channel reservoir to the existing LNRA East Delivery System pipeline serving customers to the south

For Phase 1, the project yield was provided by consultants for LNRA, based on their modeling efforts.

For Phase 2, the firm yield of the Lavaca Off-Channel Reservoir project was analyzed by the consultants for the Lavaca Region, using an unmodified version of the TCEQ Lavaca River WAM Run 3, to maintain the latest TCEQ environmental flow standards, adopted August 2012, with respect to the freshwater inflows to Lavaca Bay. Additions and changes to the Base Lavaca WAM to create the strategy analysis are in *Appendix 5F*.

The Phase 1 yield involving diversion to Lake Texana was determined to be 23,500 ac-ft/yr and is assumed to be online by 2030. For Phase 2, the firm yield of the new off-channel reservoir was determined to be approximately 30,000 ac-ft/yr and is assumed to come online by 2040. This firm yield would increase LNRA's supply as a wholesale water provider and would be available to meet potential water needs for municipal, industrial, or other water users within the Lavaca Region or neighboring Region L, as needed. Water losses associated with evaporation from the reservoir are included in the modeling analysis. Water losses from the transmission pipeline are considered negligible.

Costs

The costs were initially taken from the *Lavaca River Water Supply Project Feasibility Study.*

For Phase 1, the diversion dam and pump station costs were taken from the study and updated to September 2018 dollars. In addition, the pipeline cost from the study was reduced proportionally to represent the 2 ½ mile pipeline proposed from the diversion dam to Lake Texana, and that cost was updated to September 2018 dollars. Facility costs were estimated to be $30.4 million, with total project costs being approximately $41.2 million. Annual costs were determined to be $4.1 million, with a unit cost of $176. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*.

For Phase 2, the remaining study costs not included in Phase 1 were used. The study costs were for a 25,000 ac-ft capacity reservoir, so those costs were upsized to a 50,000 ac-ft capacity reservoir. The costs were then converted to September 2018 dollars. Actual costs could vary significantly due to project implementation requirements. Facility costs were estimated to be $200.1 million, with total project costs being approximately $290 million. Annual costs were determined to be $18.5 million, with a unit cost of $618. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*.

If Phase 1 comes online in 2030 and Phase 2 comes online in 2040, debt service costs will combine for the two phases during the 2040 decade.

Issues and Considerations

The off-channel reservoir minimizes challenges to implementation as compared to an on-channel scenario. Water rights, land acquisition, and relocation of infrastructure are considerations in the feasibility of this strategy. The evaluation of this strategy assumes that a new water right permit would be obtained for the project. As such, the TCEQ-adopted, Senate Bill 3-developed environmental flow standards, effective August 30, 2012, would need to be met in order for TCEQ to approve the permit.

Environmental and Other Impacts

The proposed off-channel reservoir would have substantially less impacts on valuable habitat than an on-channel reservoir option. In the off-channel scenario, some habitat would be altered or lost as a result of temporary flooding and the area impacted would be smaller than that of the on-channel reservoir. The impact of the proposed off-channel reservoir appears to have minimal or no impact on threatened and endangered species.

The proposed location of the off-channel reservoir is such that it is downstream of all TCEQ adopted environmental flow standard instream flow measurement points along the Lavaca River. The only TCEQ standard flows that needs to be met are the Bay and Estuary Freshwater Inflow standards for the Lavaca Bay System. Because the current version of the TCEQ Lavaca WAM Run 3 incorporates the environmental flow standards in the model, and the diversion for the reservoir was modeled using a junior water right priority date, diversions to the reservoir are made only after the environmental flow standard is met.

As a result of developing a reservoir to capture and store flow from the river, up to 50,000 ac-ft/yr would be diverted to storage in any given year. Additionally, the new reservoir could provide up to 2,000 acres of new waterfowl habitat.

Impacts to Agriculture

The proposed off-channel reservoir scenarios would have a marginal impact on local agricultural activities. Siting of the project and inundation of the off-channel reservoir would remove approximately 2,500 acres of agricultural land from production but would have minimal influence given the large quantity of agricultural land in the area.

Impacts to Navigation

The proposed off-channel reservoir scenarios would have no impact on navigation. Any diversion dam structure would need to consider navigation impacts.

5.1.3.2 LNRA Desalination

The Lavaca-Navidad River Authority (LNRA) has been evaluating water supply sources to provide raw water to industry and other possible raw water and potable water users along FM 1593 from Lolita to Point Comfort. Given that the largest single raw water user in the area, Formosa Plastics, shows future demands totaling 10,000 ac-ft/yr, LNRA engaged NRS Engineers to develop water supply strategies for these sources. A preliminary engineering feasibility study was prepared for LNRA by NRS Engineers in January 2013. Water supply sources identified include brackish groundwater and brackish surface water from the Lavaca River downstream of Lake Texana.

At a November 2012 LNRA Board Meeting, NRS Engineers presented three options of site locations. Two options were based on desalination of the brackish groundwater supply in the vicinity of the Formosa Plastics owned property and one option was based on desalination of a combination of brackish groundwater and surface water located on LNRA property just south of Lake Texana. The options evaluated used a variety of water supply volumes due to the uncertainty of the development and production of brackish groundwater in Jackson County, and the unknown quantity of brackish surface water that would be available.

For the 2021 Regional Water Plan, the Lavaca Regional Water Planning Group (LRWPG) evaluated desalination using a combination of brackish groundwater and brackish surface water. Available groundwater under the MAG and additional brackish surface water volumes was used for sizing potential water supply strategies. Based on these criteria, the infrastructure required for this strategy consists of:

- Groundwater wells
- Desalination plant
- Raw and finished water transmission lines
- Concentrate disposal line
- Microfiltration treatment train
- River intake and pump station
- East drain reservoir
- Sludge lagoon

This strategy is dependent upon the receipt of a groundwater pumping contract from the Texana Groundwater Conservation District (GCD).

The proposed wellfield site is located in the Colorado-Lavaca Basin in Jackson County. For groundwater, after accounting for existing supplies being used, the available yield for groundwater in this basin is approximately 4,800 ac-ft/yr (4.3 MGD average). This groundwater yield value was used for this analysis in place of the estimated groundwater yields proposed by NRS Engineers. For surface water, the yield was estimated to be approximately 1,652 ac-ft/yr (1.5 MGD average). This surface water yield was used for this analysis in place of the estimated surface water yields proposed by NRS Engineers as there was a variety of yield options, but additional information is required to determine water rights. Water Availability Modeling (WAM) was performed using an unmodified version of the TCEQ Lavaca River WAM Run 3. A diversion of at least 11,664 ac-ft was available every year over the drought of record, so the 1,652 ac-ft/yr assumed for this strategy evaluation is likely to be available at the desired Total Dissolved Solids (TDS) level. This volume accounts for water loss associated with the diversion and treatment. Total yield for this strategy is estimated to be 6,452 ac-ft/yr (5.8 MGD average). If additional groundwater or surface water is available and needed, the yield would increase. This strategy is expected to be online by 2040.

Costs

The infrastructure required for this strategy was determined by NRS Engineers as presented at the November 2012 LNRA Board Meeting. The quantity and sizing of the infrastructure was modified to match the groundwater and surface water yield projected for the Lavaca Basin in Jackson County.

The following infrastructure was proposed:

- River Intake and Pump Station
- Three (3) 1,000 gpm Water Supply Wells and well piping
- 5.8 MGD Average (11.5 MGD Peak) Brackish Desalination Water Treatment Plant (RO for Groundwater and MF for Surface Water)
- Approximately 2 miles of well field transmission piping
- Approximately 1.5 miles of transmission piping and appurtenances
- Approximately 1.5 miles of concentrate discharge piping and appurtenances
- Finished Water Pump Station

- Concentrate Pump Station
- One (1) ground storage tank for finished water

A capital cost estimate was provided by NRS Engineers as part of their presentation. However, the cost estimate was for larger infrastructure than what was sized based on available yield. In order to provide a comparable cost consistent with other strategies in this report, facility and project costs were developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2018 dollars. The Cost Estimating Tool was also used to determine operating costs.

The facility cost for this strategy is primarily driven by the cost of a water treatment facility and the well field. In September 2018 values, the probable facility cost for LNRA needs is approximately $35.6 million, with the project cost being $49.9 million. This would result in a total annual cost (including operations and maintenance of approximately $8,460,000. The resulting unit cost of water is $1,311/ac-ft. If larger amounts of groundwater or surface water are available, unit costs would potentially decrease.

Environmental and Other Impacts

The LNRA desalination strategy will require extensive permitting to ensure it complies with all environmental considerations. The primary regulatory agencies and permitting requirements include the TCEQ's administration of surface water diversion permitting and Texana GCD's regulation of pumping of groundwater.

The advantage of this strategy is dependent on the status of the sustainable yield of the aquifer. Having a groundwater withdrawal rate higher than the recharge rate will create water shortages in the future as well as affect the groundwater sustainability. This proposed well field would be within the Texana GCD and the groundwater use could be limited to an amount that can be replenished on an annual basis. LNRA customers are currently surface water users, so the increased use from groundwater would increase return flows to the streams. A discharge permit would be required for brine disposal.

Permitting would also be required to pump brackish surface water from the tidal stream of the Navidad River. Capturing surface water that spills over the Palmetto Dam would be subject to the TCEQ SB3 environmental flow standards for bay and estuary inflows. It was determined that the yield used in this evaluation would be available while meeting or exceeding the SB3 bay and estuary requirements. The LRWPG acknowledges the importance of pulse flows reaching Lavaca Bay, and that capturing pulse flow volumes that otherwise would have made it to Lavaca Bay may have some impact on salinity levels.

Impacts to Agriculture

As agricultural demands have been met in Jackson County, there should be no impacts to agriculture from this strategy.

5.1.4 Recommended Strategies for Municipal Utilities

The municipalities in the region have no identified water needs, as all their projected water demands are met. Even so, the LRWPG is recommending drought management, municipal conservation, and reuse as water management strategies in the 2021 Regional Water Plan.

5.1.4.1 Drought Management

Drought management is considered as a water management strategy for all municipal WUGs, regardless of water needs. The purpose for the drought management strategy is to encourage utilities to maintain and implement their Drought Contingency Plans during times of reduced water availability, as well as to prepare for potential emergency situations that may occur. *Chapter 7* discusses drought response for the region in more detail.

Drought management was evaluated by considering each municipal WUG's Drought Contingency Plan (as available), including drought triggers and responses, and projected water demands. Demand reductions were considered individually with respect to the type of trigger, and how often that trigger might be reached. The following table shows the potential demand reductions for each utility:

Table 5-2 Drought Management Municipal Water Demand Reductions

WUG	County	Basin	Percent Reduction	Demand Reduction (ac-ft/yr)					
				2020	2030	2040	2050	2060	2070
EDNA	JACKSON	LAVACA	15%	33	33	33	33	33	33
GANADO	JACKSON	LAVACA	20%	47	47	46	46	46	47
HALLETTSVILLE	LAVACA	LAVACA	30%	48	47	46	46	46	46
MOULTON	LAVACA	LAVACA	20%	36	35	34	34	34	34
SHINER	LAVACA	LAVACA	10%	49	48	47	46	46	46
YOAKUM	LAVACA	LAVACA	30%	16	16	16	15	15	15
EL CAMPO	WHARTON	COLORADO	15%	12	12	12	13	13	13
EL CAMPO	WHARTON	COLORADO -LAVACA	15%	72	74	75	76	78	80
EL CAMPO	WHARTON	LAVACA	15%	2	2	2	2	2	2
WHARTON COUNTY WCID 1*	WHARTON	LAVACA	15%	28	29	29	30	31	32

*No Drought Contingency Plan was made available. Demand reductions were assumed proportional to the demands for the other utilities.

The costs considered for implementing drought management focused on effort for public outreach and enforcement. No capital costs were assumed, and unit costs were estimated at $100/ac-ft.

No environmental impacts are anticipated from utilities implementing their Drought Contingency Plans. No impacts to agriculture are anticipated, either.

5.1.4.2 Municipal Conservation

With no projected water needs, there is not a large incentive for municipalities in the region to implement conservation. That being said, deteriorating infrastructure can have high rates of water loss. Water loss is discussed further in *Chapter 1*. The LRWPG feels it is important to recommend municipal conservation as a water management strategy to encourage conservation in the region and to aid municipalities in obtaining funding to perform conservation measures such as leak detection and repair and installing smart meters.

A methodology was developed to determine the anticipated municipal water conservation savings for the WUGs within the Lavaca Region. First, WUGs were required to meet the following criteria to be chosen for conservation measures:

- Be a municipal WUG.

- Have a year 2030 per capita water usage of greater than 140 GPCD, indicating a potential for savings through conservation.

Conservation was considered, regardless of whether a municipality had a water need.

Per capita water demands were determined from the measured or projected population and water demands for each WUG during each decade. The following methodology was used in calculating water demand reductions:

- If the 2030 GPCD is greater than 140,
  - 5 percent GPCD reduction per decade until 140 GPCD is reached.
- If the 2030 GPCD is less than 140,
  - No conservation considered.

This method is slightly higher than the recommendation of a 0.5 percent per year reduction in per capita water demand until the target demand of 140 GPCD was reached, as proposed by the Water Conservation Implementation Task Force (WCITF). Conservation was applied beginning in 2030.

The new GPCD for each decade was used along with the WUG population to determine the revised water demands for each decade. These values were subtracted from the original water demands to determine the amount of water conserved in each decade.

This strategy is recommended using the criteria above, with the potential target GPCDs and the resulting demand reductions as shown below in *Tables 5-3 and 5-4.* HB 807 requires that the 2021 Regional Water Plan shall “set one or more specific goals for gallons of water use per capita per day in each decade of the period covered by the plan for the municipal water user groups in the RWPA.”

Table 5-3 Municipal Conservation Target GPCDs

WUG	County	Basin	Base GPCD (2011)	Target GPCD					
				2020	2030	2040	2050	2060	2070
HALLETTSVILLE	LAVACA	LAVACA	212	203	189	179	170	162	154
MOULTON	LAVACA	LAVACA	192	183	170	161	153	146	140
SHINER	LAVACA	LAVACA	220	211	196	186	177	168	160
YOAKUM	LAVACA	LAVACA	168	159	147	140	140	140	140
EL CAMPO	WHARTON	COLORADO	178	169	156	149	141	140	140
EL CAMPO	WHARTON	COLORADO-LAVACA	178	169	156	149	141	140	140
EL CAMPO	WHARTON	LAVACA	178	169	156	149	141	140	140
WHARTON COUNTY WCID 1	WHARTON	LAVACA	162	153	141	140	140	140	140

Table 5-4 Municipal Conservation Water Demand Reductions

WUG	County	Basin	Demand Reduction (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
HALLETTSVILLE	LAVACA	LAVACA	0	31	50	73	98	124
MOULTON	LAVACA	LAVACA	0	9	13	20	26	32
SHINER	LAVACA	LAVACA	0	24	38	56	75	94
YOAKUM	LAVACA	LAVACA	0	32	47	39	38	38
EL CAMPO	WHARTON	COLORADO	0	16	26	39	41	42
EL CAMPO	WHARTON	COLORADO-LAVACA	0	98	159	237	253	259
EL CAMPO	WHARTON	LAVACA	0	3	5	7	7	7
WHARTON COUNTY WCID 1	WHARTON	LAVACA	0	10	7	4	4	4

Costs were calculated to include a variety of conservation measures. The Texas Water Development Board (TWDB) Cost Estimating Tool methodology was used to determine project costs, annual costs, and unit costs, once the facility costs were developed. The unit cost is presented as an average, with some conservation measures being more expensive and some being less.

Facility costing efforts focused on smart meters and leak detection and repair but were meant to encompass other types of capital-cost associated conservation measures as well. Costs for leak detection and repair were estimated assuming 10 percent of the individual WUG’s pipeline is replaced in a 50-year timespan. Implementing this conservation strategy would reduce approximately 3 percent of the demand. Smart meters were assumed a cost of $150 per home, with the assumption that 100 percent of homes would implement this strategy over the planning horizon. Implementing this conservation strategy would reduce approximately 5 percent of the demand. These assumptions were modified as needed if they caused the demand reduction to be higher than the assumed water savings based on our target GPCD methodology.

Remaining conservation measures were assumed to be non-capital approaches, which could include both labor and materials associated with implementing standards, incentives, and outreach. Many of the non-capital cost measures include, but are not limited to, drought tolerant landscape, public education and outreach – including school programs, rebate and incentive programs – local ordinances that increase water efficiency by customers, support of legislation that increases water efficiency in plumbing products and appliances at both the State and Federal level, increased water efficiency in utility operations, and conservation-oriented rate structures. Conservation measures for non-capital approaches were included in the annual costs at an average of $250/ac-ft of water savings.

The following table provides the estimated costs for municipal conservation. Higher unit costs represent WUGs where a higher portion of the demand reduction is met with capital cost measures. The Lavaca Region encourages the TWDB to provide funding for all types of conservation measures for WUGs and wholesale water providers within the region and around the state. Costing backup information can be located in *Appendix 5D*.

Table 5-5 Municipal Conservation Costs

WUG	County	Basin	Facility Cost	Project Cost	Annual Cost	Unit Cost
			$	$	$	$
HALLETTSVILLE	LAVACA	LAVACA	$1,124,000	$1,502,000	$237,000	$1,911
MOULTON	LAVACA	LAVACA	$307,000	$410,000	$65,000	$2,031
SHINER	LAVACA	LAVACA	$606,000	$810,000	$132,000	$1,404
YOAKUM	LAVACA	LAVACA	$1,134,000	$1,515,000	$220,000	$4,681
EL CAMPO	WHARTON	MULTIPLE	$2,748,000	$3,671,000	$560,000	$1,812
WHARTON COUNTY WCID 1	WHARTON	LAVACA	$306,000	$409,000	$60,000	$6,000

Environmental and other impacts are expected to be negligible.

5.1.4.3 Reuse

El Campo is currently planning to produce a Type 1 wastewater effluent that could be used by the utility or sold to potential customers. As such, they requested to have their reuse project as a recommended water management strategy in the 2021 Lavaca Regional Water Plan.

El Campo currently produces one million gallons per day (1 MGD) of treated wastewater effluent that is discharged to the Tres Palacios Creek. The proposed yield from the strategy is 0.5 MGD or 560 ac-ft/yr, beginning in 2030. Currently, the utility has no identified users of the effluent, but is moving forward with installing a sand filtration system. The water may be used by another WUG in the region, such as Manufacturing.

For costing purposes, the sand filtration system and five miles of 12” transmission pipeline were assumed. Costs were developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2018 dollars. Capital costs were calculated to be approximately $5.6 million, with total project costs of approximately $7.8 million. Annual costs were calculated at $766,000 per year, for a unit cost of $1,368/ac-ft. Annual unit cost after 20-year debt service is $191/ac-ft.

Water that is currently discharged into streams in the basin would be consumed instead. In addition, if effluent is used for agricultural purpose, it would start with higher dissolved solids levels than either groundwater or surface water in the area. Agricultural use would further increase dissolved solids levels. Agricultural demands would continue to be met, with associated discharges to the watercourses of agricultural return flows.

Stress on the groundwater in the area would be reduced. However, return flows to the streams in the area would also be reduced and dissolved solids concentrations would increase slightly. The overall effect would be minimal because of the limited amount of effluent available, although during drought, return flows can at times be the only flows in the creeks.

If water is used for irrigation purposes, it would provide up to an additional 560 ac-ft/yr of water supply, and as noted previously, provides for wildlife habitat as well. If it is used for municipal or manufacturing purposes, it would have no impact on agriculture.

5.1.5 Alternative Strategies

The LRWPG included five alternative strategies in the 2021 Lavaca Regional Water Plan.

5.1.5.1 Expand Use of Groundwater (Alternative Strategy)

The majority of water supplies in the Lavaca Region are provided by groundwater supplies, notably from the Gulf Coast Aquifer. Groundwater in the region is pumped for domestic, agricultural, municipal, and industrial purposes.

Groundwater availability is limited to the Modeled Available Groundwater (MAG) volumes as calculated based on the Desired Future Conditions (DFCs) as established by the Groundwater Management Area (GMA) process. The Lavaca Region is within GMA 15. The Groundwater Conservation Districts (GCD) within GMA 15 collaborated to determine the DFC for the Central Gulf Coast Aquifer. The DFC, adopted April 29, 2016, states that no more than 13 feet of average drawdown can occur by 2069 relative to year 2000 conditions.

The planning requirements do allow use of a MAG Peak Factor, which is a percentage (e.g., greater than 100 percent) applied to a MAG value reflecting annual groundwater availability that, for planning purposes, shall be considered temporarily available for pumping consistent with DFCs. The Lavaca Regional Water Planning Group considered, but ultimately decided against, implementing a MAG Peak Factor in the Gulf Coast Aquifer.

This strategy proposes to use additional groundwater during drier years only, beginning in 2020, to meet irrigation needs in Wharton County (8,067 ac-ft/yr in the Lavaca Basin).

Costs

A unit cost of $66/ac-ft was calculated as the additional pumping cost for estimated additional drawdown using the TWDB Costing Tool. No capital costs were assumed. This cost would only be assessed when needed. It is further assumed that the aquifer would recover between droughts.

Environmental and Other Impacts

The continued use of current levels of irrigation water would have the environmental benefit of ensuring that current or near-current volumes of agricultural return flows will continue to be discharged to the streams in the region. Additionally, wildlife habitats benefit from sustained return flows in drought. There are no springs, so diminished springflow from reduced aquifer levels is not a concern. If increased use continues over a long period of time, there is a potential for land subsidence with attendant environmental effects.

The Gulf Coast Aquifer underlying Wharton County has sufficient water in storage to meet short-term demands in drought-of-record conditions, so the localized impacts of increased use would be unlikely to impact other water resources of the state. However, in a widespread drought, the adjacent regions are likely to be increasing groundwater use as well, with some potential for additional drawdown. Additionally, prolonged drought-level use within the Lavaca Region portion of Wharton County could create increased drawdowns in adjacent counties and regions.

Impacts to Agriculture

Availability of water for irrigation purposes reduces the threats to agriculture by providing an additional supply of 8,067 ac-ft/yr.

5.1.5.2 Lake Texana Dredging (Alternative Strategy)

The Lavaca-Navidad River Authority (LNRA) is considering the dredging of Lake Texana as a strategy to improve the capacity of an existing water supply. Dredging is defined by the National Oceanic and Atmospheric Administration (NOAA) as the removal of sediment and debris from the bottom of a body of water such as a port, bay, river, channel, or lake. The TWDB conducted a *Volumetric Survey of Lake Texana, January-March 2010 Survey (Volumetric Survey*), dated August 2011, in order to calculate the lost storage of the reservoir due to sediment accrual. The report estimates Lake Texana's storage volume to have decreased from 171,307 ac-ft pre-impoundment in 1980 to 159,845 ac-ft in 2010. Projected sedimentation used in evaluating the firm yield of Lake Texana, as determined by the TCEQ Lavaca River WAM Run 3, shows that by 2040, the storage volume will have decreased further to 152,179 ac-ft. This strategy would seek to restore the reservoir to its original capacity by removing 19,128 ac-ft of sediment in 2040.

Selection of end-use for dredged material is largely dependent on sediment characteristics. Per the TWDB *Volumetric Survey*, the sediments to be dredged consist of fine silty loam soils with high water content. Sediment testing of Lake Texana will be required to determine percent composition of clay, organic matter, nutrients, regulated contaminants, oil, and grease. If sand content is high, favorable end-uses include beach restoration and repurposing of dredged material for construction. For higher silt and mud contents, favorable end-uses include: riparian buffer zone augmentation, wetland restoration or creation, and agricultural/field application. If contaminants are present, confined disposal is required. Given the presence of silty loam soils in Lake Texana, the preliminary selection for end-use for this strategy is to dewater and amend dredged material for use as an agricultural product for use by nearby field owners.

Dredging methods may be categorized broadly as either mechanical or hydraulic (suction). Mechanical dredging is accomplished by lifting material via "clamshells" or buckets; material is then loaded and trucked to end use. Mechanical dredging is especially economically favorable when drought conditions lead to low lake levels, exposing and drying sediment for removal by heavy equipment. Hydraulic dredging involves the use of water jets or a suction head to take up lake sediment and a floating pipeline system to deliver material to its end use. Assuming dewatering and nearby land application as the end use, hydraulic dredging is a favorable extraction method, and is thus assumed.

For the purposes of this report, the majority of sediment removal is assumed to occur within the southern portion of Lake Texana. Per *Figure 11* in the TWDB *Volumetric Survey*, the portion of Lake Texana south of Texas State Highway 111 has accrued the most sediment since the reservoir was impounded.

While the strategy assumes removal of 19,128 ac-ft of sediment from Lake Texana, the impact on the firm yield of the reservoir is much smaller. The TCEQ Lavaca WAM Run 3 model was used to compare the firm yield of the reservoir with restoring the reservoir to its original capacity to the projected firm yield for 2040-2070 if projected sedimentation were to continue.

The firm yield of this strategy was determined to be 390 ac-ft/yr, beginning in the 2040 planning decade, and increasing each decade to 1,210 ac-ft by 2070. Based on the impacts shown in the TCEQ Lavaca WAM Run 3 for sedimentation occurring between 1980 and 2020, It is assumed that additional sediment accrual after the dredging occurs will not negatively impact the overall firm yield within the planning horizon. The yield for this strategy is shown in *Table 5-6*.

Table 5-6 LNRA Lake Texana Dredging Yield

Lake Texana Dredging Firm Yield (ac-ft/yr)					
2020	**2030**	**2040**	**2050**	**2060**	**2070**
0	0	390	663	937	1,210

This strategy would provide yield within the existing water rights of the LNRA by restoring the reservoir to its original design capacity.

Costs

Costs for this strategy were calculated using the World Bank's simplified dredging RESCON equation, as recommended in the TWDB's *Dredging vs. New Reservoirs* report, dated December 2005:

$$\text{Cost Dredging } (\$US/m^3) = 6.62 \times [\text{Vol Dredged } (m^3)/106]^{-0.43}$$

Assuming 19,128 ac-ft (23,594,005 m^3) of sediment removal, the cost of dredging was calculated to be $2,614/ac-ft ($2.119/m^3) of sediment removed. Thus, for 19,128 ac-ft of sediment removal, the total construction cost is calculated to be $50,001,000. The unit cost for the firm yield of 1,210 ac-ft is $2,988/ac-ft. O&M costs are not included, as dredging is not assumed to continue after the 2040 yield is achieved.

The calculated costs assume that:

- Land costs are relatively low ($1,500-$3,000/acre).
- Distance from dredged water body to end-use site is ≤ 2 miles.
- Dredged material composition is silty loam; the presence of dense clay sediments substantially increases dredging costs.
- Dredged material is not contaminated.

Sediments containing contaminants (e.g. herbicides, pesticides, hydrocarbons, toxic metals, PCBs, etc.) are much more expensive to dredge, as they must be treated and/or confined prior to disposal. The TWDB *Dredging vs. New Reservoirs* report cites unit costs of $100 to $400 per cubic yard (approximately $161,000/ac-ft to $645,000/ac-ft) for dredging operations for contaminated sediments. Additional testing is needed to confirm that sediments in Lake Texana do not contain elevated levels of regulated contaminants.

The major capital costs for this strategy include:

- Hydraulic dredging equipment
- Pumps and floating pipeline to transport dredged materials to dewatering facility
- Dewatering and soil amendment facility
- Gravity feed line for discharge of effluent to Lake Texana

Environmental and Other Impacts

Dredging often requires a combination of environmental permits due to its invasive mechanism and varied pathways to end use. Conventional dredging methods destroy lake floor habitat, increase turbidity, decrease dissolved oxygen levels, and can volatilize contaminants. In combination, these effects lead to the death of aquatic life and reduced quality of raw water supply. Dredging must be performed during non-spawning seasons for aquatic life and may be prohibited if endangered species are present. Refer to *Chapter 1, Table 1-5,* for the complete list by county of threatened and endangered species in the Lavaca Regional Water Planning Area.

Contemporary suction dredging methods can minimize undesired turbidity increases and reduce impact on aquatic life by using adaptive auger heads. Use of this technology can help preserve the water quality of the reservoir, prevent aquatic organism and fish population decline, and ensure compliance with environmental regulations.

If dredged material contains high levels of contaminants, the material must be properly treated and disposed of in regulated Confined Disposal Facilities (CDFs). Additionally, effluent from dewatering facilities is regulated as a discharge to the waters of the United States, and subject to permitting requirements as defined by the Clean Water Act (CWA).

Table 5-7 below shows potential applicable regulations, as reported in the TWDB's *Dredging vs. New Reservoirs* report, dated December 2005.

Table 5-7 Potential Applicable Regulations for Dredging Activities

Statute	Regulation	Agency	Remarks
Clean Water Act Section 401	40 CFR 121	TCEQ	Dredge and fill discharges to waters of U.S.
Section 402	40 CFR 122	TCEQ	Stormwater discharges
Section 404	33 CFR 320-30	USACE	Dredge and fill discharges to waters of U.S.
R&H Act 1899	33 CFR 403	USACE	Navigable waters of the U.S.
Coastal Zone Management Act	15 CFR 923	Texas	Dredging, disposal of solids in water in coastal zone
NEPA	40 CFR 1500-1508	USEPA	Federal action or permit issuance
Fish & Wildlife Coordination Act	16 CFR 661-667e	USFWS	Federal agency projects and federal permits
Endangered Species Act	16 CFR 1531-1544	USFWS	Activities that could impact threatened or endangered species
RCRA	40 CFR 257-258	USEPA	Storage, treatment and disposal of hazardous waste
TSCA	40CFR 761	USEPA	Handling or disposal of PCB-contaminated sediments
National Historic Preservation Act	36 CFR 800	THC	Requires survey and investigation for pre- and historic sites

This strategy provides a flood control benefit by providing an additional 19,128 ac-ft of flood water retention for the contributing watershed.

Impacts to Agriculture

Assuming dredged material is dewatered and amended, this strategy provides a benefit to agricultural users by offering a potentially low-cost alternative agricultural topsoil. Additional study is needed to determine agricultural user interest in this material.

5.1.5.3 LNRA Aquifer Storage and Recovery (Alternative Strategy)

The Lavaca-Navidad River Authority (LNRA) participated with the City of Victoria, the Victoria County Groundwater Conservation District, the Guadalupe-Blanco River Authority, and the Port of Victoria on the *Victoria Area Aquifer Storage and Recovery (ASR) Feasibility Study*, prepared in 2014 by Naismith Engineering Inc., for a study area consisting of Victoria, Jackson, and Calhoun counties. The Jackson County portion of the study was limited to assessing potential locations and feasibility and did not include any modeling or cost determination efforts. Information from the feasibility study related to location and permitting issues is included in this report.

The feasibility study suggested that there are numerous suitable sites for ASR in southern Jackson County, specifically near Carancahua Bay. The site area suggested by the feasibility study was used for costing purposes. This area is in the vicinity of Highway 35 and Highway 172. The targeted interval for ASR wells in this area is between -300 feet mean sea level (msl) and -1050 feet msl, which intersects the Lissie and Willis formation of the Chicot aquifer and the Upper Goliad formation of the Evangeline aquifer. For regional water planning purposes, these are all considered part of the Gulf Coast aquifer. Sand beds are common in the area, with estimated hydraulic conductivity ranging from 5 ft/day to 18 ft/day, depending on the formation. The estimated migration rate from the ASR wells would be less than 2 ft/yr. Fresh water is expected to occur down to approximately -500 feet msl. Below -600 feet msl, TDS concentrations may range from 1,500 to 5,000 mg/L.

The source of water for the ASR project is assumed to be the Lavaca River, downstream of Lake Texana. A water right permit for a junior water right would need to be obtained from TCEQ. The firm yield of the ASR project was analyzed, using an unmodified version of the TCEQ Lavaca River WAM Run 3, to have no negative impacts to the freshwater inflows to Lavaca Bay, as dictated by the latest TCEQ environmental flow standards, adopted August 2012. An authorized diversion of 25,000 ac-ft/yr was assumed, using a 50 MGD river intake structure and pump station to divert excess flows from the river.

Due to the nature of the strategy where excess flows are stored in the aquifer for later use, the available diversions over the period of record were averaged to provide an annual supply yield. The yield for this project is 8,665 ac-ft/yr, to be implemented for the 2040 planning horizon. Modifications to the assumptions, such as authorized diversion and infrastructure size, could modify the resulting yield. The ASR modeling assumed that the Lavaca Off-Channel Reservoir strategy had already been implemented.

ASR reduces the water losses associated with evaporation from a reservoir, but there can be water losses due to recovery efficiency from the aquifer. Migration rates are estimated at less than 2 ft/yr, so impacts will depend on how long the stored water remains in the aquifer. Recovery efficiency will have some impacts on water volume but should have negligible impacts on the firm yield volume.

This yield would increase LNRA's supply as a major water provider and would be available to meet potential water needs for existing and future customers either within or outside of the region.

Costs

The following infrastructure was proposed:

- 50 MGD River Intake Structure and Pump Station
- Eleven (11) 1,000 gpm Aquifer Storage and Recovery Wells and well transmission piping
- 20 MGD Water Treatment Plant
- Approximately fifteen (15) miles of raw water transmission piping and appurtenances and seven (7) miles of treated water transmission piping and appurtenances
- Two (2) 20 MG Raw Water Storage Tanks (to handle peak flows to reduce water treatment plant size)

A facility cost estimate was developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2018 dollars. The facility cost is $187,455,000. The Cost Estimating Tool was also used to determine total project costs and operating costs.

In September 2018 values, the project cost for this strategy is approximately $260,074,000. This would result in a total annual cost (including operations and maintenance) of approximately $26,567,000. The unit cost of water is $3,066/ac-ft. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*. Note that the project cost increased as compared to the 2016 Plan, even though the same infrastructure was assumed, due to the updated version of the Costing Tool and its costing determinations.

Environmental and Other Impacts

The aquifer storage and recovery strategy will require extensive permitting to ensure it complies with all environmental considerations. The primary regulatory agencies would be the TCEQ and the Texana Groundwater Conservation District. ASR wells used for both recharge and recovery are subject to permitting requirements based on the source of the water being injected and the aquifer in which the water is stored. The primary regulatory requirements include TCEQ's administration of underground injection of water and surface water diversion permitting; and the regulation of recharge and recovery of water by the GCD.

Surface water from the Lavaca River contains more dissolved oxygen (DO) than groundwater. When DO is present in the water introduced to an aquifer, a chain of oxygen reduction reactions results in selective leaching and/or mineral dissolution, releasing metals such as arsenic.

The proposed location of the assumed diversion point is such that it is downstream of all TCEQ adopted environmental flow standard instream flow measurement points along the Lavaca River. The only TCEQ standard that needs to be met is the Bay and Estuary Freshwater Inflow standards for the Lavaca Bay System. Because the current version of the TCEQ Lavaca WAM Run 3 incorporates the environmental flow standards in the model, and the diversion for the ASR was modeled using a junior water right priority date, diversions to the ASR are made only after the environmental flow standard is met.

As described, this project could remove up to 25,000 ac-ft/yr of streamflow from the Lavaca River in any given year. Flows may ultimately be returned to river after use.

Impacts to Agriculture

The proposed strategy would have a negligible impact on local agricultural activities. Siting of the project would remove approximately 130 acres of total agricultural land from production but would have negligible influence given the large quantity of agricultural land in the area.

5.1.5.4 Irrigation Conservation – Alternate Wetting and Drying (Alternative Strategy)

Conservation via irrigation techniques – such as alternate wetting and drying (AWD) – was considered as a strategy to meet irrigation water needs in Wharton County. AWD is the implementation of intermittent irrigation. Though monitoring of soil moisture, the field is left to dry to a point when there is still sufficient water in the soil for sustained plant growth before it is re-flooded. This cycle is done repeatedly except during flowering stage of crop growth when the plants are sensitive to dry conditions and field is kept in flooded conditions. It is assumed that implementation of AWD can result in a water savings of 38 percent.

The strategy assumes AWD will be applied to 5 percent of planted rice in Wharton County, or 599 acres. Water savings from this strategy were calculated to be 633 ac-ft/yr for Wharton County. As the practice of AWD does not require the installation of infrastructure, it was assumed to have no capital costs.

5.1.5.5 Drought Management for Manufacturing (Alternative Strategy)

Drought management is considered as a water management strategy for the portion of the Manufacturing water use category in Jackson County that relies on surface water, regardless of water needs. The purpose for the drought management strategy is to acknowledge that surface water may be restricted per LNRA's Drought Contingency Plan during times of severe drought, as well as to prepare for potential emergency situations that may occur. *Chapter 7* discusses drought response for the region in more detail.

Drought management was evaluated by reviewing LNRA's Drought Contingency Plan and applying the severe drought trigger response for demand reduction. Under severe drought, LNRA customers will be required to reduce demand by 10 percent. Since a small portion of the Manufacturing water use category in Jackson County utilizes groundwater, only the demands relying on surface water are considered for reduction. The following table shows the potential demand reductions for each WUG:

Table 5-8 Drought Management for Manufacturing Water Demand Reductions

WUG	County	Basin	Demand Reduction (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	JACKSON	COLORADO-LAVACA	1,063	1,063	1,063	1,063	1,063	1,063
MANUFACTURING	JACKSON	LAVACA	15	15	15	15	15	15
MANUFACTURING	JACKSON	LAVACA-GUADALUPE	18	18	18	18	18	18

Costs

To determine the costs of restricted water use during drought, the TWDB's 2019 *Socioeconomic Impacts of Projected Water Shortages* was considered. This document is included with the regional water plans and identifies the social and economic costs of not meeting the identified water needs in the plans.

The analysis showed that Manufacturing in the Lavaca Region provides $255.0 million to the economy. Manufacturing in the Lavaca Region is projected to use 11,521 ac-ft of water in 2020. This equates to a unit cost of $22,133/ac-ft of unavailable water. For Jackson County, this would give an annual cost of $24,258,000 if drought restrictions were put in place.

There are no capital costs associated with this strategy. The costs reflect income losses to the facilities based on the anticipated reduced output of product due to the water restrictions.

No environmental impacts are anticipated from this strategy. No impacts to agriculture are anticipated either.

5.1.6 Strategies Considered but Not Recommended

These strategies were evaluated and considered by the LRWPG, but ultimately not recommended.

5.1.6.1 Drought Management for Irrigation (Considered)

Polypipe irrigation, implemented during periods of drought, acts as an alternative to furrow irrigation or field inundation. The strategy involves the installation of flexible poly-ethylene resin pipes. These pipe systems provide a higher irrigation efficiency and better irrigation control but can only last up to one season and may require replacement throughout the growing season. It is assumed that using flexible polypipe can result in a water savings of 25 percent.

The strategy was initially evaluated for rice irrigation. Upon receiving feedback that the strategy may not be feasible for rice, the strategy was re-evaluated assuming polypipe will be applied to 20 percent of planted cotton in Wharton County, Lavaca Basin, during periods of drought (4,919 acres). Water savings from this strategy were calculated to be 1,180 ac-ft/yr for Wharton County.

Unit costs for polypipe irrigation are $106/ac-ft of water savings. The costs were determined using the 2005 report *Using Flexible Poly-Pipe with Surface Irrigation* by the Texas A&M System AgriLife Extension Service. The report's 2005 cost per foot installed was updated to September 2018 dollars ($0.32) and converted to the acreage for Wharton County, Lavaca Basin, assuming it takes approximately 34 feet of pipe per acre, per the TWDB 2013 report "Best Management Practices for Agricultural Water Users." It was also assumed the polypipe would require one full replacement during growing season. Total facilities costs are $106,000. Total project cost is $122,000 and total annual cost is $125,000. Costs are assumed to be paid back within one year. The capital costs shown are associated with the full demand reduction volume listed.

Minimal reductions to return flows are expected, and no impacts to agriculture are expected, other than the cost to pay for the polypipe.

Because this strategy was determined to be not as viable as other considered strategies to meet irrigation demands, the LRWPG decided not to recommend drought management as a strategy in the 2021 Lavaca Regional Water Plan.

5.1.6.2 Irrigation Conservation – Row-Irrigated Rice (Considered)

Furrow irrigation, or row-irrigated rice, was also considered as an alternative irrigation conservation technique, but it was found that there were no appreciable water savings when compared to permanent flood.

5.1.7 Strategy Allocation

The recommended management strategies to meet irrigation water needs were applied to meet the irrigation shortages in the Lavaca Basin in Wharton County. This is shown in *Appendix 5C*.

5.2 Water Conservation

The 2021 Lavaca Regional Water Plan is required to have a subsection of *Chapter 5* that discusses all of the recommended conservation strategies. Conservation is recommended as a water management strategy for Irrigation in Wharton County, Manufacturing, and for several municipal utilities in the region. The LRWPG recognizes the need for financial assistance in rural and agricultural areas for implementing conservation requiring infrastructure improvements.

5.2.1 Municipal Conservation

With no projected water needs, there is not a large incentive for municipalities in the region to implement conservation. That being said, deteriorating infrastructure can have high rates of water loss. Water loss is discussed further in *Chapter 1*. The LRWPG feels it is important to recommend municipal conservation as a water management strategy to encourage conservation in the region and to aid municipalities in obtaining funding to perform conservation measures such as leak detection and repair and installing smart meters.

A methodology was developed to determine the anticipated municipal water conservation savings for the WUGs within the Lavaca Region. First, WUGs were required to meet the following criteria to be chosen for conservation measures:

- Be a municipal WUG.
- Have a year 2030 per capita water usage of greater than 140 GPCD, indicating a potential for savings through conservation.

Conservation was considered, regardless of whether a municipality had a water need.

Specific details related to Municipal Conservation are included in *Section 5.1.4.2*.

5.2.2 Conservation for Manufacturing

Water for manufacturing can be used for a large number of purposes: the product manufacturing process, cooling (either removing heat from a process or air conditioning the facility), conveyance, rinsing or cleaning, and landscape irrigation.

Because of the variations in facilities and water uses, it is difficult to come up with a specific plan for each facility for regional water planning purposes. In addition, there are no identified water needs (shortages) for Manufacturing in the Lavaca Region. Even so, the Lavaca Regional Water Planning Group would like to encourage all water users in the region to reduce water wasting where possible.

There are a number of Best Management Practices (BMPs) that the TWDB recommends (*TWDB Report 362 – Best Management Practices for Industrial Water Users*) that a particular facility could implement in order to conserve water. Those BMPs include:

1. Water Audit
2. Water Waste Reduction
3. Industrial Submetering
4. Cooling Systems and Cooling Tower
5. Industrial Alternative Sources and Reuse of Process Water
6. Rinsing/Cleaning
7. Water Treatment
8. Boiler and Steam Systems
9. Refrigeration (including Chilled Water)
10. Once Through Cooling
11. Management and Employee Programs
12. Industrial Landscape

Each individual manufacturing facility should review the BMPs to determine if any of the identified measures would be feasible for the facility. The Water Audit could be one of the first BMPs implemented to account for all of the water use within a facility and determine where efficiencies could be made and which of the other BMPs should be followed.

If a water audit has not been previously performed, water savings from implementing recommendations from the audit can range from 10 to 35 percent. For regional water planning purposes, water savings for each county and basin is determined to be 10 percent of the manufacturing water demand and is assumed to be implemented by 2030. *Table 5-9* shows the water savings in ac-ft/yr.

Table 5-9 Conservation for Manufacturing Water Demand Reductions

WUG	County	Basin	Demand Reduction (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
MANUFACTURING	JACKSON	COLORADO-LAVACA	0	1,063	1,063	1,063	1,063	1,063
MANUFACTURING	JACKSON	LAVACA	0	15	15	15	15	15
MANUFACTURING	JACKSON	LAVACA-GUADALUPE	0	23	23	23	23	23
MANUFACTURING	LAVACA	LAVACA	0	63	63	63	63	63
MANUFACTURING	WHARTON	COLORADO-LAVACA	0	3	3	3	3	3

Costs

An industrial water audit is assumed to have negligible costs for a particular facility. Any costs to implement measures determined from the audit would be borne by the private facility, which is not eligible for State funding. Therefore, it is impractical to determine overall costs by county/basin for the manufacturing water use category for the purposes of regional water planning.

Environmental and Other Impacts

No impacts to other water resources in the State are expected.

Impacts to Agriculture

Agricultural and natural resource impacts are expected to be negligible.

5.2.3 Irrigation Conservation

Several methods of conservation for agriculture were considered in the 2021 Lavaca Regional Water Plan to help meet irrigation needs. The recommended conservation measures for irrigation include On-Farm Conservation and Tail Water Recovery. Conservation is recommended as a water management strategy to meet irrigation water needs in Wharton County. Recommended conservation measures focus on Wharton County (within the Lavaca Basin), where irrigation needs are identified, but the Lavaca Regional Water Planning Group (LRWPG) supports conservation for irrigation in the whole region.

There are issues with irrigation conservation in the region; on the agricultural side, conservation savings would not result in a reduction of capital expenditures but a forced expenditure of funding to garner any savings. There is a finite upper limit to the amount of money that can be spent to conserve agricultural water and still be supported by on-farm income. The high cost of conservation and the lack of funds to pay for it make large scale conservation projects unlikely. Implementation largely depends on funding from the Natural Resources Conservation Service (NRCS). Programs such as the Environmental Quality Incentive Program (EQIP) have made the costs of improvements more reasonable for farmers with some success. However, the way in which agricultural operations in Lavaca Region are managed prevent such programs from having substantial effects. A large portion of the irrigated acreage within Lavaca Region is farmed by tenant farmers who have only year-to-year leases. These farmers have a limited incentive for investing in conservation measures without financial backing from the owner of the property.

Increased conservation in agricultural irrigation would have a potentially negative impact on streamflows in the area. During dry months, return flows from agricultural operations represent nearly all the streamflow seen in the region. Therefore, additional conservation during these times could have adverse effects on wildlife habitat. The more efficient usage of available supply may reduce habitat if canals with current plant growth and wildlife harborage are converted to pipelines or are lined to reduce seepage and plant growth.

Water management strategies related to Irrigation Conservation are discussed in detail in *Section 5.1.2.1*.

5.2.3.1 On-Farm Conservation

On-farm conservation measures include a combination of land leveling, multiple inlets, irrigation well meters, and replacement of canal ditches with pipeline. These measures increase water efficiency and reduce water loss. All measures focused on rice production, with the exception of irrigation well meters, which could also be applied for rice production, but focused on non-rice crops in this analysis.

Specific details related to On-Farm Conservation are included in *Section 5.1.2.1.1*.

5.2.3.2 Tail Water Recovery

Tail water recovery is also recommended as a water management strategy. Tail water recovery is defined by the Natural Resources Conservation Service as a planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tail water and/or rainfall runoff for reuse have been installed. The system allows for the capture of a portion of the irrigation field return flows, stores them until needed, and then conveys the water from the storage facility to a point of entry back into the irrigation system.

Specific details related to Tail Water Recovery are included in *Section 5.1.2.1.2*.

APPENDIX 5A
Consideration of Strategies that are Potentially Feasible for Meeting Water Needs

Appendix 5A – Water Management Strategies Considered and Evaluated

Every WUG Entity with an Identified Need		**WMSs REQUIRED TO BE CONSIDERED BY STATUTE**											**Additional**									
Water User Group Name	Maximum Need 2020-2070 (af/yr)	Conservation	Drought Management	Reuse	Reallocation/ management of existing supplies	Development of large-scale marine seawater or brackish groundwater	Conjunctive Use	Acquisition of available existing supplies	Development of new supplies	Development of regional water supply or regional management of water supply facilities	Voluntary transfer of water (incl. regional water banks, sales, leases, options, subordination agreements, and financing agreements)	Emergency transfer of water under Section 11.139	System optimization, subordination, leases, enhancement of yield, improvement of water quality	New SW	New GW	Brush control; precipitation enhancement	Interbasin transfers of surface water	Aquifer storage and recovery	Amendment of water rights/permits	Rainwater harvesting	other	other
Irrigation, Wharton	*8,067*	PF	PF	nPF	nPF	nPF	nPF	PF	PF	nPF	nPF	nPF	PF	nPF	nPF	nPF	nPF	nPF	nPF	nPF		

nPF = considered but determined 'not potentially feasible' (may include WMSs that were initially identified as potentially feasible)

PF = considered 'potentially feasible' and therefore evaluated

(all WMS evaluations shall be presented in the regional water plan including for WMSs considered potentially feasible but not recommended)

APPENDIX 5B
Potential Management Strategies and Impacts

Lavaca Region
Potentially Feasible Water Management Strategy Screening (for 2021 Lavaca Regional Water Plan)

	Water Management Strategy	Water User Group or Wholesale Provider	Strategy Description	Does WUG/WWP Have a Need?	Strategy Cost ($)	Cost of Water ($/ac-ft)	Max Yield (ac-ft/yr)	Starting Decade	Basin	Interbasin Transfer (Yes/No)	Impacts on Habitat / Stream / B&E Flows	Impacts on Landform	Additional Impacts	Screening Matrix Factors (Positive (1), Neutral (0), Negative (-1)) Cost	Yield	Location	Water Quality	Environmental and Natural Resources	Local Preference	Institutional Constraints	Impacts on Water Resources	Impacts on Agricultural Resources	Impacts to Recreation	Impacts on Other Management Strategies	Total of Screening Factors
1	**Drought Management**	IRRIGATION, WHARTON	During periods of drought, installation of flexible poly-ethylene resin pipe as an alternative to furrow irrigation or field inundation	Yes	$122,000	$106	1,180	2020	LAVACA	No	Reduced return flows for stream/B&E.	None expected	None expected	1	0	1	0	-1	-1	0	0	0	0	0	0
2	**Drought Management**	EDNA	Reduce water demands following Drought Continegency Plan	No	$3,300	$100	33	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
3	**Drought Management**	GANADO	Reduce water demands following Drought Continegency Plan	No	$4,700	$100	47	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
4	**Drought Management**	HALLETTSVILLE	Reduce water demands following Drought Continegency Plan	No	$4,800	$100	48	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
5	**Drought Management**	MOULTON	Reduce water demands following Drought Continegency Plan	No	$3,600	$100	36	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
6	**Drought Management**	SHINER	Reduce water demands following Drought Continegency Plan	No	$4,900	$100	49	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
7	**Drought Management**	YOAKUM	Reduce water demands following Drought Continegency Plan	No	$1,600	$100	16	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
8	**Drought Management**	EL CAMPO	Reduce water demands following Drought Continegency Plan	No	$9,500	$100	95	2020	Multiple	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	1	1	0	0	0	3
9	**Drought Management**	WHARTON COUNTY WCID 1	Reduce water demands following Drought Continegency Plan	No	$3,200	$100	32	2020	LAVACA	No	Minimal to None dependent on type of restriction imposed	None expected	None expected	1	0	1	0	0	-1	0	1	0	0	0	2
10	**Drought Management**	MANUFACTURING, JACKSON	Reduce water demands following LNRA Drought Contingency Plan	No	$24,258,000	$22,133	1,096	2020	Multiple	No	None expected	None expected	Potential economic / production impacts	-1	0	1	0	0	-1	1	1	0	0	0	1
11	**Lavaca Off-Channel Reservoir**	LNRA (MWP)	Construct off-channel reservoir to capture flows not needed for senior water rights or the environment	No	$331,200,000	$424	53,500	2030	Reservoir	No	Impacts limited based on implementation of new TCEQ Env Requirements	Construction of reservoir, diversion structure, and transmission line	Local social impacts	0	1	1	0	0	0	0	1	0	1	0	4
12	**LNRA Desalination**	LNRA (MWP)	Desalination of brackish groundwater and surface water in Jackson County	No	$49,900,000	$1,311	1,652	2040	LAVACA	No	Increased return flows for stream/B&E	Wellfield, treatment plant, and transmission line construction	Yield limited by MAG	-1	0	1	1	0	0	-1	1	0	0	0	1
13	**LNRA Aquifer Storage and Recovery**	LNRA (MWP)	Diverting excess flows downstream of Lake Texana	No	$260,074,000	$3,066	8,665	2040	LAVACA	No	Diversion of higher flows from Lavaca River while meeting TCEQ environmental standards.	Wellfield, treatment plant, and transmission line construction	None expected	-1	1	0	0	0	0	0	1	0	0	0	1
14	**Lake Texana Dredging**	LNRA (MWP)	Removal of sediment and debris from bottom of Lake Texana	No	$50,001,000	$2,988	1,210	2040	LAVACA	No	Environmental permitting required; potential damage to habitat	Potentially low-cost alternative agricultural topsoil	Dredged material may require treatment and disposal	-1	0	1	0	-1	1	-1	0	0	-1	0	-2
15	**Reuse**	EL CAMPO	Reuse portion of wastewater effluent for municipal and/or agricultural purposes	No	$7,800,000	$1,368	560	2030	Multiple	No	Reduction of discharge flows to Tres Palacios Creek	Transmission line construction	Reduction of demand on aquifer	0	0	1	0	-1	0	0	1	0	0	0	1
16	**Conservation - Municipal**	HALLETTSVILLE	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$1,502,000	$1,911	124	2030	LAVACA	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1
17	**Conservation - Municipal**	MOULTON	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$410,000	$2,031	32	2030	LAVACA	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1
18	**Conservation - Municipal**	SHINER	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$810,000	$1,404	94	2030	LAVACA	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1
19	**Conservation - Municipal**	YOAKUM	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$1,515,000	$4,681	47	2030	LAVACA	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1
20	**Conservation - Municipal**	EL CAMPO	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$3,671,000	$1,812	309	2030	All	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1
21	**Conservation - Municipal**	WHARTON COUNTY WCID 1	If 2030 GPCD is > 140, apply a 5% reduction in GPCD per decade until 140 is reached. Leak detection & repair, smart meters, and education/public outreach	No	$409,000	$6,000	10	2030	LAVACA	No	Reduced return flows for stream/B&E	None expected	None expected	-1	0	1	0	-1	0	1	1	0	0	0	1

Lavaca Region
Potentially Feasible Water Management Strategy Screening (for 2021 Lavaca Regional Water Plan)

	Water Management Strategy	Water User Group or Wholesale Provider	Strategy Description	Does WUG/WWP Have a Need?	Strategy Cost ($)	Cost of Water ($/ac-ft)	Max Yield (ac-ft/yr)	Starting Decade	Basin	Interbasin Transfer (Yes/No)	Impacts on Habitat / Stream / B&E Flows	Impacts on Landform	Additional Impacts	Screening Matrix Factors (Positive (1), Neutral (0), Negative (-1)) Cost	Yield	Location	Water Quality	Environmental and Natural Resources	Local Preference	Institutional Constraints	Impacts on Water Resources	Impacts on Agricultural Resources	Impacts to Recreation	Impacts on Other Management Strategies	Total of Screening Factors
22	**Conservation - Manufacturing**	MANUFACTURING, JACKSON	Individual manufacturing facilities follow Best Management Practices (BMPs)	No	$0	$0	1,101	2030	Multiple	No	None expected	None expected	None expected	1	1	0	0	0	0	0	0	0	0	0	2
23	**Conservation - Manufacturing**	MANUFACTURING, LAVACA	Individual manufacturing facilities follow Best Management Practices (BMPs)	No	$0	$0	63	2030	LAVACA	No	None expected	None expected	None expected	1	0	0	0	0	0	0	0	0	0	0	1
24	**Conservation - Manufacturing**	MANUFACTURING, WHARTON	Individual manufacturing facilities follow Best Management Practices (BMPs)	No	$0	$0	3	2030	COLORADO-LAVACA	No	None expected	None expected	None expected	1	0	0	0	0	0	0	0	0	0	0	1
25	**Conservation - Irrigation**	IRRIGATION, WHARTON	Row-Irrigated Rice	Yes	N/A	N/A	N/A	2020	LAVACA	No	N/A	N/A	N/A	0	-1	0	0	-1	-1	0	1	0	0	0	-2
26	**Conservation - Irrigation**	IRRIGATION, WHARTON	Alternate wetting and drying	Yes	$0	$0	633	2020	LAVACA	No	None expected	None expected	Increased labor	1	0	1	0	0	-1	0	0	0	0	0	1
27	**Conservation - Irrigation**	IRRIGATION, WHARTON	On-farm conservation including land leveling, multiple inlets, irrigation well meters meters, and irrigation pipelines instead of ditches	Yes	$7,200,000	$54	9,496	2020	LAVACA	No	Reduced return flows for stream/B&E	None expected	No appreciable water savings	1	1	1	0	0	-1	0	0	1	0	0	3
28	**Conservation - Irrigation**	IRRIGATION, WHARTON	Tailwater recovery	Yes	$19,100,000	$442	5,733	2020	LAVACA	No	Reduced return flows for stream/B&E	Reduced acreage for farming	Cost prohibitive to irrigators	1	0	1	-1	-1	-1	0	1	0	0	0	0
29	**Expand Use of Groundwater**	IRRIGATION, WHARTON	Alternative strategy - Pump additional groundwater needed for dry years only, allowing aquifer to recharge during wet periods, acknowledging that the MAG is a long-term average.	Yes, but not as a recommended strategy	$532,422	$66	8,067	2020	LAVACA	No	Increased return flows for stream/B&E	Long-term increased pumping could negatively impact the aquifer and increase subsidence	Prolonged drought-level use within the Lavaca Region portion of Wharton County could create increased drawdowns in adjacent counties	1	1	1	0	-1	0	-1	-1	1	0	0	1

Rating Criteria for Decision Matrix Factors for Identifying Potential Water Managment Strategies

Category	Rating Criteria		
	-1	**0**	**1**
Cost	>$1,000/ac-ft	<$1,000/ac-ft	<$500/ac-ft
Yield	Size of project is too small or too large for likely need	Size of project is flexible or meets needs of service area	Size of project is flexible and can be adjusted to fit optimum requirements
Location	IBT required. Large distance from demand. Outside of Region K area.	No IBT required. Significant conveyance required. May cross watersheds.	No IBT required. Located within Region K area. Relatively close to demand.
Water Quality	Quality of supply is reduced. May aggravate water quality issues in source supply.	No known water quality issues.	Existing water quality problems are reduced due to this strategy.
Environmental and Natural Resources	Significant environmental issues and community opposition. Negative impacts to natural resources, including reduction in instream or B&E flows.	Environmental impacts can be easily mitigated. Limited concerns by environmental community. No impacts to natural resources or instream/B&E flows.	Positive or limited or no known negative environmental impacts. Positive impacts to natural resources, including increased instream/B&E flows.
Local Preference	No local support. Significant local opposition.	Some local support. Limited opposition.	Widespread local support. Multi-use benefits likely. No local opposition.
Institutional Constraints / Risk of Implementability	Permits opposed. Significant property acquisition required. Construction will be complex.	Permits expected with minimal problems. Necessary property available. No expected construction difficulties.	Permits issued. Facilities constructed or land owned. Water available to contract.
Impacts on Water Resources	Negative impact on other water supplies. (groundwater or surface water)	No impact.	Positive impact on other water supplies. (groundwater or surface water)
Impacts on Agricultural Resources	Negative impact.	No impact.	Positive impact.
Impacts on Recreation	Negative impact.	No impact.	Positive impact.
Impacts on Other Management Strategies	Negative impact.	No impact.	Positive impact.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **Conservation for Irrigation**

Identified WUG/MWP Irrigation in Wharton County

Shortage Amount Wharton County, Lavaca Basin – 8,067 ac-ft/yr

Supply Quantity Irrigation, Wharton County – 15,828 ac-ft/yr, online in 2020

Water Source Conservation through On-Farm Conservation, Tail Water Recovery, and Alternate Wetting and Drying (AWD)

Quality Negligible changes in treated water quality.

Cost ($/acre-foot) On-Farm Conservation – $54/acre-foot
Tail Water Recovery -- $442/acre-foot
Alternate Wetting and Drying – Negligible

Environmental Impacts
AWD increases nitrous oxide (N_2O) emissions.

Impacts on other Water Resources of the State
No impacts to other water resources in the State are expected.

Impacts on Threats to Agriculture and other Natural Resources of the State
Tail water recovery may result in a decrease of water quality and disease problems that result from the reuse of irrigation water. Natural resource impacts are expected to be negligible.

Other Impacts N/A

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **LNRA Lavaca Off-Channel Reservoir (Lake Texana Yield Enhancement)**

Identified WUG/MWP LNRA

Shortage Amount Potential existing and future customers of LNRA within Region P or neighboring Region L (unallocated supply for future needs).

Supply Quantity Phase 1 – 23,500 ac-ft/yr, online in 2030
Phase 2 – 30,000 ac-ft/yr, online in 2040

Water Source Lavaca River

Quality No change in treated water quality to end user.

Treatment Raw water

Cost ($/acre-foot) Phase 1 - $176/ac-ft
Phase 2 - $618/ac-ft

Environmental Impacts

The impact of the proposed off-channel reservoir appears to have minimal or no impact on threatened and endangered species.

Because the current version of the TCEQ Lavaca WAM Run 3 incorporates the environmental flow standards in the model, and the diversion for the reservoir was modeled using a junior water right priority date, diversions to the reservoir are made only after the environmental flow standard is met.

As a result of constructing a diversion dam to either send water to Lake Texana or to a new reservoir to capture and store flow from the river, up to 50,000 ac-ft/yr would be diverted to storage in any given year. Additionally, the new reservoir could provide up to 2,000 acres of new waterfowl habitat.

Impacts on other Water Resources of the State

The Lavaca off-channel reservoir project was modeled to divert water without detracting from the required TCEQ Bay and Estuary Freshwater Inflow standards for the Lavaca Bay System.

Impacts on Threats to Agriculture and other Natural Resources of the State

The proposed off-channel reservoir would have a marginal impact on local agricultural activities in that siting of the project and inundation of the off-channel reservoir would remove approximately 2,500 acres of agricultural land from production.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy	**LNRA Desalination**
Identified WUG/MWP	LNRA
Shortage Amount	Potential existing and future customers of LNRA within Region P and possibly neighboring Region L.
Supply Quantity	6,452 ac-ft/yr, online in 2040. Project yield based on available groundwater from Gulf Coast Aquifer (4,800 ac-ft/yr) and brackish surface water from the tidal stream of the Navidad River (1,652 ac-ft/yr). Brackish surface water modeling assumes Lavaca Off-Channel Reservoir strategy has already been implemented.
Water Source	Gulf Coast Aquifer and tidal stream of the Navidad River
Quality	Increased quality from brackish to fresh
Treatment	Treated
Cost ($/acre-foot)	$1,311/ac-ft. Project cost is $49,883,000; facilities include a raw water intake and pump station, 3 – 1,000 gpm supply wells, a 5.8 MGD water treatment plant, two additional pump stations for the finished water and brine concentrate, one (1) finished water storage tank, and associated pipelines and appurtenances.

Environmental Impacts

LNRA customers are currently surface water users, so the increased use from groundwater would increase return flows to the streams. Up to 1,652 ac-ft/year would be diverted from the tidal stream of the Navidad River, while meeting or exceeding SB3 bay and estuary requirements. A discharge permit would be required for brine disposal.

Impacts on other Water Resources of the State

Permitting by Texana GCD and TCEQ would be required. This strategy stays within the MAG, so no impacts to other water resources.

Impacts on Threats to Agriculture and other Natural Resources of the State

There should be no impacts to agriculture from this strategy. See *Chapter 1* for list of rare, threatened, and endangered species in the region.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **Drought Management (Municipal)**

Identified WUG/MWP Edna, Ganado, Hallettsville, Moulton, Shiner, Yoakum, El Campo, Wharton County WCID 1

Shortage Amount None

Supply Quantity Strategy assumes entity would follow drought contingency plans and reduce demands.
Potential water savings:
Edna – 33 ac-ft/yr
Ganado – 47 ac-ft/yr
Hallettsville – 46 ac-ft/yr
Moulton – 34 ac-ft/yr
Shiner – 46 ac-ft/yr
Yoakum – 15 ac-ft/yr
El Campo – 95 ac-ft/yr
Wharton County WCID 1 – 32 ac-ft/yr

Water Source Drought Management

Quality No change in treated water quality to end user.

Cost ($/acre-foot) Costs for municipalities were assumed at $100/ac-ft, based on assumed effort for public outreach and enforcement. No capital costs.

Environmental Impacts
Reduced streamflow from irrigation return flows in second half of year. May reduce habitat for migratory birds.

Impacts on other Water Resources of the State
None expected.

Impacts on Threats to Agriculture and other Natural Resources of the State
Drought Management for municipal utilities would have negligible impact to the amount of water available to meet Irrigation needs in Wharton County.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy	**Municipal Conservation**
Identified WUG/MWP	Hallettsville, Moulton, Shiner, Yoakum, El Campo, Wharton County WCID 1
Shortage Amount	None
Supply Quantity	Online in 2030 – maximum water demand reduction for: Hallettsville – 124 ac-ft/yr Moulton – 32 ac-ft/yr Shiner – 94 ac-ft/yr Yoakum – 47 ac-ft/yr El Campo – 309 ac-ft/yr Wharton County WCID 1 – 10 ac-ft/yr
Water Source	Conservation
Quality	No Change in treated water quality to end user
Treatment	N/A
Cost ($/acre-foot)	Hallettsville ($1,911/ac-ft), Moulton ($2,031/ ac-ft), Shiner ($1,404/ ac-ft), Yoakum ($4,681/ ac-ft), El Campo ($1,812/ ac-ft), Wharton County WCID 1 ($6,000/ ac-ft). Higher unit costs represent WUGs where a higher portion of the demand reduction is met with capital cost measures.

Environmental Impacts

Yield amounts are relatively low, so impacts would be negligible, but any reductions in water use that is treated by WWTP would reduce return flows to the local creeks.

Impacts on other Water Resources of the State

None expected.

Impacts on Threats to Agriculture and other Natural Resources of the State

Minimal reduction in municipal groundwater use would have negligible impacts on the amount of groundwater available for irrigation use.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **Reuse of municipal effluent**

Identified WUG/MWP El Campo

Shortage Amount None

Supply Quantity 560 ac-ft/yr (50% of total effluent), online in 2030

Water Source Groundwater based municipal wastewater effluent

Quality Increased dissolved solids and bacterial content, plus some beneficial nutrients

Treatment Treated (non-potable)

Cost ($/acre-foot) Project Cost is $7,881,000, with a unit cost of $1,368/ac-ft; Calculated based information from El Campo and assumed transmission distance. Sand filtration system and 5 miles of 12” transmission line were included in costs.

Environmental Impacts

Water that is currently discharged into streams in the basin would be consumed instead, by a volume of up to 560 ac-ft/yr. In addition, if effluent is used for agricultural purpose, it would start with higher dissolved solids levels than either groundwater or surface water in the area. Agricultural use would further increase dissolved solids levels. Agricultural demand would continue to be met, with associated discharges to the watercourses of agricultural return flows.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced. However, return flows to the streams in the area would also be reduced and dissolved solids concentrations would increase slightly. The overall effect would be minimal because of the limited amount of effluent available.

Impacts on Threats to Agriculture and other Natural Resources of the State

If water is used for irrigation purposes, it would provide up to an additional 560 ac-ft/yr of water supply, and as noted previously, provides for wildlife habitat as well. If it is used for municipal or manufacturing purposes, it would have no impact on agriculture.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy	**Conservation for Manufacturing**
Identified WUG/MWP	Manufacturing in Jackson, Lavaca, and Wharton counties
Shortage Amount	None
Supply Quantity	Manufacturing, Jackson County – 1,101 ac-ft/yr, online in 2030 Manufacturing, Lavaca County – 63 ac-ft/yr, online in 2030 Manufacturing, Wharton County – 3 ac-ft/yr, online in 2030
Water Source	Conservation
Quality	Negligible changes in treated water quality. Decreased water quality if landscape irrigation changes from potable to non-potable as an implemented measure.
Cost ($/acre-foot)	Negligible

Environmental Impacts

Environmental impacts are expected to be negligible.

Impacts on other Water Resources of the State

No impacts to other water resources in the State are expected.

Impacts on Threats to Agriculture and other Natural Resources of the State

Agricultural and natural resource impacts are expected to be negligible.

Other Impacts N/A

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **Alternative Strategy: Expand Use of the Gulf Coast Aquifer – Wharton County**

Identified WUG/MWP Wharton County Irrigation (Lavaca Basin)

Shortage Amount Wharton County Irrigation, Lavaca Basin – 8,067 ac-ft

Supply Quantity 8,067 ac-ft/yr

Water Source Gulf Coast Aquifer

Quality No Change

Treatment Raw

Cost ($/acre-foot) $66/ac-ft. Calculated as the additional pumping cost for estimated additional drawdown using the TWDB Costing Tool. This cost would only be assessed when needed. It is further assumed that the aquifer would recover between droughts.

Environmental Impacts

The continued use of current levels of irrigation water would have the environmental benefit of ensuring that current or near-current volumes of agricultural return flows will continue to be discharged to the streams in the region. There are no springs, so diminished springflow from reduced aquifer levels is not a concern. If increased use continues over a long period of time, there is a potential for land subsidence with attendant environmental effects.

Impacts on other Water Resources of the State

The Gulf Coast Aquifer underlying Wharton County has sufficient water in storage to meet short-term demands in drought-of-record conditions, so the localized impacts of increased use would be unlikely to impact other water resources of the state. However, in a widespread drought, the adjacent regions are likely to be increasing groundwater use as well, with some potential for additional drawdown. Additionally, prolonged drought-level use within the LRWPA portion of Wharton County could create increased drawdowns in adjacent counties and regions.

Impacts on Threats to Agriculture and other Natural Resources of the State

Availability of water for irrigation purposes reduces the threats to agriculture, by providing an additional supply of 8,067 ac-ft/yr. Additionally, wildlife habitats benefit from sustained return flows in drought.

Lavaca Regional Water Planning Area
Potential Water Management Strategies

Strategy	**LNRA Lake Texana Dredging**
Identified WUG/MWP	LNRA
Shortage Amount	Potential existing and future customers of LNRA within Region P (unallocated supply for future needs)
Supply Quantity	390 ac-ft/yr (2040) – 1,210 ac-ft/yr (2070), online in 2040
Water Source	Lake Texana (tributaries: Brushy Creek, Navidad River, Mustang Creek)
Quality	Strategy may elevate suspended solids levels in Lake Texana due to sediment disturbance.
Treatment	Raw water
Cost ($/acre-foot)	$2,988/ac-ft

Environmental Impacts

Conventional dredging methods elevate turbidity and can lower dissolved oxygen levels and overall water quality. This strategy could have direct negative impacts on aquatic ecosystems in Lake Texana.

Impacts on other Water Resources of the State

No impacts to water resources are anticipated as a result of implementing this strategy.

Impacts on Threats to Agriculture and other Natural Resources of the State

This strategy may provide benefit to agricultural users by providing an alternative soil amendment product.

Other Impacts

This strategy provides a flood control benefit by providing an additional 19,128 ac-ft of flood water retention for the contributing watershed.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy — **LNRA Aquifer Storage and Recovery**

Identified WUG/MWP — LNRA

Shortage Amount — Potential existing and future customers of LNRA within Region P and possibly neighboring Region L.

Supply Quantity — 8,665 ac-ft/yr, online in 2040. Project yield based on available excess flows from Lavaca River, averaged over period of record, while meeting the TCEQ environmental flow standards. ASR modeling assumes Lavaca Off-Channel Reservoir strategy has already been implemented.

Water Source — Lavaca River

Quality — No change in treated water quality to end user

Treatment — Treated going into aquifer, not treated in recovery

Cost ($/acre-foot) — Project cost is $260,074,000, with unit cost of $3,066/ac-ft. Facility costs were developed using the current version of the TWDB Costing tool. Facilities would include a 50 MGD raw water intake and pump station on the Lavaca River, 11 – 1,000 gpm wells for injection and recovery, a 20 MGD water treatment plant to treat the water before injection, two 20 MG raw water storage tanks to reduce need for peaking-sized treatment plant, and associated pipelines and appurtenances to pump water from the Lavaca River and deliver to the ASR site, and then return the recovered water to the LNRA system.

Environmental Impacts

Permitting would be required for ASR and diversion. New TCEQ environmental flow standards are met, but up to 25,000 ac-ft/yr that would normally reach the bay would be diverted for storage. Flows may ultimately be returned to river after use. When dissolved oxygen is present in the water introduced to an aquifer, a chain of oxygen reduction reactions results in selective leaching and/or mineral dissolution, releasing metals such as arsenic.

Impacts on other Water Resources of the State

Study needed to determine any potential impacts to local groundwater. Treatment of water prior to injection should prevent water quality issues.

Impacts on Threats to Agriculture and other Natural Resources of the State

The proposed ASR project should have a negligible impact on local agricultural activities. Siting of the project may remove approximately 130 acres of agricultural land from production, depending on actual location, but would have negligible influence given the large quantity of agricultural land in the area. See *Chapter 1* for list of rare, threatened, and endangered species in the region.

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy **Drought Management (Manufacturing)**

Identified WUG/MWP Manufacturing in Jackson County

Shortage Amount None

Supply Quantity Colorado-Lavaca Basin – 1,063 ac-ft/yr, online in 2020
Lavaca Basin – 15 ac-ft/yr, online in 2020
Lavaca-Guadalupe Basin – 18 ac-ft/yr, online in 2020

Water Source Drought Management

Quality No change in treated water quality to end user.

Cost ($/acre-foot) $22,133/ac-ft, to reflect dollar impact on economy due to reduced water based on data in the 2019 *TWDB Socioeconomic Impacts of Projected Water Shortages*.

Environmental Impacts
No environmental impacts anticipated.

Impacts on other Water Resources of the State
None expected.

Impacts on Threats to Agriculture and other Natural Resources of the State
No agricultural impacts anticipated.

APPENDIX 5C
Recommended and Alternative Water Management Strategy Summaries

WUG Name	County	River Basin	Water Management Strategy Name	Region of Source	Source County Name	Source Name	Recommended Water Management Strategies (ac-ft/yr) 2020	2030	2040	2050	2060	2070
Shortage/Surplus							(8,067)	(8,067)	(8,067)	(8,067)	(8,067)	(8,067)
IRRIGATION	WHARTON	LAVACA	Conservation (On-Farm, including land-leveling, multipe inlets, well meters, and irrigation pipeline)				9,496	9,496	9,496	9,496	9,496	9,496
IRRIGATION	WHARTON	LAVACA	Conservation (Tail Water Recovery)				5,733	5,733	5,733	5,733	5,733	5,733
Remaining Surplus/Shortage							**7,162**	**7,162**	**7,162**	**7,162**	**7,162**	**7,162**

Recommended Water Management Strategy Summary Table

Region	ID	Recommended Water Management Strategy	Total Capital Costs ($)	Estimated Annual Average Unit Cost ($/ac-ft/yr)	Water Supply Volume (ac-ft/yr) 2020	2030	2040	2050	2060	2070
P	P1	Municipal Conservation	$8,317,000	$1,404 - $6,000	0	223	345	475	542	600
P	P2	Reuse of Municipal Effluent - El Campo	$3,272,000	$1,368	560	560	560	560	560	560
P	P3	Irrigation Conservation - On-farm Conservation	$7,239,000	$54	9,496	9,496	9,496	9,496	9,496	9,496
P	P4	Irrigation Conservation - Tail water Recovery	$19,092,000	$442	5,733	5,733	5,733	5,733	5,733	5,733
P	P5	Lavaca River Off-Channel Reservoir	$331,200,000	$794	0	23,500	30,000	30,000	30,000	30,000
P	P6	Drought Management - Municipalities	$0	$100	343	343	340	341	344	348
P	P7	LNRA Desalination	$49,883,000	$1,311	0	0	6,452	6,452	6,452	6,452
P	P8	Conservation for Manufacturing	$130,169,000	$1,641	14,163	14,163	14,163	14,163	14,163	14,163

Alternative Water Management Strategy Summary Table

Region	ID	Alternative Water Management Strategy	Total Capital Costs ($)	Estimated Annual Average Unit Cost ($/ac-ft/yr)	Water Supply Volume (ac-ft/yr) 2020	2030	2040	2050	2060	2070
P	PA1	LNRA Aquifer Storage and Recovery	$260,074,000	$3,066	0	0	8,665	8,665	8,665	8,665
P	PA2	Lake Texana Dredging	$51,377,000	$2,988	0	0	390	663	937	1,210
P	PA3	Drought Management - Manufacturing	$0	$4,570	1,096	1,096	1,096	1,096	1,096	1,096
P	PA4	Irrigation Conservation - Alternate Wetting and Drying	$0	$0	633	633	633	633	633	633
P	PA5	Expand Use of the Gulf Coast Aquifer - Wharton County	$0	$66	8,067	8,067	8,067	8,067	8,067	8,067

APPENDIX 5D
Water Management Strategy Cost Tables

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Wharton County Irrigation - On-Farm Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
Integration, Relocations, & Other	$6,358,000
TOTAL COST OF FACILITIES	**$6,358,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (10% for pipes & 10% for all other facilities)	$636,000
Interest During Construction (4% for 1 years with a 1% ROI)	$245,000
TOTAL COST OF PROJECT	**$7,239,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$509,000
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$509,000**
Available Project Yield (acft/yr)	9,496
Annual Cost of Water ($ per acft), based on PF=1	$54
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$0.16
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.00

Note: One or more cost element has been calculated externally

Jaime Burke/Alicia Smiley *8/12/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Irrigation - Wharton County, Lavaca Basin - Tail Water Recovery

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Integration, Relocations, & Other	$16,769,000
TOTAL COST OF FACILITIES	**$16,769,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (10% for pipes & 10% for all other facilities)	$1,677,000
Interest During Construction (4% for 1 years with a 1% ROI)	$646,000
TOTAL COST OF PROJECT	**$19,092,000**
ANNUAL COST	
Debt Service (3.5 percent, 10 years)	$2,296,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$168,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (893854 kW-hr @ 0.08 $/kW-hr)	$72,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$2,536,000**
Available Project Yield (acft/yr)	5,733
Annual Cost of Water ($ per acft), based on PF=1	$442
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$42
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.13

Note: One or more cost element has been calculated externally

Alicia Smiley/Jaime Burke *7/1/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
LNRA - LNRA Lavaca Off-Channel Reservoir Phase 1

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Primary Pump Station (0 MGD)	$20,700,000
Transmission Pipeline (0 in dia., miles)	$9,670,000
TOTAL COST OF FACILITIES	**$30,370,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$10,146,000
Environmental & Archaeology Studies and Mitigation	$83,000
Land Acquisition and Surveying (14 acres)	$63,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,119,000
TOTAL COST OF PROJECT	**$41,781,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,940,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$97,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$517,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (7132124 kW-hr @ 0.08 $/kW-hr)	$571,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$4,125,000**
Available Project Yield (acft/yr)	23,500
Annual Cost of Water ($ per acft), based on PF=2	$176
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$50
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$0.54
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.15

Note: One or more cost element has been calculated externally

Kiera Brown *12/11/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
LNRA - LNRA Lavaca Off-Channel Reservoir Phase 2

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Dam and Reservoir (Conservation Pool 50000 acft, 2500 acres)	$154,795,000
Transmission Pipeline (0 in dia., miles)	$38,680,000
Integration, Relocations, & Other	$6,627,000
TOTAL COST OF FACILITIES	**$200,102,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$68,102,000
Environmental & Archaeology Studies and Mitigation	$3,523,000
Land Acquisition and Surveying (2541 acres)	$10,488,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$7,762,000
TOTAL COST OF PROJECT	**$289,977,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$4,550,000
Reservoir Debt Service (3.5 percent, 40 years)	$10,551,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$453,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$2,322,000
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (8232580 kW-hr @ 0.08 $/kW-hr)	$659,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$18,535,000**
Available Project Yield (acft/yr)	30,000
Annual Cost of Water ($ per acft), based on PF=2	$618
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$114
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$1.90
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.35

Note: One or more cost element has been calculated externally

Kiera Brown *1/10/2020*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Lavaca-Navidad River Authority - LNRA Desalination

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Intake Pump Stations (8.6 MGD)	$7,671,000
Transmission Pipeline (24 in dia., miles)	$2,044,000
Well Fields (Wells, Pumps, and Piping)	$4,175,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,297,000
Water Treatment Plant (5.8 MGD)	$20,363,000
TOTAL COST OF FACILITIES	**$35,550,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$12,340,000
Environmental & Archaeology Studies and Mitigation	$367,000
Land Acquisition and Surveying (54 acres)	$290,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,336,000
TOTAL COST OF PROJECT	**$49,883,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,510,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$75,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$192,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$4,073,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (7625589 kW-hr @ 0.08 $/kW-hr)	$610,000
Purchase of Water (6452 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$8,460,000**
Available Project Yield (acft/yr)	6,452
Annual Cost of Water ($ per acft), based on PF=2	$1,311
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$767
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$4.02
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$2.35

KB *7/19/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
El Campo - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$2,748,000
TOTAL COST OF FACILITIES	**$2,748,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$824,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$99,000
TOTAL COST OF PROJECT	**$3,671,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$258,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$275,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Non-Capital Costs (106 acft/yr @ $250/acft)	$27,000
TOTAL ANNUAL COST	**$560,000**
Available Project Yield (acft/yr)	309
Annual Cost of Water ($ per acft), based on PF=1	$1,812
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$890
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.56
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.73

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Hallettsville - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$1,124,000
TOTAL COST OF FACILITIES	**$1,124,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$337,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$41,000
TOTAL COST OF PROJECT	**$1,502,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$106,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$112,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Non-Capital Costs (75 acft/yr @ $250/acft)	$19,000
TOTAL ANNUAL COST	**$237,000**
Available Project Yield (acft/yr)	124
Annual Cost of Water ($ per acft), based on PF=1	$1,911
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$903
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$5.86
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.77

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Moulton - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$307,000
TOTAL COST OF FACILITIES	**$307,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$92,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$410,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Non-Capital Costs (18 acft/yr @ $250/acft)	$5,000
TOTAL ANNUAL COST	**$65,000**
Available Project Yield (acft/yr)	32
Annual Cost of Water ($ per acft), based on PF=1	$2,031
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$969
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$6.23
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$2.97

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Shiner - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
Conservation (Leaking Pipe/Meter Replacement)	$606,000
TOTAL COST OF FACILITIES	**$606,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$182,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$22,000
TOTAL COST OF PROJECT	**$810,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$57,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$61,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Non-Capital Costs (57 acft/yr @ $250/acft)	$14,000
TOTAL ANNUAL COST	**$132,000**
Available Project Yield (acft/yr)	94
Annual Cost of Water ($ per acft), based on PF=1	$1,404
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$649
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$4.31
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$1.99

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Wharton County WCID 1 - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
Conservation (Leaking Pipe/Meter Replacement)	$306,000
TOTAL COST OF FACILITIES	**$306,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$92,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$11,000
TOTAL COST OF PROJECT	**$409,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$29,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Non-Capital Costs (0 acft/yr @ $250/acft)	$0
TOTAL ANNUAL COST	**$60,000**
Available Project Yield (acft/yr)	10
Annual Cost of Water ($ per acft), based on PF=1	$6,000
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$3,100
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$18.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$9.51

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Yoakum - Conservation

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Conservation (Leaking Pipe/Meter Replacement)	$1,134,000
TOTAL COST OF FACILITIES	**$1,134,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$340,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$41,000
TOTAL COST OF PROJECT	**$1,515,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$107,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (10% of Cost of Facilities)	$113,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$220,000**
Available Project Yield (acft/yr)	47
Annual Cost of Water ($ per acft), based on PF=1	$4,681
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$2,404
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$14.36
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$7.38

Alicia Smiley/Jaime Burke *7/25/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
El Campo - Water Reuse

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Primary Pump Station (0 MGD)	$3,216,000
Transmission Pipeline (12 in dia., miles)	$2,038,000
Water Treatment Plant (0 MGD)	$363,000
TOTAL COST OF FACILITIES	**$5,617,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,864,000
Environmental & Archaeology Studies and Mitigation	$125,000
Land Acquisition and Surveying (7 acres)	$8,000
Interest During Construction (4% for 1 years with a 1% ROI)	$267,000
TOTAL COST OF PROJECT	**$7,881,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$659,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$20,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$80,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (75153 kW-hr @ 0.09 $/kW-hr)	$7,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$766,000**
Available Project Yield (acft/yr)	560
Annual Cost of Water ($ per acft), based on PF=2	$1,368
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$191
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$4.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.59

Note: One or more cost element has been calculated externally

Jaime Burke/Alicia Smiley *5/14/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
Irrigation - Wharton County, Lavaca Basin - Expand use of Groundwater

Cost based on ENR CCI 11170.28 for September 2018 and
a PPI of 202.4 for September 2018

Item	*Estimated Costs for Facilities*
ANNUAL COST	
Operation and Maintenance	
Intakes and Pump Stations (2.5% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (6666777 kW-hr @ 0.08 $/kW-hr)	$533,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$533,000**
Available Project Yield (acft/yr)	8,067
Annual Cost of Water ($ per acft), based on PF=2	$66
Annual Cost of Water After Debt Service ($ per acft), based on PF=2	$66
Annual Cost of Water ($ per 1,000 gallons), based on PF=2	$0.20
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2	$0.20

JB *7/29/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
LNRA - Lake Texana Dredging

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	***Estimated Costs for Facilities***
Integration, Relocations, & Other	$50,001,000
TOTAL COST OF FACILITIES	**$50,001,000**
Interest During Construction (3% for 1 years with a 0.5% ROI)	$1,376,000
TOTAL COST OF PROJECT	**$51,377,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$3,615,000
Operation and Maintenance	
Intakes and Pump Stations (0% of Cost of Facilities)	$0
Dam and Reservoir (0% of Cost of Facilities)	$0
Water Treatment Plant	$0
Advanced Water Treatment Facility	$0
Pumping Energy Costs (0 kW-hr @ 0 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,615,000**
Available Project Yield (acft/yr)	1,210
Annual Cost of Water ($ per acft), based on PF=1	$2,988
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$0
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$9.17
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.00

Note: One or more cost element has been calculated externally

KB *7/22/2019*

Cost Estimate Summary
Water Supply Project Option
September 2018 Prices
LNRA - LNRA Aquifer Storage and Recovery

Cost based on ENR CCI 11170.28 for September 2018 and a PPI of 202.4 for September 2018

Item	Estimated Costs for Facilities
Intake Pump Stations (50.2 MGD)	$37,474,000
Transmission Pipeline (54 in dia., miles)	$38,442,000
Well Fields (Wells, Pumps, and Piping)	$13,208,000
Storage Tanks (Other Than at Booster Pump Stations)	$22,903,000
Water Treatment Plant (20 MGD)	$75,428,000
TOTAL COST OF FACILITIES	**$187,455,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$63,687,000
Environmental & Archaeology Studies and Mitigation	$1,057,000
Land Acquisition and Surveying (170 acres)	$914,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$6,961,000
TOTAL COST OF PROJECT	**$260,074,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$18,299,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$746,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$937,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant	$5,280,000
Advanced Water Treatment Facility	$0
Pumping Energy Costs (16316874 kW-hr @ 0.08 $/kW-hr)	$1,305,000
Purchase of Water (10974 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$26,567,000**
Available Project Yield (acft/yr)	8,665
Annual Cost of Water ($ per acft), based on PF=2.25	$3,066
Annual Cost of Water After Debt Service ($ per acft), based on PF=2.25	$954
Annual Cost of Water ($ per 1,000 gallons), based on PF=2.25	$9.41
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=2.25	$2.93

KB *11/15/2019*

County	WUG Name	Basin	Region P Gallons per Capita per Day (GPCD) Projections						Conservation applied? (2030 GPCD > 140)	Conservation Demand Reduction (AFY)						Advanced Metering Infrastructure		
			2020	2030	2040	2050	2060	2070		2020	2030	2040	2050	2060	2070	Smart Meters Installed by 2070	Project Yield 2070 (5% Demand)	AMI Facilities Cost (Assuming $150/SM)
JACKSON	COUNTY-OTHER, JACKSON	COLORADO-LAVACA	94	89	86	85	84	84	No	-	-	-	-	-	-	-	-	-
JACKSON	COUNTY-OTHER, JACKSON	LAVACA	94	89	86	85	84	84	No	-	-	-	-	-	-	-	-	-
JACKSON	COUNTY-OTHER, JACKSON	LAVACA-GUADALUPE	94	89	86	85	84	84	No	-	-	-	-	-	-	-	-	-
JACKSON	EDNA	LAVACA	136	132	129	127	127	127	No	-	-	-	-	-	-	-	-	-
JACKSON	GANADO	LAVACA	102	98	95	93	93	93	No	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	GUADALUPE	115	111	107	105	105	105	No	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	LAVACA	115	111	107	105	105	105	No	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	LAVACA-GUADALUPE	115	111	107	105	105	105	No	-	-	-	-	-	-	-	-	-
LAVACA	HALLETTSVILLE	LAVACA	203	199	195	193	193	193	Yes	-	31	50	73	98	124	940	31	$ 141,000
LAVACA	MOULTON	LAVACA	183	179	175	174	173	173	Yes	-	9	13	20	26	32	291	8	$ 43,700
LAVACA	SHINER	LAVACA	211	206	203	201	201	201	Yes	-	24	38	56	75	94	685	23	$ 102,700
LAVACA	YOAKUM	LAVACA	159	155	151	149	149	149	Yes	-	32	47	39	38	38	1234	31	$ 185,050
WHARTON	COUNTY-OTHER, WHARTON	COLORADO	118	113	110	109	109	109	No	-	-	-	-	-	-	-	-	-
WHARTON	COUNTY-OTHER, WHARTON	COLORADO-LAVACA	118	113	110	109	109	109	No	-	-	-	-	-	-	-	-	-
WHARTON	COUNTY-OTHER, WHARTON	LAVACA	118	113	110	109	109	109	No	-	-	-	-	-	-	-	-	-
WHARTON	EL CAMPO	TOTAL	169	165	161	160	159	159	Yes	-	117	190	283	302	309	4728	127	$ 709,150
WHARTON	WHARTON COUNTY WCID 1	LAVACA	153	148	145	143	143	143	Yes	-	10	7	4	4	4	444	11	$ 66,550

AMI Assumptions: 3 people per household; 100% of household will install smart meters by 2070; Installation of smart meters saves ~ 5% of demand.

County	WUG Name	Basin	Leak Detection and Repair			Municipal Conservation										Total Facilities Cost
			Project Yield 2070 (3% Demand)	Pipe Replaced (Miles)	LDR Facilities Cost	Max Conservation Reduction	Total Capital Yield 2070 (AMI + LDR)	Percent WUG Capital Implemented	Actual Smart Meters Installed	AMI Facilities Cost	Actual Pipe Replaced	LDR Facilities Cost	Savings from Capital Improve-ments	Savings from Non-Capital Improve-ments	Non-Capital Costs ($250/ac-ft)	
JACKSON	COUNTY-OTHER, JACKSON	COLORADO-LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JACKSON	COUNTY-OTHER, JACKSON	LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JACKSON	COUNTY-OTHER, JACKSON	LAVACA-GUADALUPE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JACKSON	EDNA	LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JACKSON	GANADO	LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	GUADALUPE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAVACA	COUNTY-OTHER, LAVACA	LAVACA-GUADALUPE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAVACA	HALLETTSVILLE	LAVACA	18	4.1	$ 983,224	124	49	100%	940	$ 141,000	4.1	$ 983,224	49	75	$ 18,750	$ 1,124,224
LAVACA	MOULTON	LAVACA	5	1.1	$ 263,792	32	14	100%	291	$ 43,700	1.1	$ 263,792	14	18	$ 4,500	$ 307,492
LAVACA	SHINER	LAVACA	14	2.1	$ 503,603	94	37	100%	685	$ 102,700	2.1	$ 503,603	37	57	$ 14,250	$ 606,303
LAVACA	YOAKUM	LAVACA	19	4.2	$ 1,007,421	47	49	95%	1173	$ 175,917	4.0	$ 957,702	47	0	$ -	$ 1,133,652
WHARTON	COUNTY-OTHER, WHARTON	COLORADO	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHARTON	COUNTY-OTHER, WHARTON	COLORADO-LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHARTON	COUNTY-OTHER, WHARTON	LAVACA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHARTON	EL CAMPO	TOTAL	76	8.5	$ 2,038,391	309	203	100%	4728	$ 709,150	8.5	$ 2,038,391	203	106	$ 26,500	$ 2,747,541
WHARTON	WHARTON COUNTY WCID 1	LAVACA	6	1.9	$ 455,640	10	17	59%	260	$ 39,055	1.1	$ 267,395	10	0	$ -	$ 306,395

LDR Assumptions: Assumes 3% of 2030 demand is reduced by replacement of 10% of the pipe. 80% of the replaced pipeline is 8”, 20% is 12”.

APPENDIX 5E
TWDB DB22 Reports

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

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

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY - COLORADO-LAVACA BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA BASIN						
EDNA	0	0	0	0	0	0
GANADO	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
JACKSON COUNTY - LAVACA-GUADALUPEBASIN						
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
LAVACA COUNTY - LAVACA BASIN						
HALLETTSVILLE	0	0	0	0	0	0
MOULTON	0	0	0	0	0	0
SHINER	0	0	0	0	0	0
YOAKUM*	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY - LAVACA-GUADALUPEBASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
WHARTON COUNTY - COLORADO BASIN						
EL CAMPO*	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
WHARTON COUNTY - COLORADO-LAVACA BASIN						
EL CAMPO*	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
MANUFACTURING*	0	0	0	0	0	0
MINING*	0	0	0	0	0	0
LIVESTOCK*	0	0	0	0	0	0

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

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

	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY - COLORADO-LAVACA BASIN						
IRRIGATION*	0	0	0	0	0	0
WHARTON COUNTY - LAVACA BASIN						
EL CAMPO*	0	0	0	0	0	0
WHARTON COUNTY WCID 1	0	0	0	0	0	0
COUNTY-OTHER*	0	0	0	0	0	0
MINING*	0	0	0	0	0	0
STEAM ELECTRIC POWER*	0	0	0	0	0	0
LIVESTOCK*	0	0	0	0	0	0
IRRIGATION*	0	0	0	0	0	0

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

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

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

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Region P Water User Group (WUG) Unmet Needs

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070

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

Region P Water User Group (WUG) Unmet Needs Summary

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zerc so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

WUG CATEGORY	NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
EDNA	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	33	33	33	33	33	33
EL CAMPO*	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	86	88	89	91	93	95
EL CAMPO*	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1812	0	117	190	283	301	308
GANADO	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	47	47	47	47	47	47
HALLETTSVILLE	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	48	47	46	46	46	46
HALLETTSVILLE	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1911	0	31	50	73	98	124
IRRIGATION, WHARTON*	P	IRRIGATION CONSERVATION	DEMAND REDUCTION	$200	$200	15,229	15,229	15,229	15,229	15,229	15,229
MANUFACTURING, JACKSON	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	1,101	1,101	1,101	1,101	1,101
MANUFACTURING, LAVACA	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	63	63	63	63	63
MANUFACTURING, WHARTON*	P	CONSERVATION FOR MANUFACTURING	DEMAND REDUCTION	N/A	$0	0	3	3	3	3	3
MOULTON	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	36	35	34	34	34	34
MOULTON	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$2031	0	9	13	20	26	32
SHINER	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	49	48	47	46	46	46
SHINER	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$1404	0	24	38	56	75	94
WHARTON COUNTY WCID 1	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	28	29	29	30	31	32
WHARTON COUNTY WCID 1	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$6000	0	10	7	4	4	4
YOAKUM*	P	DROUGHT MANAGEMENT - MUNICIPAL	DEMAND REDUCTION	$100	$100	16	16	16	15	15	15
YOAKUM*	P	MUNICIPAL CONSERVATION	DEMAND REDUCTION	N/A	$4681	0	32	47	39	38	38

REGION P RECOMMENDED WMS SUPPLY TOTAL 15,572	16,962	17,082	17,213	17,283	17,344

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

Region P Recommended Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
EL CAMPO	YES	2030	MUNICIPAL CONSERVATION - EL CAMPO	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$3,671,000
EL CAMPO	YES	2030	REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$7,881,000
HALLETTSVILLE	YES	2030	MUNICIPAL CONSERVATION - HALLETTSVILLE	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$1,502,000
IRRIGATION, WHARTON	NO	2020	IRRIGATION CONSERVATION - ON FARM	CONSERVATION - AGRICULTURAL	$7,239,000
IRRIGATION, WHARTON	NO	2020	IRRIGATION CONSERVATION - TAILWATER RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$19,092,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2030	LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; DIVERSION AND CONTROL STRUCTURE; PUMP STATION	$41,781,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$289,977,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$49,900,000
MOULTON	NO	2030	MUNICIPAL CONSERVATION - MOULTON	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$410,000
SHINER	YES	2030	MUNICIPAL CONSERVATION - SHINER	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$810,000
WHARTON COUNTY WCID 1	NO	2030	MUNICIPAL CONSERVATION - WHARTON COUNTY WCID 1	CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); DATA GATHERING/MONITORING TECHNOLOGY; WATER LOSS CONTROL	$409,000
YOAKUM	YES	2020	MUNICIPAL CONSERVATION - YOAKUM	DATA GATHERING/MONITORING TECHNOLOGY; CONSERVATION - MUNICIPAL (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$85,984

REGION P RECOMMENDED CAPITAL COST TOTAL	**$422,757,984**

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

						WATER MANAGEMENT STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
WUG ENTITY NAME	WMS SPONSOR REGION	WMS NAME	SOURCE NAME	UNIT COST 2020	UNIT COST 2070	2020	2030	2040	2050	2060	2070
IRRIGATION, WHARTON*	P	EXPAND USE OF GROUNDWATER	P | GULF COAST AQUIFER SYSTEM | WHARTON COUNTY	$66	$66	8,067	8,067	8,067	8,067	8,067	8,067
IRRIGATION, WHARTON*	P	IRRIGATION CONSERVATION	DEMAND REDUCTION	$0	$0	633	633	633	633	633	633
MANUFACTURING, JACKSON	P	DROUGHT MANAGEMENT - MANUFACTURING	DEMAND REDUCTION	$4570	$4570	1,096	1,096	1,096	1,096	1,096	1,096
REGION P ALTERNATIVE WMS SUPPLY TOTA						9,796	9,796	9,796	9,796	9,796	9,796

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

Region P Alternative Projects Associated with Water Management Strategies

SPONSOR NAME	SPONSOR IS WWP?	ONLINE DECADE	PROJECT NAME	PROJECT DESCRIPTION	CAPITAL COST
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$260,074,000
LAVACA NAVIDAD RIVER AUTHORITY	YES	2040	LAKE TEXANA DREDGING	DREDGE TO RECOVER CAPACITY	$51,377,000

REGION P ALTERNATIVE CAPITAL COST TOTAL	**$311,451,000**

Region P Water User Group (WUG) Management Supply Factor

WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin, the combined total of existing and future supply is divided by the total projected demand. If a WUG is split by more than one planning region, the whole WUG's management supply factor will show up in each of its planning region's management supply factor reports.

	WUG MANAGEMENT SUPPLY FACTOR					
WUG NAME	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, JACKSON	1.4	1.4	1.5	1.5	1.5	1.5
COUNTY-OTHER, LAVACA	1.3	1.3	1.4	1.4	1.4	1.4
COUNTY-OTHER, WHARTON*	1.3	1.3	1.3	1.2	1.2	1.1
EDNA	1.5	1.5	1.5	1.5	1.5	1.5
EL CAMPO*	1.1	1.2	1.2	1.2	1.2	1.2
GANADO	1.6	1.6	1.7	1.7	1.7	1.7
HALLETTSVILLE	1.4	1.5	1.5	1.6	1.6	1.7
IRRIGATION, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, LAVACA	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, WHARTON*	1.0	1.0	1.0	1.0	1.1	1.1
LIVESTOCK, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, LAVACA	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, WHARTON*	1.1	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, JACKSON	1.0	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, LAVACA	1.1	1.1	1.1	1.1	1.1	1.1
MANUFACTURING, WHARTON*	1.1	1.0	1.0	1.0	1.0	1.0
MINING, JACKSON	1.0	1.0	1.3	1.8	2.8	3.8
MINING, LAVACA	1.0	1.4	1.8	2.6	4.7	8.6
MINING, WHARTON*	1.0	1.0	1.3	1.8	2.8	4.4
MOULTON	1.5	1.6	1.6	1.7	1.7	1.8
SHINER	1.4	1.5	1.6	1.6	1.6	1.7
STEAM ELECTRIC POWER, WHARTON*	1.0	1.0	1.0	1.0	1.0	1.0
WHARTON COUNTY WCID 1	1.3	1.3	1.3	1.2	1.2	1.2
YOAKUM*	1.3	1.3	1.3	1.3	1.3	1.4

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

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

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

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

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

IBT WMS supply is the portion of the total WMS benefitting the WUG basin split listed that will require a new or amended IBT permit that is not considered exempt under the Texas Water Code § 11.085. Total conservation supply represents all conservation WMS volumes recommended within the WUG's region-basin geographic split.

BENEFITTING WUG NAME | BASIN	WMS SOURCE ORIGIN BASIN | WMS NAME	WMS SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070

Region P Sponsored Recommended Water Management Strategy (WMS) Supplies Unallocated* to Water User Groups (WUG)

WMS NAME	WMS SPONSOR	SOURCE NAME	UNALLOCATED STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
			2020	2030	2040	2050	2060	2070
DIRECT REUSE - EL CAMPO	EL CAMPO	P | DIRECT NON-POTABLE REUSE	0	560	560	560	560	560
LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	LAVACA NAVIDAD RIVER AUTHORITY	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	0	23,500	0	0	0	0
LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	LAVACA NAVIDAD RIVER AUTHORITY	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	0	0	30,000	30,000	30,000	30,000
LNRA DESALINATION - BRACKISH GROUNDWATER	LAVACA NAVIDAD RIVER AUTHORITY	P | GULF COAST AQUIFER SYSTEM | JACKSON COUNTY	0	0	4,800	4,800	4,800	4,800
LNRA DESALINATION - BRACKISH SURFACE WATER	LAVACA NAVIDAD RIVER AUTHORITY	P | NAVIDAD RIVER TIDAL FRESH/BRACKISH	0	0	1,652	1,652	1,652	1,652
TOTAL UNALLOCATED STRATEGY SUPPLIES			**0**	**24,060**	**37,012**	**37,012**	**37,012**	**37,012**

* Strategy supplies created through the WMS that have not been assigned to a WUG will be allocated to the entity responsible for the water through an‘unassigned water volumes’ entity. Only strategy supplies associated with an 'unassigned water volume' entity are shown in this report, and may not represent all strategy supplies associated with the listed WMS.

Region P Water User Group (WUG) Strategy Supplies by Water Management Strategy (WMS) Type

WMS TYPE *	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
DROUGHT MANAGEMENT	343	343	341	342	345	348
GROUNDWATER WELLS & OTHER	0	0	0	0	0	0
IRRIGATION CONSERVATION	15,229	15,229	15,229	15,229	15,229	15,229
MUNICIPAL CONSERVATION	0	223	345	475	542	600
OTHER CONSERVATION	0	1,167	1,167	1,167	1,167	1,167
NEW MAJOR RESERVOIR	0	0	0	0	0	0
SEAWATER DESALINATION	0	0	0	0	0	0
AQUIFER STORAGE & RECOVERY	0	0	0	0	0	0
CONJUNCTIVE USE	0	0	0	0	0	0
OTHER STRATEGIES	0	0	0	0	0	0
INDIRECT REUSE	0	0	0	0	0	0
OTHER DIRECT REUSE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	0	0	0	0	0
OTHER SURFACE WATER	0	0	0	0	0	0
GROUNDWATER DESALINATION	0	0	0	0	0	0
TOTAL STRATEGY SUPPLIES	**15,572**	**16,962**	**17,082**	**17,213**	**17,283**	**17,344**

* WMS type descriptions can be found on the interactive state water plan website at http://texasstatewaterplan.org/ using the 'View data for' drop-down menus to navigate to a specific WMS Type page. The data used to create each WMS type value is available in Appendix 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region P Water User Group (WUG)
Recommended Water Management Strategy (WMS) Supplies by Source Type

SOURCE SUBTYPE*	STRATEGY SUPPLY (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
AQUIFER STORAGE & RECOVERY	0	0	0	0	0	0
GROUNDWATER	0	0	0	0	0	0
GROUNDWATER TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
DIRECT NON-POTABLE REUSE	0	0	0	0	0	0
DIRECT POTABLE REUSE	0	0	0	0	0	0
INDIRECT NON-POTABLE REUSE	0	0	0	0	0	0
INDIRECT POTABLE REUSE	0	0	0	0	0	0
REUSE TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
ATMOSPHERE	0	0	0	0	0	0
GULF OF MEXICO	0	0	0	0	0	0
LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
OTHER LOCAL SUPPLY	0	0	0	0	0	0
RAINWATER HARVESTING	0	0	0	0	0	0
RESERVOIR	0	0	0	0	0	0
RESERVOIR SYSTEM	0	0	0	0	0	0
RUN-OF-RIVER	0	0	0	0	0	0
SURFACE WATERTOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**
REGION P TOTAL STRATEGY SUPPLIES	**0**	**0**	**0**	**0**	**0**	**0**

* A full list of source subtype definitions can be found in section 3 of the Guidelines for Regional Water Planning Data Deliverable (Exhibit D) document at http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/contract_docs/ExhibitD.pdf.

Region P Major Water Provider (MWP) Existing Sales and Transfers

Major Water Providers are entities of particular significance to a region's water supply as defined by the Regional Water Planning Group (RWPG), and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity , or both (WUG/WWP).

Retail denotes WUG projected demands and existing water supplies used by the WUG. Wholesale denotes a WWP or WUG/WWP selling water to another entity.

LAVACA NAVIDAD RIVER AUTHORITY- WWP	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	2020	2030	2040	2050	2060	2070
PROJECTED WHOLESALE CONTRACT DEMANDS	73,850	73,850	73,850	73,850	73,850	73,850
TOTAL PROJECTED WHOLESALE CONTRACT AND RETAIL DEMANDS	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**
SURFACE WATER SALES TO WHOLESALE CUSTOMERS	73,850	73,850	73,850	73,850	73,850	73,850
TOTAL WHOLESALE AND RETAIL SALES TO CUSTOMERS	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**	**73,850**

Region P Major Water Provider (MWP) Water Management Strategy (WMS) Summary

MWPs are entities of significance to a region's water supply as defined by the Regional Water Planning Group (RWPG) and may be a Water User Group (WUG) entity, Wholesale Water Provider (WWP) entity, or both (WUG/WWP).'MWP Retail Customers' denotes recommended WMS supply used by the WUG. 'Transfers Related to Wholesale Customers' denotes a WWP or WUG/WWP selling or transferring recommended WMS supply to another entity. Supply associated with the MWP's wholesale transfers will only display if it is listed as the main seller in the State Water Planning database, even if multiple sellers are involved with the sale of water to WUGs. Unallocated water volumes represent MWP recommended WMS supply not currently allocated to a customer of the MWP.'Total MWP Related WMS Supply' will display if the MWP's WMS is related to more than one WMS supply type (retail, wholesale, and/or unallocated). Associated WMS Projects are listed when the MWP is one of the project's sponsors. Report contains draft data and is subject to change.

LAVACA NAVIDAD RIVER AUTHORITY | LAVACA OFF-CHANNEL RESERVOIR						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RELATED UNALLOCATED WMS WATER VOLUMES	0	23,500	30,000	30,000	30,000	30,000
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
LAVACA OFF-CHANNEL RESERVOIR - PHASE 1	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; DIVERSION AND CONTROL STRUCTURE; PUMP STATION					
LAVACA OFF-CHANNEL RESERVOIR - PHASE 2	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION					

LAVACA NAVIDAD RIVER AUTHORITY | LNRA DESALINATION						
	WATER VOLUMES (ACRE-FEET PER YEAR)					
DATA DESCRIPTION	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RELATED UNALLOCATED WMS WATER VOLUMES	0	0	6,452	6,452	6,452	6,452
WMS RELATED MWP SPONSORED PROJECTS	**PROJECT DESCRIPTION**					
LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT NO IBT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK					

APPENDIX 5F
Strategy WAM Coding

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T1      WRAP MODEL
T2      Lavaca River Basin Water Availability Model - original from BR/LNRA modifications completed
by staff September 2001
T3      KA 09/02/2014 DRAFT SUBJECT TO REVISION - INCLUDES DRAFT REPRESENTATION OF ADOPTED
ENVIRONMENTAL FLOW STANDARDS
**
** AECOM Strategy Model to evaluate yield for LNRA OCR 111419 50,000AFY capacity
**
** Run 3: full diversion amounts, authorized area capacity, no term permits, and one-hundred percent
reuse
JD    57    1940       1      -1      -1               5
RO    -1
**
**Activation of the FY record for the Lavaca OCR - written to .YRO file
**
FY         50000    1000     100      10  NewWR1                       1
**
** UC FOR COLLINS APPLICATION 5579
UC  5579       0       0       0      60     200     403
UC           403     200       0       0       0       0
UC     1  0.0700  0.0600  0.0700  0.0700  0.0800  0.1000
UC        0.1300  0.1200  0.0900  0.0800  0.0600  0.0700
UC     2   0.076   0.074   0.092   0.088   0.092   0.085
UC         0.079   0.087   0.083   0.086   0.082   0.077
UC     3   0.000   0.001   0.003   0.083   0.149   0.261
UC         0.333   0.154   0.008   0.005   0.002   0.000
UC     7  0.0833  0.0833  0.0833  0.0833  0.0833  0.0834
UC        0.0834  0.0834  0.0834  0.0833  0.0833  0.0833
UC     8  0.0833  0.0833  0.0833  0.0833  0.0833  0.0834
UC        0.0834  0.0834  0.0834  0.0833  0.0833  0.0833
UC IF214  0.0000  0.0000  0.0000  0.1595  0.1738  0.1595
UC        0.1738  0.1738  0.1595  0.0000  0.0000  0.0000
UC IF503  0.1117  0.1009  0.1117  0.1081  0.1117  0.1081
UC        0.0479  0.0479  0.0463  0.0479  0.0463  0.1117
UCIF1023  0.0768  0.0694  0.0768  0.0743  0.0768  0.1699
UC        0.0768  0.0768  0.0743  0.0768  0.0743  0.0768
UCIF1021  0.0770  0.0695  0.0770  0.0745  0.0770  0.1677
UC        0.0770  0.0770  0.0745  0.0770  0.0745  0.0770
UCIF1001  0.0565  0.0510  0.0565  0.0546  0.1129  0.1093
UC        0.1129  0.1129  0.1093  0.1129  0.0546  0.0565
UC IF816  0.0307  0.0278  0.0307  0.1192  0.1232  0.1192
UC        0.1232  0.1232  0.1192  0.1232  0.0297  0.0307
UC IF815  0.0242  0.0219  0.0242  0.1406  0.1454  0.1406
UC        0.1454  0.1454  0.1406  0.0242  0.0234  0.0242
UC IF814  0.0321  0.0291  0.0321  0.1183  0.1222  0.1183
UC        0.1222  0.1222  0.1183  0.1222  0.0311  0.0321
UC IF807  0.0557  0.0503  0.0557  0.0539  0.1254  0.1213
UC        0.1254  0.1254  0.1213  0.0557  0.0539  0.0557
UC IF887  0.0462  0.0417  0.0462  0.1341  0.1386  0.1341
UC        0.1386  0.1386  0.0447  0.0462  0.0447  0.0462
UC IF843  0.0630  0.0568  0.0630  0.1116  0.1154  0.1116
UC        0.1154  0.1154  0.0609  0.0630  0.0609  0.0630
UC    TA    3050    3040    3050    3050    4100    4100
UC          4100    4100    4100    3050    3050    3050
** UC for instream flow restriction for App 5168
UC  1018     254     253     254     253     253     253
UC           254     253     253     253     254     253
** UC for instream flow restriction for App. 5370
UC   916    60.2    60.2    60.2    60.2    60.2    60.3
UC          60.3    60.2    60.2    60.2    60.2    60.3
UCBAYEST    5196    7908    5337   48007   71897   70892
UC          7778   16337   61128   43551    4064    4876
UC   INT       0       0       0       0       0       0
UC             0       0       0       0       0   12000
```

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UCBAYES1  0.0150  0.0228  0.0154  0.1384  0.2072  0.2043
UC        0.0224  0.0471  0.1762  0.1255  0.0117  0.0140
*** Start Eflows UC
** LE UCs
UC LESUB     523     476     615     595     615     595     =     4318
UC            80      80      71      74      71     523
UC LEDRY    1844    1681    1844    1785    1844    1785     =    18694
UC          1229    1229    1190    1229    1190    1844
UC LEAVG    3381    3081    3381    3272    3381    3272     =    33162
UC          2029    2029    1963    2029    1963    3381
UC LEWET    5778    5266    5778    5592    5778    5592     =    55929
UC          2951    2951    3450    3565    3450    5778
** SG UCs
UC SGSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC SGDRY     307     280     307     297     307     297     =     4831
UC           553     553     535     553     535     307
UC SGAVG     861     784     861     833     861     833     =    12265
UC          1291    1291    1249    1291    1249     861
UC SGWET    1844    1681    1844    1785    1844    1785     =    24458
UC          2397    2397    2320    2397    2320    1844
** WM UCs
UC WMSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC WMDRY     246     224     307     297     307     297     =     4237
UC           615     615     357     369     357     246
UC WMAVG     553     504     676     654     676     654     =     9011
UC          1107    1107     833     861     833     553
UC WMWET    1229    1120    1229    1190    1229    1190     =    17042
UC          1967    1967    1547    1598    1547    1229
** EM UCs
UC EMSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC EMDRY      61      56      61      59      61      59     =      843
UC           123     123      59      61      59      61
UC EMAVG     123     112     184     178     184     178     =     2236
UC           307     307     178     184     178     123
UC EMWET     369     336     369     357     369     357     =     4954
UC           492     492     476     492     476     369
**END E-FLOWS  UCs
** All 100, 200, 300 and 400 control point numbers are on the Lavaca River or one of its tributaries
** All 500 and 600 control point numbers are on the Navidad River or one of its tributaries
** All 700 control point numbers are on Mustang Creek or East Mustang Creek
** All 800 control point numbers are on West Mustang Creek
** All 900 and 1000 control point numbers are on the Sandy, West Sandy, or
** Middle Sandy Creek or one of their tributaries
** For the control point numbers T=Tributary, W=West, M=Middle, and E=East
** For the control point numbers DV=DiVersion, WW=Waste Water discharge,
** GS=Gage Station, CB=ComBine point, RF=Return Flow, OS=On Stream reservoir,
** WQ=Water Quality point, and EP=End Point
**      2       3       4       5       6       7       8       9      10
** COMPUTATIONAL CP FOR INTERRUPTIBLE WATER
CPINTER1     OUT                        2    NONE    NONE
CP DV402   WW401                        7           GS400      -1
CP WW401   GS400                        7           GS400      -1
CP GS400   CB330                        1
CPTDV333  TDV332                        7           GS300      -1
CPTDV332   CB330                        7           GS300      -1
CPTWW331   CB330                        7           GS300      -1
CP CB330   CB320                        7           GS300      -1
CPTOS323  TWW322                        7           GS300      -1
CPTWW322  TOS321                        7           GS300      -1
CPTOS321   CB320                        7           GS300      -1
CP CB320   CB310                        7           GS300      -1
```

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CPTOS313   CB310                        7           GS300      -1
CPTOS312   CB310                        7           GS300      -1
CPTOS311   CB310                        7           GS300      -1
CP CB310   DV301                        7           GS300      -1
CP DV301   GS300                        7           GS300      -1
**CP GS300   DV214                        1
CP GS300  LESUBS                        1
CPLESUBS  LEBASE                        2   GS300    NONE
CPLEBASE  LESPUL                        2   GS300    NONE
CPLESPUL  LELPUL                        2   GS300    NONE
CPLELPUL  LEAPUL                        2   GS300    NONE
CPLEAPUL   DV214                        2   GS300    NONE
**
**
CP DV214   DV215                        7           GS300      -2
CP DV215   DV216                        7           GS300      -2
CP DV216   DV213                        7           GS300      -2
CP DV213   WQ002                        7           GS300      -2
**CP WQ002   DV212                        5           GS300      -2
CP WQ002   20955                        7           GS300      -2
CP 20955   DV212                        7           GS300      -2
CP DV212   DV211                        7           GS300      -2
CP DV211   CB220                        7           GS300      -2
CPTWW217   CB220                        7           GS300      -1
CP CB220   CB210                        7           GS300      -2
CP OS623   CB620                        7           GS600      -1
CP WW622   CB620                        7           GS600      -1
CP WW621   CB620                        7           GS600      -1
CPTDV626   CB620                        7           GS600      -1
CP CB620   CB610                        7           GS600      -1
CP CB610   GS600                        7           GS600      -1
CP GS600   CB560                        1
CPTOS554   CB560                        7           GS550      -1
CP CB560   DV553                        7           GS550      -1
CP DV553   DV551                        7           GS550      -1
CP DV551   GS550                        7           GS550      -1
CP GS550   DV504                        1
CP DV504   DV503                        7           GS500      -1
CP RF505   DV503                        7           GS500      -1
CP DV503   RF502                        7           GS500      -1
CP RF502   DV501                        7           GS500      -1
CP WQ005   DV501                        7           GS500      -1
CP DV501   CB510                        7           GS500      -1
CPOS1052  CB1040                        7          GS1000      -1
CPOS1051  CB1040                        7          GS1000      -1
CPDV1042  CB1040                        7          GS1000      -1
CPCB1040  CB1010                        7          GS1000      -1
CPDV1034  OS1033                        7          GS1000      -1
CPOS1033  DV1031                        7          GS1000      -1
CPDV1031  CB1030                        7          GS1000      -1
CPCB1030  DV1023                        7          GS1000      -1
CPDV1023  DV1021                        7          GS1000      -1
CPDV1021  DV1020                        7          GS1000      -1
CPDV1020  DV1018                        7          GS1000      -1
CPDV1018  RF1017                        7          GS1000      -1
CPRF1017  RF1016                        7          GS1000      -1
CPRF1016  RF1015                        7          GS1000      -1
CPRF1015  RF1014                        7          GS1000      -1
CPRF1014  RF1012                        7          GS1000      -1
CPRF1012  RF1011                        7          GS1000      -1
CPRF1011  CB1010                        7          GS1000      -1
CPCB1010  DV1002                        7          GS1000      -1
CPDV1002  DV1001                        7          GS1000      -1
CPDV1001  CB1005                        7          GS1000      -1
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CPOS1003  CB1005                        7          GS1000      -1
CPCB1005  GS1000                        7          GS1000      -1
**CPGS1000   CB910                        1
CPGS1000  SGSUBS                        1
CPSGSUBS  SGBASE                        2  GS1000    NONE
CPSGBASE  SGSPUL                        2  GS1000    NONE
CPSGSPUL  SGLPUL                        2  GS1000    NONE
CPSGLPUL  SGAPUL                        2  GS1000    NONE
CPSGAPUL   CB910                        2  GS1000    NONE
**
CP RF902   CB910                        7          GS1000      -1
CPTRF918  TDV916                        7          GS1000      -1
CPTDV916  TRF915                        7          GS1000      -1
CPTRF915  TRF914                        7          GS1000      -1
CPTRF914  TRF913                        7          GS1000      -1
** add control point for Application No. 5595
CPTRF913    5595                        7          GS1000      -1
CP  5595  TDV911                        7          GS1000      -1
**CPTRF913  TDV911                        4          GS1000      -1
CPTDV911   CB910                        7          GS1000      -1
CP CB910   CB905                        7          GS1000      -1
CPTDV901   CB905                        7          GS1000      -1
CP CB905   GS900                        7          GS1000      -1
CP GS900   CB510                        7          GS1000      -1
CP CB510   GS500                        7           GS500      -1
CP GS500   CB230                        1
CP WM824  WRF824                        7          WGS800      -1
CPWRF824  WCB825                        7          WGS800      -1
CPWRF823  WRF822                        7          WGS800      -1
CPWRF822  WCB825                        7          WGS800      -1
CPWCB825  WCB821                        7          WGS800      -1
CPWRF821  WCB821                        7          WGS800      -1
CP WM827  WCB821                        7          WGS800      -1
CPWRF828  WCB821                        7          WGS800      -1
CPWCB821  WCB820                        7          WGS800      -1
CPWDV818  WDV817                        7          WGS800      -1
CPWDV817  WDV816                        7          WGS800      -1
CPWDV816  WDV815                        7          WGS800      -1
CPWDV815  WDV814                        7          WGS800      -1
CPWDV814  WDV813                        7          WGS800      -1
CPWDV813  WDV811                        7          WGS800      -1
CPWDV812  WDV811                        7          WGS800      -1
CPWDV811  WDV810                        7          WGS800      -1
CPWDV810  WDV809                        7          WGS800      -1
CPWDV809  WDV808                        7          WGS800      -1
CPWDV808  WDV807                        7          WGS800      -1
CPWDV807  WRF805                        7          WGS800      -1
** change cp routing to add Brandl app. 5706
** CPWRF805  WDV804                        5          WGS800      -1
CPWRF805    5706                        7          WGS800      -1
CP  5706  WDV804                        7          WGS800      -1
CPWDV804  WDV803                        7          WGS800      -1
CPWDV803  WRF802                        7          WGS800      -1
CPWRF802  WCB840                        7          WGS800      -1
CPWDV887  WRF881                        7          WGS800      -1
CPWRF882  WRF881                        7          WGS800      -1
CPWRF881  WCB890                        7          WGS800      -1
CPWRF888  WCB890                        7          WGS800      -1
CPWCB890  WDV868                        7          WGS800      -1
CPWDV868  WCB880                        7          WGS800      -1
CPWCB880  WDV867                        7          WGS800      -1
CPWDV867  WRF866                        7          WGS800      -1
CPWRF866  WDV865                        7          WGS800      -1
CPWDV865  WRF864                        7          WGS800      -1
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CPWRF864  WRF863                    7           WGS800      -1
CPWRF863  WDV862                    7           WGS800      -1
CPWDV862  WRF861                    7           WGS800      -1
CPWRF861  WCB860                    7           WGS800      -1
CPWRF872  WDV871                    7           WGS800      -1
CPWDV871  WCB860                    7           WGS800      -1
CPWCB860  WCB850                    7           WGS800      -1
CPWRF857  WRF858                    7           WGS800      -1
CPWRF858  WRF856                    7           WGS800      -1
CPWRF856  WDV853                    7           WGS800      -1
CPWDV855  WDV853                    7           WGS800      -1
CPWDV853  WRF851                    7           WGS800      -1
CPWRF851  WCB845                    7           WGS800      -1
CPWRF852  WCB845                    7           WGS800      -1
** Collins Application 5579
** CPWCB845  WCB850                   4           WGS800      -1
CPWCB845  557901                    7           WGS800      -1
CP557901  WCB850                    7           WGS800      -1
**
CPWCB850  WRF844                    7           WGS800      -1
CPWRF844  WDV843                    7           WGS800      -1
CPWDV843  WRF842                    7           WGS800      -1
CPWRF842  WRF841                    7           WGS800      -1
CPWRF841  WCB840                    7           WGS800      -1
CPWCB840  WDV801                    7           WGS800      -1
CPWDV801  WCB830                    7           WGS800      -1
CPWRF832  WRF831                    7           WGS800      -1
CPWRF831  WCB830                    7           WGS800      -1
CPWCB830  WCB820                    7           WGS800      -1
CPWCB820  WGS800                    7           WGS800      -1
**CPWGS800  MCB710                    1
CPWGS800  WMSUBS                    1
CPWMSUBS  WMBASE                    2  WGS800    NONE
CPWMBASE  WMSPUL                    2  WGS800    NONE
CPWMSPUL  WMLPUL                    2  WGS800    NONE
CPWMLPUL  WMAPUL                    2  WGS800    NONE
CPWMAPUL  MCB710                    2  WGS800    NONE
**
CPERF728  EDV726                    7           WGS800      -1
CPEDV726  ERF725                    7           WGS800      -1
CPERF725  EDV724                    7           WGS800      -1
CPEDV724  EDV723                    7           WGS800      -1
CPEDV723  ERF722                    7           WGS800      -1
CPERF722  EDV721                    7           WGS800      -1
CPEDV721  ECB720                    7           WGS800      -1
CPEDV734  EDV733                    7           WGS800      -1
CPEDV733  EDV731                    7           WGS800      -1
CPEDV731  ECB720                    7           WGS800      -1
CPECB720  EDV712                    7           WGS800      -1
***** East Mustang Creek near Louise
**CPEDV712  ERF711                    7           WGS800      -1
CPEDV712  EMSUBS                    7           WGS800      -1
CPEMSUBS  EMBASE                    7           WGS800      -1
CPEMBASE  EMSPUL                    7           WGS800      -1
CPEMSPUL  EMLPUL                    7           WGS800      -1
CPEMLPUL  EMAPUL                    7           WGS800      -1
CPEMAPUL  ERF711                    7           WGS800      -1
**
**
CPERF711  MCB710                    7           WGS800      -1
CPMCB710   GS700                    7           WGS800      -2
CP GS700   CB230                    7           WGS800      -2
CP CB230  DV221A                    7            GS300      -2
CPDV221A  DV221B                    7            GS300      -2
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CPDV221B  RSRTRN                       7           GS300      -2
CPRSRTRN   WQ004                       7           GS300      -2
CP WQ004   CB210                       7           GS300      -2
CP CB210   WQ003                       7           GS300      -1
CP WQ003   GS200                       7           GS300      -1
CP GS200   DV201                       7           GS300      -1
CP DV201   GS100                       7           GS300      -1
CP GS100   WQ001                       7           GS300      -1
CP WQ001   EP000                       7           GS300      -1
CP EP000     OUT                       7           GS300      -1
**
** AECOM entered control points for off-channel reservoir
*******************CONTROL POINTS for OCR*********************************
**
CPWQ002A   20956                       5           GS300      -2
CP 20956  WQ002B                       5           GS300      -2
CPNEWOCR     OUT                       2    NONE   GS300      -3
CPWQ002B  WQ002C                       5            NONE      -2
CPWQ002C  WQ002D                       5            NONE      -2
CPWQ002D  WQ002E                       5            NONE      -2
CPWQ002E   DV212                       5            NONE      -2
**
**
************************************************************************************Off Channel
Reservoirs
CP537041     OUT                       2    ZERO  GS1000
CP397841     OUT                       2    ZERO   GS300
CP207741     OUT                       2    ZERO   GS550
CP391241     OUT                       2    ZERO   GS500
CP391041     OUT                       2    ZERO  GS1000
CP390541     OUT                       2    ZERO  GS1000
CP425241     OUT                       2    ZERO  GS1000
CP424141     OUT                       2    ZERO  WGS800
CP390941     OUT                       2    ZERO  WGS800
** fake CP for Texana's offchannel reservoir used to simulate interruptible water availability.
CP  NOUT     OUT                       2    ZERO    ZERO      -1
** end fake CP record
********************************************************
**---------Start Environmental Flows Dummy CPs---------------------------------------------------
CPDAYSPY     OUT                       2    ZERO    ZERO
**** LE Base Flows CPS
CPLESEVT    OUT                       2    NONE    NONE
CPLESVD1    OUT                       2    NONE    NONE
CPLESVT2    OUT                       2    NONE    NONE
CPLESVT3    OUT                       2    NONE    NONE
CPLEBDRY    OUT                       2    NONE    NONE
CPLEBAVG    OUT                       2    NONE    NONE
CPLEBWET    OUT                       2    NONE    NONE
**
** LE Pulse CPS
CPLESPND     OUT                       2    ZERO    ZERO
CPLELPND     OUT                       2    ZERO    ZERO
CPLEAPND     OUT                       2    ZERO    ZERO
**
CPFKLE01     OUT                       2    NONE    NONE
CPFKLE02     OUT                       2    NONE    NONE
CPFKLE03     OUT                       2    NONE    NONE
CPFKLE04     OUT                       2    NONE    NONE
CPFKLE05     OUT                       2    NONE    NONE
CPFKLE06     OUT                       2    NONE    NONE
CPFKLE07     OUT                       2    NONE    NONE
CPFKLE08     OUT                       2    NONE    NONE
CPFKLE09     OUT                       2    NONE    NONE
CPFKLE10     OUT                       2    NONE    NONE
```

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CPFKLE11      OUT                          2     NONE     NONE
CPFKLE12      OUT                          2     NONE     NONE
CPFKLE13      OUT                          2     NONE     NONE
CPFKLE14      OUT                          2     NONE     NONE
CPFKLE15      OUT                          2     NONE     NONE
CPFKLE16      OUT                          2     NONE     NONE
CPFKLE17      OUT                          2     NONE     NONE
CPFKLE18      OUT                          2     NONE     NONE
CPFKLE19      OUT                          2     NONE     NONE
CPFKLE20      OUT                          2     NONE     NONE
CPFKLE21      OUT                          2     NONE     NONE
CPFKLE22      OUT                          2     NONE     NONE
CPLEAPFA      OUT                          2     NONE     NONE
CPLEAPFB      OUT                          2     NONE     NONE
**
**** SG Base Flows CPS
CPSGSEVT     OUT                          2     NONE     NONE
CPSGSVD1     OUT                          2     NONE     NONE
CPSGSVT2     OUT                          2     NONE     NONE
CPSGSVT3     OUT                          2     NONE     NONE
CPSGBDRY     OUT                          2     NONE     NONE
CPSGBAVG     OUT                          2     NONE     NONE
CPSGBWET     OUT                          2     NONE     NONE
**
** SG Pulse CPS
CPSGSPND      OUT                          2     ZERO     ZERO
CPSGLPND      OUT                          2     ZERO     ZERO
CPSGAPND      OUT                          2     ZERO     ZERO
**
CPFKSG01      OUT                          2     NONE     NONE
CPFKSG02      OUT                          2     NONE     NONE
CPFKSG03      OUT                          2     NONE     NONE
CPFKSG04      OUT                          2     NONE     NONE
CPFKSG05      OUT                          2     NONE     NONE
CPFKSG06      OUT                          2     NONE     NONE
CPFKSG07      OUT                          2     NONE     NONE
CPFKSG08      OUT                          2     NONE     NONE
CPFKSG09      OUT                          2     NONE     NONE
CPFKSG10      OUT                          2     NONE     NONE
CPFKSG11      OUT                          2     NONE     NONE
CPFKSG12      OUT                          2     NONE     NONE
CPFKSG13      OUT                          2     NONE     NONE
CPFKSG14      OUT                          2     NONE     NONE
CPFKSG15      OUT                          2     NONE     NONE
CPFKSG16      OUT                          2     NONE     NONE
CPFKSG17      OUT                          2     NONE     NONE
CPFKSG18      OUT                          2     NONE     NONE
CPFKSG19      OUT                          2     NONE     NONE
CPFKSG20      OUT                          2     NONE     NONE
CPFKSG21      OUT                          2     NONE     NONE
CPFKSG22      OUT                          2     NONE     NONE
CPSGAPFA      OUT                          2     NONE     NONE
CPSGAPFB      OUT                          2     NONE     NONE
**** WM Base Flows CPS
CPWMSEVT     OUT                          2     NONE     NONE
CPWMSVD1     OUT                          2     NONE     NONE
CPWMSVT2     OUT                          2     NONE     NONE
CPWMSVT3     OUT                          2     NONE     NONE
CPWMBDRY     OUT                          2     NONE     NONE
CPWMBAVG     OUT                          2     NONE     NONE
CPWMBWET     OUT                          2     NONE     NONE
**
** WM Pulse CPS
CPWMSPND      OUT                          2     ZERO     ZERO
```

```
CPWMLPND     OUT                         2    ZERO    ZERO
CPWMAPND     OUT                         2    ZERO    ZERO
**
CPFKWM01     OUT                         2    NONE    NONE
CPFKWM02     OUT                         2    NONE    NONE
CPFKWM03     OUT                         2    NONE    NONE
CPFKWM04     OUT                         2    NONE    NONE
CPFKWM05     OUT                         2    NONE    NONE
CPFKWM06     OUT                         2    NONE    NONE
CPFKWM07     OUT                         2    NONE    NONE
CPFKWM08     OUT                         2    NONE    NONE
CPFKWM09     OUT                         2    NONE    NONE
CPFKWM10     OUT                         2    NONE    NONE
CPFKWM11     OUT                         2    NONE    NONE
CPFKWM12     OUT                         2    NONE    NONE
CPFKWM13     OUT                         2    NONE    NONE
CPFKWM14     OUT                         2    NONE    NONE
CPFKWM15     OUT                         2    NONE    NONE
CPFKWM16     OUT                         2    NONE    NONE
CPFKWM17     OUT                         2    NONE    NONE
CPFKWM18     OUT                         2    NONE    NONE
CPFKWM19     OUT                         2    NONE    NONE
CPFKWM20     OUT                         2    NONE    NONE
CPFKWM21     OUT                         2    NONE    NONE
CPFKWM22     OUT                         2    NONE    NONE
CPWMAPFA     OUT                         2    NONE    NONE
CPWMAPFB     OUT                         2    NONE    NONE
**
**---------Start Environmental Flows Dummy CPs For
EM---------------------------------------------------**
**** EM Base Flows CPS
CPEMSEVT    OUT                         2    NONE    NONE
CPEMSVD1    OUT                         2    NONE    NONE
CPEMSVT2    OUT                         2    NONE    NONE
CPEMSVT3    OUT                         2    NONE    NONE
CPEMBDRY    OUT                         2    NONE    NONE
CPEMBAVG    OUT                         2    NONE    NONE
CPEMBWET    OUT                         2    NONE    NONE
**
** EM Pulse CPS
CPEMSPND     OUT                         2    ZERO    ZERO
CPEMLPND     OUT                         2    ZERO    ZERO
CPEMAPND     OUT                         2    ZERO    ZERO
**
CPFKEM01     OUT                         2    NONE    NONE
CPFKEM02     OUT                         2    NONE    NONE
CPFKEM03     OUT                         2    NONE    NONE
CPFKEM04     OUT                         2    NONE    NONE
CPFKEM05     OUT                         2    NONE    NONE
CPFKEM06     OUT                         2    NONE    NONE
CPFKEM07     OUT                         2    NONE    NONE
CPFKEM08     OUT                         2    NONE    NONE
CPFKEM09     OUT                         2    NONE    NONE
CPFKEM10     OUT                         2    NONE    NONE
CPFKEM11     OUT                         2    NONE    NONE
CPFKEM12     OUT                         2    NONE    NONE
CPFKEM13     OUT                         2    NONE    NONE
CPFKEM14     OUT                         2    NONE    NONE
CPFKEM15     OUT                         2    NONE    NONE
CPFKEM16     OUT                         2    NONE    NONE
CPFKEM17     OUT                         2    NONE    NONE
CPFKEM18     OUT                         2    NONE    NONE
CPFKEM19     OUT                         2    NONE    NONE
CPFKEM20     OUT                         2    NONE    NONE
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CPFKEM21     OUT                          2    NONE    NONE
CPFKEM22     OUT                          2    NONE    NONE
CPEMAPFA     OUT                          2    NONE    NONE
CPEMAPFB     OUT                          2    NONE    NONE
**
**
************* START EFLOWS CIs*************************
CIDAYSPY       31   28.25      31      30      31      30
CI             31      31      30      31      30      31
**** Lavaca River near Edna BASE CIs
CILESEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** LE PULSE CIs
*** LE Pulse Duration
CILESPND        6       6       7       7       7       7
CI              4       4       5       5       5       6
CILELPND        7       7       7       7       7       7
CI              6       6       6       6       6       7
CILEAPND        7       7       7       7       7       7
CI              7       7       7       7       7       7
*** LE Pulse Calculation
CIFKLE01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE16 9999999 9999999 9999999 9999999 9999999 9999999
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CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**** Sandy Creek near Ganado BASE CIs
CISGSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** SG PULSE CIs
*** SG Pulse Duration
CISGSPND       6       6       6       6       6       6
CI             4       4       6       6       6       6
CISGLPND       8       8      10      10      10      10
CI             6       6       6       6       6       8
CISGAPND      10      10      10      10      10      10
CI            10      10      10      10      10      10
*** SG Pulse Calculation
CIFKSG01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
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CIFKSG12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**** West Mustange Creek near Ganado BASE CIs
CIWMSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** WM PULSE CIs
*** WM Pulse Duration
CIWMSPND       6       6       6       6       6       6
CI             4       4       6       6       6       6
CIWMLPND       8       8       8       8       8       8
CI             6       6       8       8       8       8
CIWMAPND       8       8       8       8       8       8
CI             8       8       8       8       8       8
*** WM Pulse Calculation
CIFKWM01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
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CIFKWM08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**** West Mustange Creek near Ganado BASE CIs
CIEMSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** EM PULSE CIs
*** EM Pulse Duration
CIEMSPND       5       5       7       7       7       7
CI             5       5       6       6       6       5
CIEMLPND       8       8       9       9       9       9
CI             6       6       7       7       7       8
CIEMAPND      10      10      10      10      10      10
CI            10      10      10      10      10      10
*** EM Pulse Calculation
CIFKEM01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM03 9999999 9999999 9999999 9999999 9999999 9999999
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CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**
*******************************************************
** Constant Inflow Cards  (based on monthly min of last 5 years of USBR's FAD cards).
**CIDV1034       0       0       0    1863    4478    6351
**CI         11107    6993   10627     145       0       0
**CITWW217      30      26      41      47      29      41
**CI            35      42      45      31      32      32
**CITWW322      53      52      54      55      57      50
**CI            53      54      55      56      55      52
**CITWW331      24      24      18       3      26      28
**CI            20      26      17      21      21      25
**CIWDV818       0       0       0     646    1552    2201
**CI          3849    2424    3683      50       0       0
**CI WW401      36      31      35      34      35      38
**CI            37      39      38      36      34      34
**CI WW621       7       7       6       7       8       6
**CI             5       6       7       7       8       7
**CI WW622       7       7       6       7       8       6
**CI             5       6       7       7       8       7
**
```

```
**WR GS300 9999999  XMONTH20131231                                        TESTFLOWS
**WRGS1000 9999999  XMONTH20131231                                        TESTFLOWS
**WRWGS800 9999999  XMONTH20131231                                        TESTFLOWS
**WREDV712 9999999  XMONTH20131231                                        TESTFLOWS
*******
******* START E-FLOWS ***************
**Dry, Average or Wet Hydrologic Condition in HIS File.
**
*************START E-Flows Lavaca River near Edna
**Start Base LE
** During Severe Conditions set Sub or Base trigger
WRLESVD1   18694   LEDRY20110301                                        FKLESEVD1
WRLESEVT          XMONTH20110301                                       SEVTRIGGER
TO     2            ADD                  GS300                              CONT
TO     6            DIV                                  FKLESEVD1
**** Severe Condition Subsistence or Base
WRLESVT2   18694   LEDRY20110301                                        FKLESEVD2
TO    16            LIM       1       1  DV221A
FS     5  LESEVT      1       0       1 9999999   1
WRLESVT3    4318   LESUB20110301                                       FKLESEVSUB
TO    16            LIM       1       1  DV221A
FS     5  LESVT2      1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS file for Hydrologic conditions
WRLEBDRY   18694   LEDRY20110301                                         FKLEBASD
TO    16            LIM       2       2  DV221A
WRLEBAVG   33162   LEAVG20110301                                         FKLEBASM
TO    16            LIM       3       3  DV221A
WRLEBWET   55929   LEWET20110301                                         FKLEBASW
TO    16            LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFLEBASE                20110301   2                   LEBASEFIN
TO    13            ADD                                  FKLESEVSUB    CONT
TO    13            ADD                                   FKLESEVD2    CONT
TO    13            ADD                                    FKLEBASD    CONT
TO    13            ADD                                    FKLEBASM    CONT
TO    13            ADD                                    FKLEBASW
***
********** LE SMALL PULSE ************************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE01          XMONTH20110301                                       BF-LEB-SP1
TO     2            ADD                 DAYSPY                              CONT
TO     2            SUB                 LESPND
WRFKLE01          XMONTH20110301                                       BF-LEB-SP2
TO     6            ADD                                  BF-LEB-SP1    CONT
TO     2            DIV                 DAYSPY
WRFKLE01          XMONTH20110301                                       BF-LEB-SP3
TO    13            ADD                                   LEBASEFIN    CONT
TO     6            MUL                                  BF-LEB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
WRFKLE04    8000  XMONTH20110301                                        FKLESPULW
TO     6            ADD                                  BF-LEB-SP3
WRFKLE05          XMONTH20110301                                       LEWINONOFF
TO     2            ADD                  GS300                              CONT
TO     6            DIV                                   FKLESPULW
**
WRFKLE06   18400  XMONTH20110301                                        FKLESPUSP
TO     6            ADD                                  BF-LEB-SP3
WRFKLE07          XMONTH20110301                                       LESPRONOFF
TO     2            ADD                  GS300                              CONT
TO     6            DIV                                   FKLESPUSP
**
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WRFKLE08     370  XMONTH20110301                                           FKLESPULS
TO     6            ADD                                           BF-LEB-SP3
WRFKLE09          XMONTH20110301                                          LESUMONOFF
TO     2            ADD                   GS300                                 CONT
TO     6            DIV                                            FKLESPULS
**
WRFKLE10    6100  XMONTH20110301                                           FKLESPULF
TO     6            ADD                                           BF-LEB-SP3
WRFKLE11          XMONTH20110301                                          LEFALONOFF
TO     2            ADD                   GS300                                 CONT
TO     6            DIV                                            FKLESPULF
** ENGAGING  PULSE
IFLESPUL    8000  XMONTH20110301                                LESPULW1
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE05       1       0       1 9999999   2   1   2   2  12   2
IFLESPUL    8000  XMONTH20110301   3                            LESPULW2
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE05       1       0       1 9999999   2   1   2   0  12   2
IFLESPUL   18400  XMONTH20110301                                LESPUSP1
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE07       1       0       1 9999999   2   1   2   3   3   6
IFLESPUL   18400  XMONTH20110301   3                            LESPUSP2
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE07       1       0       1 9999999   2   1   2   0   3   6
IFLESPUL     370  XMONTH20110301                                LESPULS1
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE09       1       0       1 9999999   2   1   2   1   7   8
IFLESPUL     370  XMONTH20110301   3                            LESPULS2
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE09       1       0       1 9999999   2   1   2   0   7   8
IFLESPUL    6100  XMONTH20110301                                LESPULF1
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE11       1       0       1 9999999   2   1   2   2   9  11
IFLESPUL    6100  XMONTH20110301   3                            LESPULF2
TO     6            ADD                                           BF-LEB-SP3
FS     5  FKLE11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLESPUL                20110301                                 LESPFIN
TO    13            ADD                                              LESPULW2    CONT
TO    13            ADD                                              LESPUSP2    CONT
TO    13            ADD                                              LESPULS2    CONT
TO    13            ADD                                              LESPULF2
**
***********LE LARGE PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE02          XMONTH20110301                                          BF-LEB-LP1
TO     2            ADD                  DAYSPY                                 CONT
TO     2            SUB                  LELPND
WRFKLE02          XMONTH20110301                                          BF-LEB-LP2
TO     6            ADD                                           BF-LEB-LP1    CONT
TO     2            DIV                  DAYSPY
WRFKLE02          XMONTH20110301                                          BF-LEB-LP3
TO    13            ADD                                            LEBASEFIN    CONT
TO     6            MUL                                           BF-LEB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
WRFKLE12   18400  XMONTH20110301                                           FKLELPULW
TO     6            ADD                                           BF-LEB-LP3
WRFKLE13          XMONTH20110301                                         LELWINONOFF
TO     2            ADD                   GS300                                 CONT
TO     6            DIV                                            FKLELPULW
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WRFKLE14   18400  XMONTH20110301                                              FKLELPUSP
TO     6             ADD                                             BF-LEB-LP3
WRFKLE15          XMONTH20110301                                            LELSPRONOFF
TO     2             ADD                  GS300                                    CONT
TO     6             DIV                                              FKLELPUSP
**
WRFKLE16    1800  XMONTH20110301                                              FKLELPULS
TO     6             ADD                                             BF-LEB-LP3
WRFKLE17          XMONTH20110301                                            LELSUMONOFF
TO     2             ADD                  GS300                                    CONT
TO     6             DIV                                              FKLELPULS
**
WRFKLE18   18000  XMONTH20110301                                              FKLELPULF
TO     6             ADD                                             BF-LEB-LP3
WRFKLE19          XMONTH20110301                                            LELFALONOFF
TO     2             ADD                  GS300                                    CONT
TO     6             DIV                                              FKLELPULF
** ENGAGING  PULSE
IFLELPUL   18400  XMONTH20110301                               LELPULW1
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE13       1       0       1 9999999   2   1   1   2  12   2
IFLELPUL   18400  XMONTH20110301   3                           LELPULW2
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE13       1       0       1 9999999   2   1   1   0  12   2
IFLELPUL   18400  XMONTH20110301                               LELPUSP1
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE15       1       0       1 9999999   2   1   1   3   3   6
IFLELPUL   18400  XMONTH20110301   3                           LELPUSP2
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE15       1       0       1 9999999   2   1   1   0   3   6
IFLELPUL    1800  XMONTH20110301                               LELPULS1
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE17       1       0       1 9999999   2   1   1   1   7   8
IFLELPUL    1800  XMONTH20110301   3                           LELPULS2
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE17       1       0       1 9999999   2   1   1   0   7   8
IFLELPUL   18000  XMONTH20110301                               LELPULF1
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE19       1       0       1 9999999   2   1   1   2   9  11
IFLELPUL   18000  XMONTH20110301   3                           LELPULF2
TO     6             ADD                                             BF-LEB-LP3
FS     5  FKLE19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLELPUL                20110301                                LELPFIN
TO    13             ADD                                               LELPULW2    CONT
TO    13             ADD                                               LELPUSP2    CONT
TO    13             ADD                                               LELPULS2    CONT
TO    13             ADD                                               LELPULF2
***********************
***********LE Annual PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE03          XMONTH20110301                                             BF-LEB-AP1
TO     2             ADD                 DAYSPY                                    CONT
TO     2             SUB                 LELPND
WRFKLE03          XMONTH20110301                                             BF-LEB-AP2
TO     6             ADD                                             BF-LEB-AP1    CONT
TO     2             DIV                 DAYSPY
WRFKLE03          XMONTH20110301                                             BF-LEB-AP3
TO    13             ADD                                              LEBASEFIN    CONT
TO     6             MUL                                             BF-LEB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
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WRFKLE20   18400  XMONTH20110301                                         FKLEAPUL
TO     6            ADD                                          BF-LEB-AP3
WRFKLE21          XMONTH20110301                                       LEANNONOFF
TO     2            ADD                GS300                                 CONT
TO     6            DIV                                            FKLEAPUL
** ENGAGING  PULSE
IFLEAPFA   18400  XMONTH20110301                          LEAPLA1
TO     6            ADD                                          BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   5  1    6        1
IFLEAPFA   18400  XMONTH20110301   3                      LEAPLA2
TO     6            ADD                                          BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   0  1    6        1
IFLEAPFB   18400  XMONTH20110301                          LEAPLB1
TO     6            ADD                                          BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   5  7   12        1
IFLEAPFB   18400  XMONTH20110301   3                      LEAPLB2
TO     6            ADD                                          BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   0  7   12        1
WRFKLE22               20110301                                        LEFRSTHALF
TO    13                                                           LEAPLA2
IFLEAPFB               20110301   3                       LEAPLB3
TO    13                                                           LEAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6        1      LEFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLEAPUL               20110301                           LEAPFIN
TO    13            ADD                                            LEAPLA2    CONT
TO    13            ADD                                            LEAPLB3
***********************
******************* End E-FLOWS FOR GS300 Lavaca River near Edna
**
******************START E-Flows for Sandy Creek near Ganado
** Start BASE SG
** During Severe Conditions set Sub or Base trigger
WRSGSVD1    4831   SGDRY20110301                                        FKSGSEVD1
WRSGSEVT          XMONTH20110301                                       SEVTRIGGER
TO     2            ADD               GS1000                                 CONT
TO     6            DIV                                          FKSGSEVD1
**** Severe Condition Subsistence or Base
WRSGSVT2    4831   SGDRY20110301                                        FKSGSEVD2
TO    16            LIM       1       1  DV221A
FS     5  SGSEVT       1       0       1 9999999   1
WRSGSVT3     719   SGSUB20110301                                       FKSGSEVSUB
TO    16            LIM       1       1  DV221A
FS     5  SGSVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiSG for Hydrologic conditions
WRSGBDRY    4831   SGDRY20110301                                         FKSGBASD
TO    16            LIM       2       2  DV221A
WRSGBAVG   12265   SGAVG20110301                                         FKSGBASM
TO    16            LIM       3       3  DV221A
WRSGBWET   24458   SGWET20110301                                         FKSGBASW
TO    16            LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFSGBASE               20110301   2                    SGBASEFIN
TO    13            ADD                                          FKSGSEVSUB    CONT
TO    13            ADD                                           FKSGSEVD2    CONT
TO    13            ADD                                            FKSGBASD    CONT
TO    13            ADD                                            FKSGBASM    CONT
TO    13            ADD                                            FKSGBASW
***
********** SG SMALL PULSE ****************************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG01          XMONTH20110301                                       BF-SGB-SP1
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TO      2            ADD                   DAYSPY                                  CONT
TO      2            SUB                   SGSPND
WRFKSG01          XMONTH20110301                                             BF-SGB-SP2
TO      6            ADD                                           BF-SGB-SP1    CONT
TO      2            DIV                   DAYSPY
WRFKSG01          XMONTH20110301                                             BF-SGB-SP3
TO     13            ADD                                            SGBASEFIN    CONT
TO      6            MUL                                           BF-SGB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at SG300 exceeded target
WRFKSG04     4000  XMONTH20110301                                             FKSGSPULW
TO      6            ADD                                           BF-SGB-SP3
WRFKSG05          XMONTH20110301                                             SGWINONOFF
TO      2            ADD                   GS1000                                  CONT
TO      6            DIV                                            FKSGSPULW
**
WRFKSG06     7300  XMONTH20110301                                             FKSGSPUSP
TO      6            ADD                                           BF-SGB-SP3
WRFKSG07          XMONTH20110301                                             SGSPRONOFF
TO      2            ADD                   GS1000                                  CONT
TO      6            DIV                                            FKSGSPUSP
**
WRFKSG08      500  XMONTH20110301                                             FKSGSPULS
TO      6            ADD                                           BF-SGB-SP3
WRFKSG09          XMONTH20110301                                             SGSUMONOFF
TO      2            ADD                   GS1000                                  CONT
TO      6            DIV                                            FKSGSPULS
**
WRFKSG10     3100  XMONTH20110301                                             FKSGSPULF
TO      6            ADD                                           BF-SGB-SP3
WRFKSG11          XMONTH20110301                                             SGFALONOFF
TO      2            ADD                   GS1000                                  CONT
TO      6            DIV                                            FKSGSPULF
** ENGAGING  PULSE
IFSGSPUL     4000  XMONTH20110301                            SGSPULW1
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG05       1       0       1 9999999   2   1   2   2  12   2
IFSGSPUL     4000  XMONTH20110301   3                        SGSPULW2
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG05       1       0       1 9999999   2   1   2   0  12   2
IFSGSPUL     7300  XMONTH20110301                            SGSPUSP1
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG07       1       0       1 9999999   2   1   2   3   3   6
IFSGSPUL     7300  XMONTH20110301   3                        SGSPUSP2
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG07       1       0       1 9999999   2   1   2   0   3   6
IFSGSPUL      500  XMONTH20110301                            SGSPULS1
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG09       1       0       1 9999999   2   1   2   1   7   8
IFSGSPUL      500  XMONTH20110301   3                        SGSPULS2
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG09       1       0       1 9999999   2   1   2   0   7   8
IFSGSPUL     3100  XMONTH20110301                            SGSPULF1
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG11       1       0       1 9999999   2   1   2   2   9  11
IFSGSPUL     3100  XMONTH20110301   3                        SGSPULF2
TO      6            ADD                                           BF-SGB-SP3
FS      5  FKSG11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGSPUL                20110301                              SGSPFIN
TO     13            ADD                                             SGSPULW2    CONT
TO     13            ADD                                             SGSPUSP2    CONT
TO     13            ADD                                             SGSPULS2    CONT
TO     13            ADD                                             SGSPULF2
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**
***********SG LARGE PULSE **************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG02          XMONTH20110301                                         BF-SGB-LP1
TO     2            ADD                 DAYSPY                                 CONT
TO     2            SUB                 SGLPND
WRFKSG02          XMONTH20110301                                         BF-SGB-LP2
TO     6            ADD                                          BF-SGB-LP1    CONT
TO     2            DIV                 DAYSPY
WRFKSG02          XMONTH20110301                                         BF-SGB-LP3
TO    13            ADD                                           SGBASEFIN    CONT
TO     6            MUL                                          BF-SGB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS1000 exceeded target
WRFKSG12   10000  XMONTH20110301                                          FKSGLPULW
TO     6            ADD                                          BF-SGB-LP3
WRFKSG13          XMONTH20110301                                        SGLWINONOFF
TO     2            ADD                 GS1000                                 CONT
TO     6            DIV                                           FKSGLPULW
**
WRFKSG14   12200  XMONTH20110301                                          FKSGLPUSP
TO     6            ADD                                          BF-SGB-LP3
WRFKSG15          XMONTH20110301                                        SGLSPRONOFF
TO     2            ADD                 GS1000                                 CONT
TO     6            DIV                                           FKSGLPUSP
**
WRFKSG16    1600  XMONTH20110301                                          FKSGLPULS
TO     6            ADD                                          BF-SGB-LP3
WRFKSG17          XMONTH20110301                                        SGLSUMONOFF
TO     2            ADD                 GS1000                                 CONT
TO     6            DIV                                           FKSGLPULS
**
WRFKSG18    9200  XMONTH20110301                                          FKSGLPULF
TO     6            ADD                                          BF-SGB-LP3
WRFKSG19          XMONTH20110301                                        SGLFALONOFF
TO     2            ADD                 GS1000                                 CONT
TO     6            DIV                                           FKSGLPULF
** ENGAGING  PULSE
IFSGLPUL   10000  XMONTH20110301                           SGLPULW1
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG13      1       0       1 9999999   2   1   1   2  12   2
IFSGLPUL   10000  XMONTH20110301   3                       SGLPULW2
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG13      1       0       1 9999999   2   1   1   0  12   2
IFSGLPUL   12200  XMONTH20110301                           SGLPUSP1
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG15      1       0       1 9999999   2   1   1   3   3   6
IFSGLPUL   12200  XMONTH20110301   3                       SGLPUSP2
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG15      1       0       1 9999999   2   1   1   0   3   6
IFSGLPUL    1600  XMONTH20110301                           SGLPULS1
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG17      1       0       1 9999999   2   1   1   1   7   8
IFSGLPUL    1600  XMONTH20110301   3                       SGLPULS2
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG17      1       0       1 9999999   2   1   1   0   7   8
IFSGLPUL    9200  XMONTH20110301                           SGLPULF1
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG19      1       0       1 9999999   2   1   1   2   9  11
IFSGLPUL    9200  XMONTH20110301   3                       SGLPULF2
TO     6            ADD                                          BF-SGB-LP3
FS     5  FKSG19      1       0       1 9999999   2   1   1   0   9  11
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** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGLPUL                20110301                          SGLPFIN
TO    13            ADD                                          SGLPULW2    CONT
TO    13            ADD                                          SGLPUSP2    CONT
TO    13            ADD                                          SGLPULS2    CONT
TO    13            ADD                                          SGLPULF2
***********************
**********SG Annual PULSE ******************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG03          XMONTH20110301                                       BF-SGB-AP1
TO     2            ADD                  DAYSPY                                CONT
TO     2            SUB                  SGLPND
WRFKSG03          XMONTH20110301                                       BF-SGB-AP2
TO     6            ADD                                        BF-SGB-AP1    CONT
TO     2            DIV                  DAYSPY
WRFKSG03          XMONTH20110301                                       BF-SGB-AP3
TO    13            ADD                                         SGBASEFIN    CONT
TO     6            MUL                                        BF-SGB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at SG300 exceeded target
WRFKSG20   12200  XMONTH20110301                                         FKSGAPUL
TO     6            ADD                                        BF-SGB-AP3
WRFKSG21          XMONTH20110301                                       SGANNONOFF
TO     2            ADD                  GS1000                                CONT
TO     6            DIV                                          FKSGAPUL
** ENGAGING  PULSE
IFSGAPFA   12200  XMONTH20110301                          SGAPLA1
TO     6            ADD                                        BF-SGB-AP3
FS     5  FKSG21       1       0       1 9999999   2   1   1   5  1    6       1
IFSGAPFA   12200  XMONTH20110301   3                      SGAPLA2
TO     6            ADD                                        BF-SGB-AP3
FS     5  FKSG21       1       0       1 9999999   2   1   1   0  1    6       1
IFSGAPFB   12200  XMONTH20110301                          SGAPLB1
TO     6            ADD                                        BF-SGB-AP3
FS     5  FKSG21       1       0       1 9999999   2   1   1   5  7   12       1
IFSGAPFB   12200  XMONTH20110301   3                      SGAPLB2
TO     6            ADD                                        BF-SGB-AP3
FS     5  FKSG21       1       0       1 9999999   2   1   1   0  7   12       1
WRFKSG22                20110301                                       SGFRSTHALF
TO    13                                                          SGAPLA2
IFSGAPFB                20110301   3                      SGAPLB3
TO    13                                                          SGAPLB2
FS    10                 0       1       1 9999999   2   1   1  11  1    6       1      SGFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGAPUL                20110301                          SGAPFIN
TO    13            ADD                                           SGAPLA2    CONT
TO    13            ADD                                           SGAPLB3
***********************
***END E-Flows for Sandy Creek near Ganado ***********
**
*************START E-Flows for West Mustang Creek near Ganado
** During Severe Conditions set Sub or Base trigger
WRWMSVD1    4237   WMDRY20110301                                        FKWMSEVD1
WRWMSEVT          XMONTH20110301                                       SEVTRIGGER
TO     2            ADD                  WGS800                                CONT
TO     6            DIV                                        FKWMSEVD1
**** Severe Condition Subsistence or Base
WRWMSVT2    4237   WMDRY20110301                                        FKWMSEVD2
TO    16            LIM       1       1  DV221A
FS     5  WMSEVT       1       0       1 9999999   1
WRWMSVT3     719   WMSUB20110301                                       FKWMSEVSUB
TO    16            LIM       1       1  DV221A
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FS     5  WMSVT2        1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiGS for Hydrologic conditions
WRWMBDRY    4237   WMDRY20110301                                          FKWMBASD
TO    16            LIM       2       2  DV221A
WRWMBAVG    9011   WMAVG20110301                                          FKWMBASM
TO    16            LIM       3       3  DV221A
WRWMBWET   17042   WMWET20110301                                          FKWMBASW
TO    16            LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFWMBASE             20110301   2                 WMBASEFIN
TO    13            ADD                                   FKWMSEVSUB    CONT
TO    13            ADD                                    FKWMSEVD2    CONT
TO    13            ADD                                     FKWMBASD    CONT
TO    13            ADD                                     FKWMBASM    CONT
TO    13            ADD                                     FKWMBASW
***
********** WM SMALL PULSE ****************************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM01          XMONTH20110301                                        BF-WMB-SP1
TO     2            ADD                 DAYSPY                                CONT
TO     2            SUB                 WMSPND
WRFKWM01          XMONTH20110301                                        BF-WMB-SP2
TO     6            ADD                                   BF-WMB-SP1    CONT
TO     2            DIV                 DAYSPY
WRFKWM01          XMONTH20110301                                        BF-WMB-SP3
TO    13            ADD                                    WMBASEFIN    CONT
TO     6            MUL                                   BF-WMB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM04    2400  XMONTH20110301                                         FKWMSPULW
TO     6            ADD                                   BF-WMB-SP3
WRFKWM05          XMONTH20110301                                        WMWINONOFF
TO     2            ADD                 WGS800                                CONT
TO     6            DIV                                    FKWMSPULW
**
WRFKWM06    4400  XMONTH20110301                                         FKWMSPUSP
TO     6            ADD                                   BF-WMB-SP3
WRFKWM07          XMONTH20110301                                        WMSPRONOFF
TO     2            ADD                 WGS800                                CONT
TO     6            DIV                                    FKWMSPUSP
**
WRFKWM08     420  XMONTH20110301                                         FKWMSPULS
TO     6            ADD                                   BF-WMB-SP3
WRFKWM09          XMONTH20110301                                        WMSUMONOFF
TO     2            ADD                 WGS800                                CONT
TO     6            DIV                                    FKWMSPULS
**
WRFKWM10    2200  XMONTH20110301                                         FKWMSPULF
TO     6            ADD                                   BF-WMB-SP3
WRFKWM11          XMONTH20110301                                        WMFALONOFF
TO     2            ADD                 WGS800                                CONT
TO     6            DIV                                    FKWMSPULF
** ENGAGING  PULSE
IFWMSPUL    2400  XMONTH20110301                        WMSPULW1
TO     6            ADD                                   BF-WMB-SP3
FS     5  FKWM05        1       0       1 9999999   2   1   2   2  12   2
IFWMSPUL    2400  XMONTH20110301   3                    WMSPULW2
TO     6            ADD                                   BF-WMB-SP3
FS     5  FKWM05        1       0       1 9999999   2   1   2   0  12   2
IFWMSPUL    4400  XMONTH20110301                        WMSPUSP1
TO     6            ADD                                   BF-WMB-SP3
FS     5  FKWM07        1       0       1 9999999   2   1   2   3   3   6
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IFWMSPUL     4400  XMONTH20110301   3                   WMSPUSP2
TO      6            ADD                                      BF-WMB-SP3
FS      5  FKWM07       1       0       1 9999999   2   1   2   0   3   6
IFWMSPUL      420  XMONTH20110301                       WMSPULS1
TO      6            ADD                                      BF-WMB-SP3
FS      5  FKWM09       1       0       1 9999999   2   1   2   1   7   8
IFWMSPUL      420  XMONTH20110301   3                   WMSPULS2
TO      6            ADD                                      BF-WMB-SP3
FS      5  FKWM09       1       0       1 9999999   2   1   2   0   7   8
IFWMSPUL     2200  XMONTH20110301                       WMSPULF1
TO      6            ADD                                      BF-WMB-SP3
FS      5  FKWM11       1       0       1 9999999   2   1   2   2   9  11
IFWMSPUL     2200  XMONTH20110301   3                   WMSPULF2
TO      6            ADD                                      BF-WMB-SP3
FS      5  FKWM11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMSPUL                20110301                         WMSPFIN
TO     13            ADD                                             WMSPULW2    CONT
TO     13            ADD                                             WMSPUSP2    CONT
TO     13            ADD                                             WMSPULS2    CONT
TO     13            ADD                                             WMSPULF2
**
**********WM LARGE PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM02           XMONTH20110301                                            BF-WMB-LP1
TO      2            ADD                  DAYSPY                                   CONT
TO      2            SUB                  WMLPND
WRFKWM02           XMONTH20110301                                            BF-WMB-LP2
TO      6            ADD                                      BF-WMB-LP1     CONT
TO      2            DIV                  DAYSPY
WRFKWM02           XMONTH20110301                                            BF-WMB-LP3
TO     13            ADD                                       WMBASEFIN     CONT
TO      6            MUL                                      BF-WMB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM12     5600  XMONTH20110301                                             FKWMLPULW
TO      6            ADD                                      BF-WMB-LP3
WRFKWM13           XMONTH20110301                                           WMLWINONOFF
TO      2            ADD                  WGS800                                   CONT
TO      6            DIV                                       FKWMLPULW
**
WRFKWM14     5600  XMONTH20110301                                             FKWMLPUSP
TO      6            ADD                                      BF-WMB-LP3
WRFKWM15           XMONTH20110301                                           WMLSPRONOFF
TO      2            ADD                  WGS800                                   CONT
TO      6            DIV                                       FKWMLPUSP
**
WRFKWM16     1200  XMONTH20110301                                             FKWMLPULS
TO      6            ADD                                      BF-WMB-LP3
WRFKWM17           XMONTH20110301                                           WMLSUMONOFF
TO      2            ADD                  WGS800                                   CONT
TO      6            DIV                                       FKWMLPULS
**
WRFKWM18     5600  XMONTH20110301                                             FKWMLPULF
TO      6            ADD                                      BF-WMB-LP3
WRFKWM19           XMONTH20110301                                           WMLFALONOFF
TO      2            ADD                  WGS800                                   CONT
TO      6            DIV                                       FKWMLPULF
** ENGAGING  PULSE
IFWMLPUL     5600  XMONTH20110301                       WMLPULW1
TO      6            ADD                                      BF-WMB-LP3
FS      5  FKWM13       1       0       1 9999999   2   1   1   2  12   2
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IFWMLPUL     5600  XMONTH20110301   3                   WMLPULW2
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM13       1       0       1 9999999   2   1   1   0  12   2
IFWMLPUL     5600  XMONTH20110301                       WMLPUSP1
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM15       1       0       1 9999999   2   1   1   3   3   6
IFWMLPUL     5600  XMONTH20110301   3                   WMLPUSP2
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM15       1       0       1 9999999   2   1   1   0   3   6
IFWMLPUL     1200  XMONTH20110301                       WMLPULS1
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM17       1       0       1 9999999   2   1   1   1   7   8
IFWMLPUL     1200  XMONTH20110301   3                   WMLPULS2
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM17       1       0       1 9999999   2   1   1   0   7   8
IFWMLPUL     5600  XMONTH20110301                       WMLPULF1
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM19       1       0       1 9999999   2   1   1   2   9  11
IFWMLPUL     5600  XMONTH20110301   3                   WMLPULF2
TO      6           ADD                                       BF-WMB-LP3
FS      5  FKWM19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMLPUL                 20110301                        WMLPFIN
TO     13           ADD                                        WMLPULW2    CONT
TO     13           ADD                                        WMLPUSP2    CONT
TO     13           ADD                                        WMLPULS2    CONT
TO     13           ADD                                        WMLPULF2
***********************
***********WM Annual PULSE *************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM03           XMONTH20110301                                      BF-WMB-AP1
TO      2           ADD                 DAYSPY                               CONT
TO      2           SUB                 WMLPND
WRFKWM03           XMONTH20110301                                      BF-WMB-AP2
TO      6           ADD                                       BF-WMB-AP1    CONT
TO      2           DIV                 DAYSPY
WRFKWM03           XMONTH20110301                                      BF-WMB-AP3
TO     13           ADD                                        WMBASEFIN    CONT
TO      6           MUL                                       BF-WMB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM20     5600  XMONTH20110301                                        FKWMAPUL
TO      6           ADD                                       BF-WMB-AP3
WRFKWM21           XMONTH20110301                                      WMANNONOFF
TO      2           ADD                 WGS800                               CONT
TO      6           DIV                                          FKWMAPUL
** ENGAGING  PULSE
IFWMAPFA     5600  XMONTH20110301                        WMAPLA1
TO      6           ADD                                       BF-WMB-AP3
FS      5  FKWM21       1       0       1 9999999   2   1   1   5  1    6        1
IFWMAPFA     5600  XMONTH20110301   3                    WMAPLA2
TO      6           ADD                                       BF-WMB-AP3
FS      5  FKWM21       1       0       1 9999999   2   1   1   0  1    6        1
IFWMAPFB     5600  XMONTH20110301                        WMAPLB1
TO      6           ADD                                       BF-WMB-AP3
FS      5  FKWM21       1       0       1 9999999   2   1   1   5  7   12        1
IFWMAPFB     5600  XMONTH20110301   3                    WMAPLB2
TO      6           ADD                                       BF-WMB-AP3
FS      5  FKWM21       1       0       1 9999999   2   1   1   0  7   12        1
WRFKWM22                 20110301                                      WMFRSTHALF
TO     13                                                       WMAPLA2
IFWMAPFB                 20110301   3                    WMAPLB3
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TO    13                                                                 WMAPLB2
FS    10              0       1       1 9999999   2   1   1  11  1    6       1      WMFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMAPUL                20110301                                 WMAPFIN
TO    13             ADD                                                 WMAPLA2    CONT
TO    13             ADD                                                 WMAPLB3
***********************
** END E-Flows for West Mustang Creek near Ganado
**
**START E-Flows for East Mustang Creek near Louise
** During Severe Conditions set Sub or Base trigger
WREMSVD1     843   EMDRY20110301                                               FKEMSEVD1
WREMSEVT          XMONTH20110301                                              SEVTRIGGER
TO     2             ADD                    EDV712                                  CONT
TO     6             DIV                                              FKEMSEVD1
**** Severe Condition Subsistence or Base
WREMSVT2     843   EMDRY20110301                                               FKEMSEVD2
TO    16             LIM        1       1  DV221A
FS     5  EMSEVT       1        0       1 9999999   1
WREMSVT3     719   EMSUB20110301                                              FKEMSEVSUB
TO    16             LIM        1       1  DV221A
FS     5  EMSVT2       1        0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiGS for Hydrologic conditions
WREMBDRY     843   EMDRY20110301                                                FKEMBASD
TO    16             LIM        2       2  DV221A
WREMBAVG    2236   EMAVG20110301                                                FKEMBASM
TO    16             LIM        3       3  DV221A
WREMBWET    4954   EMWET20110301                                                FKEMBASW
TO    16             LIM        4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFEMBASE                20110301   2                          EMBASEFIN
TO    13             ADD                                      FKEMSEVSUB    CONT
TO    13             ADD                                       FKEMSEVD2    CONT
TO    13             ADD                                        FKEMBASD    CONT
TO    13             ADD                                        FKEMBASM    CONT
TO    13             ADD                                        FKEMBASW
***
********** EM SMALL PULSE *****************************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM01          XMONTH20110301                                              BF-EMB-SP1
TO     2             ADD                    DAYSPY                                  CONT
TO     2             SUB                    EMSPND
WRFKEM01          XMONTH20110301                                              BF-EMB-SP2
TO     6             ADD                                      BF-EMB-SP1    CONT
TO     2             DIV                    DAYSPY
WRFKEM01          XMONTH20110301                                              BF-EMB-SP3
TO    13             ADD                                       EMBASEFIN    CONT
TO     6             MUL                                      BF-EMB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
WRFKEM04     680  XMONTH20110301                                               FKEMSPULW
TO     6             ADD                                      BF-EMB-SP3
WRFKEM05          XMONTH20110301                                              EMWINONOFF
TO     2             ADD                    EDV712                                  CONT
TO     6             DIV                                       FKEMSPULW
**
WRFKEM06    1400  XMONTH20110301                                               FKEMSPUSP
TO     6             ADD                                      BF-EMB-SP3
WRFKEM07          XMONTH20110301                                              EMSPRONOFF
TO     2             ADD                    EDV712                                  CONT
TO     6             DIV                                       FKEMSPUSP
**
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WRFKEM08      100  XMONTH20110301                                            FKEMSPULS
TO      6             ADD                                            BF-EMB-SP3
WRFKEM09           XMONTH20110301                                           EMSUMONOFF
TO      2             ADD                 EDV712                                  CONT
TO      6             DIV                                             FKEMSPULS
**
WRFKEM10      650  XMONTH20110301                                            FKEMSPULF
TO      6             ADD                                            BF-EMB-SP3
WRFKEM11           XMONTH20110301                                           EMFALONOFF
TO      2             ADD                 EDV712                                  CONT
TO      6             DIV                                             FKEMSPULF
** ENGAGING  PULSE
IFEMSPUL      680  XMONTH20110301                              EMSPULW1
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM05        1       0       1 9999999   2   1   2   2  12   2
IFEMSPUL      680  XMONTH20110301   3                          EMSPULW2
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM05        1       0       1 9999999   2   1   2   0  12   2
IFEMSPUL     1400  XMONTH20110301                              EMSPUSP1
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM07        1       0       1 9999999   2   1   2   3   3   6
IFEMSPUL     1400  XMONTH20110301   3                          EMSPUSP2
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM07        1       0       1 9999999   2   1   2   0   3   6
IFEMSPUL      100  XMONTH20110301                              EMSPULS1
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM09        1       0       1 9999999   2   1   2   1   7   8
IFEMSPUL      100  XMONTH20110301   3                          EMSPULS2
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM09        1       0       1 9999999   2   1   2   0   7   8
IFEMSPUL      650  XMONTH20110301                              EMSPULF1
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM11        1       0       1 9999999   2   1   2   2   9  11
IFEMSPUL      650  XMONTH20110301   3                          EMSPULF2
TO      6             ADD                                            BF-EMB-SP3
FS      5  FKEM11        1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMSPUL                 20110301                               EMSPFIN
TO     13             ADD                                              EMSPULW2    CONT
TO     13             ADD                                              EMSPUSP2    CONT
TO     13             ADD                                              EMSPULS2    CONT
TO     13             ADD                                              EMSPULF2
**
***********EM LARGE PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM02           XMONTH20110301                                           BF-EMB-LP1
TO      2             ADD                 DAYSPY                                  CONT
TO      2             SUB                 EMLPND
WRFKEM02           XMONTH20110301                                           BF-EMB-LP2
TO      6             ADD                                            BF-EMB-LP1    CONT
TO      2             DIV                 DAYSPY
WRFKEM02           XMONTH20110301                                           BF-EMB-LP3
TO     13             ADD                                             EMBASEFIN    CONT
TO      6             MUL                                            BF-EMB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
WRFKEM12     1700  XMONTH20110301                                            FKEMLPULW
TO      6             ADD                                            BF-EMB-LP3
WRFKEM13           XMONTH20110301                                          EMLWINONOFF
TO      2             ADD                 EDV712                                  CONT
TO      6             DIV                                             FKEMLPULW
**
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WRFKEM14     3000  XMONTH20110301                                              FKEMLPUSP
TO      6            ADD                                               BF-EMB-LP3
WRFKEM15           XMONTH20110301                                            EMLSPRONOFF
TO      2            ADD                  EDV712                                    CONT
TO      6            DIV                                                FKEMLPUSP
**
WRFKEM16      310  XMONTH20110301                                              FKEMLPULS
TO      6            ADD                                               BF-EMB-LP3
WRFKEM17           XMONTH20110301                                            EMLSUMONOFF
TO      2            ADD                  EDV712                                    CONT
TO      6            DIV                                                FKEMLPULS
**
WRFKEM18     2100  XMONTH20110301                                              FKEMLPULF
TO      6            ADD                                               BF-EMB-LP3
WRFKEM19           XMONTH20110301                                            EMLFALONOFF
TO      2            ADD                  EDV712                                    CONT
TO      6            DIV                                                FKEMLPULF
** ENGAGING  PULSE
IFEMLPUL     1700  XMONTH20110301                         EMLPULW1
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM13       1        0       1 9999999   2   1   1   2  12   2
IFEMLPUL     1700  XMONTH20110301   3                     EMLPULW2
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM13       1        0       1 9999999   2   1   1   0  12   2
IFEMLPUL     3000  XMONTH20110301                         EMLPUSP1
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM15       1        0       1 9999999   2   1   1   3   3   6
IFEMLPUL     3000  XMONTH20110301   3                     EMLPUSP2
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM15       1        0       1 9999999   2   1   1   0   3   6
IFEMLPUL      310  XMONTH20110301                         EMLPULS1
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM17       1        0       1 9999999   2   1   1   1   7   8
IFEMLPUL      310  XMONTH20110301   3                     EMLPULS2
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM17       1        0       1 9999999   2   1   1   0   7   8
IFEMLPUL     2100  XMONTH20110301                         EMLPULF1
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM19       1        0       1 9999999   2   1   1   2   9  11
IFEMLPUL     2100  XMONTH20110301   3                     EMLPULF2
TO      6            ADD                                               BF-EMB-LP3
FS      5  FKEM19       1        0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMLPUL                 20110301                          EMLPFIN
TO     13            ADD                                                 EMLPULW2    CONT
TO     13            ADD                                                 EMLPUSP2    CONT
TO     13            ADD                                                 EMLPULS2    CONT
TO     13            ADD                                                 EMLPULF2
***********************
***********EM Annual PULSE ********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM03           XMONTH20110301                                             BF-EMB-AP1
TO      2            ADD                  DAYSPY                                    CONT
TO      2            SUB                  EMLPND
WRFKEM03           XMONTH20110301                                             BF-EMB-AP2
TO      6            ADD                                               BF-EMB-AP1    CONT
TO      2            DIV                  DAYSPY
WRFKEM03           XMONTH20110301                                             BF-EMB-AP3
TO     13            ADD                                                EMBASEFIN    CONT
TO      6            MUL                                               BF-EMB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
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```
WRFKEM20    6000  XMONTH20110301                                            FKEMAPUL
TO     6           ADD                                             BF-EMB-AP3
WRFKEM21          XMONTH20110301                                          EMANNONOFF
TO     2           ADD                 EDV712                                   CONT
TO     6           DIV                                               FKEMAPUL
** ENGAGING  PULSE
IFEMAPFA    6000  XMONTH20110301                              EMAPLA1
TO     6           ADD                                             BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   5  1    6        1
IFEMAPFA    6000  XMONTH20110301   3                          EMAPLA2
TO     6           ADD                                             BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   0  1    6        1
IFEMAPFB    6000  XMONTH20110301                              EMAPLB1
TO     6           ADD                                             BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   5  7   12        1
IFEMAPFB    6000  XMONTH20110301   3                          EMAPLB2
TO     6           ADD                                             BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   0  7   12        1
WRFKEM22             20110301                                             EMFRSTHALF
TO    13                                                              EMAPLA2
IFEMAPFB             20110301   3                             EMAPLB3
TO    13                                                              EMAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6        1      EMFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMAPUL             20110301                                 EMAPFIN
TO    13           ADD                                                EMAPLA2    CONT
TO    13           ADD                                                EMAPLB3
***********************
** END E-Flows for East Mustang Creek near Louise
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** COLLINS APPLICATION 5579
WR557901     200    557920020703   1                                   3          5579_1
SO                                                                     1
** Add perpetual water right, Application No. 5595, gw as an alternate source
IF  5595    2316       720000927                               IF5595
WR  5595    1550       320000927   1                                   3          5595_1
SO                                                                     1
** Add perpetual water right, Application No. 5706, Brandl, gw as alternate source
IF  5706    1664       720001001                               IF5706
WR  5706   104.4       320001001   1                                   3          5706_1
SO                                                                     1
** Add perpetual water right, Application No. 4353, Permit #4085, term conv. perp., gw as alternate
source
IFTDV911    2316       719830418                              IF911_1
WRTDV911     500       319830418   1                                   3          4085_1
SO                                                                     1
**Add perpetual water right, Application No. 5168, term conv. perp., gw as alternate source
IFDV1018    3040    101819880202                            IF1018_1
WRDV1018    1092       319880202   1   1    0.00  DV1018       3          5168_1
WSON1018       2    1.00   0.727    0.00
SO                                                                     1
WRDV1018     651       719880202   1   1    0.00  DV1018       3          5168_2
WSHP1018     334    1.00   0.727    0.00
SO           531     651                                               1
**
**Add perpetual water right, Application No. 5370, term conv. perp. gw as alternate source
IFTDV916   722.7     91619910701                              IF916_1
WR537041     900       319910701   1   1    0.00  TDV916       3          5370_1
WSTSO917     356    1.00   0.727    0.00
SO           660     900  TDV916                                       1
**Term water right, App. 4374 - Term Expired 12/31/03
**IFWDV887    1331   IF88719830613      1
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**WRWDV887     400       319830613   1   2    0.00                             4046_1
**WSWSO886      98    1.00   0.727    0.00
**SO           672      98
**App. 5263, term converted to perpetual water right
IFEDV723    2896       719891121       1                    IF5263
WREDV724     140       319891121   1   1    0.00                 3          5263_1
SO                                                               1
**
WR DV402       0       719870424   1   1    0.00                            5130_1
WS OS402    6.08    1.00   0.727    0.00
WRTDV332      33       319610228   1   1    0.00                            2096_1
WS OS332    12.0    1.00   0.727    0.00
IF DV301    8688        19830103       1                    IF3978
WR397841    1800       319830103   1   1    0.00                            3978_1
WS SO301   480.0    1.00   0.727    0.00
SO         529.6    1800   DV301
WR DV214  226.25       319391117   1   1    0.00                          61602099
WR DV214   452.5       319391117   1   1    0.00                            2098_1
IF DV214  4598.7    IF21419821122       1                    IF2098
WR DV214   747.5       319821122   1   1    0.00                            2098_2
WR DV215  226.25       319391117   1   1    0.00                          61602100
WR DV216      95       319391117   1   1    0.00                          61602097
WR DV213    0.14       219970424   1   1    0.00                            5584_1
WR DV212    1000       319391128   1   1    0.00                          61602101
WR DV211    0.02       219970424   1   1    0.00                            5584_2
WRTDV626       4       319541231   1   1    0.00                          61602075
WSTOS627    1.75    1.00   0.727    0.00
WR DV551    61.0       319490228   1   1    0.00                            2077_1
WR207741     4.0       319561231   1   1    0.00                            2077_2
WS SO552    10.0    1.00   0.727    0.00
SO            99       4   DV551
IF DV504  7240.0        19820208       1                    IF3912
WR391241     340       319820208   1   1    0.00   RF505                    3912_1
WS SO507   100.0    1.00   0.727    0.00
SO         265.4     340   DV504
WR DV501    1138       319030930   1   1    0.00                            2078_1
WR DV501     450       319381210   1   1    0.00                            2078_2
WRDV1042       0       719631007   1   1    0.00                          61602079
WSOS1042   455.0    1.00   0.727    0.00
WRDV1034     248       319381231   1   1    0.00                          61602080
WRDV1031  683.27       319550430   1   1    0.00                          61602081
IFDV1023  2801.7  IF102319811116       1                    IF3910
WR391041    1000       319811116   1   1    0.00                            3910_1
WSSO1024    63.0    1.00   0.727    0.00
SO         410.6    1000  DV1023
IFDV1021  3193.3  IF102119811116       1                    IF3905
WR390541    1332       319811116   1   1    0.00                            3905_1
WS O1021      84    1.00   0.727    0.00
SO         624.6    1332  DV1021
WRDV1020     932       319290331   1   1    0.00                          61602082
WRDV1002     623       319480510   1   1    0.00                            2083_1
WRDV1002    2400       319691027   1   1    0.00                            2083_2
IFDV1001  5444.5  IF100119850416       1                    IF4252
WR425241    5500       319850416   1   1    0.00                 3        11604252
WSWOS824     4.9    1.00   0.727    0.00
SO        2651.5    5500  DV1001                                 1
WRTDV901   400.0       319501110   1   1    0.00                          61602084
** diversions for this water right are assumed to be at the most downstream diversion point
WRWDV817      13       319621231   1   1    0.00                            2085_1
IFWDV816   998.6    IF81619811116       1                    IF3906
WRWDV816     140       319811116   1   1    0.00                          11603906
WSWOS816    20.0    1.00   0.727    0.00
IFWDV815  1269.3    IF81519811116       1                    IF3904
WRWDV815      60       319811116   1   1    0.00                          11603904
```

```
IFWDV814   956.1   IF81419811116       1                   IF3908
WRWDV814     279       319811116   1   1    0.00                          11603908
** This water right has two diversion points and was
** modeled to take water from the main stem backed up by diversions from the trib
WRWDV813     282       319550430   1   1    0.00                            2086_1
SO                        WDV812
WRWDV811      84       319460430   1   1    0.00                          61602087
WSWOS811    20.0    1.00   0.727    0.00
WRWDV810      45       319240430   1   1    0.00                          61602088
WRWDV809      48       319660531   1   1    0.00                          61602089
WRWDV808     527       319560331   1   1    0.00                          61602090
IF DV503 11561.5   IF50319830222       1                   IF4102
WR DV503      57       319830222   1   1    0.00   RF502         3        11604102
SO                                                               1
IFWDV807  4413.3   IF80719850430       1                   IF4241
WR424141  272.63       319850430   1   1    0.00  WRF805         3        11604241
WSWSO806    25.2    1.00   0.727    0.00
SO         420.7  272.63  WDV807                                 1
WRWDV804     290       319530331   1   1    0.00                          61602091
IFWDV803  1448.0        19790129       1                   IF3665
WRWDV803     211       319790129   1   1    0.00                          11603665
WRWDV868     990       319450330   1   1    0.00                          61602092
IFWDV865   724.0        19800121       1                   IF3725
WRWDV865     420       319800121   1   1    0.00  WRF866                  11603725
IFWDV862   724.0        19810518       1                 IF3876_1
IFWDV871     362        19810518       1                 IF3876_2
**this water right has been modified to allow diversions from Porter's Creek with a backup from
Lookout Creek
WRWDV862     626       319810518   1   1    0.00  WRF863                    3876_1
WRWDV871               319810518   1   1    0.00  WRF863                    3876_2
BU
** this water right has been modified to allow diversions from the reservoir backed up by diversions
** from CPWDV855
IFWDV853   362.0        19811207       1                   IF3911
WRWDV853     400       319811207   1   1    0.00  WRF851                    3911_1
WSWOS854     2.4    1.00   0.727    0.00
SO                        WDV855
IFWDV843  2929.5   IF84319810526       1                   IF3836
WRWDV843     550       319810526   1   1    0.00  WRF844                    3836_1
WRWDV801    1750       319640731   1   1    0.00                          61602093
IFEDV726  3403.0        19811116       1                   IF3909
WR390941     350       319811116   1   1    0.00  ERF728                  11603909
WSWSO727    45.0    1.00   0.727    0.00
SO         148.8     350  EDV726
IFEDV723  2896.0        19800121       1                   IF3727
WREDV723     913       319800121   1   1    0.00  ERF722                  11603727
IFEDV721  3620.0        19811116       1                 IF3907_1
WREDV721     640       319811116   1   1    0.00                            3907_1
WSEOS721     1.5    1.00   0.727    0.00
WREDV734   398.7       319520430   1   1    0.00                            2094_1
WREDV733   241.3       319520430   1   1    0.00                            2094_2
IFEDV731  3620.0        19811116       1                 IF3907_2
WREDV731     520       319811116   1   1    0.00                            3907_2
WSEOS732     1.5    1.00   0.727    0.00
IFEDV712  1448.0        19811116       1                   IF3903
WREDV712     800       319811116   1   1    0.00  ERF711                  11603903
**
** Start Lake Texana (Navidad River)(no assumed return flows for Texana in BR's run1)
IFDV221B    3570        19720515       1       1              IF2
IFDV221A  346972  BAYEST19720515       1       2              IF1
WRDV221A   74500      TA19720515   1   1                                 C2095_1 TEXANA1
WSTEXANA  151919
**refill Texana to 45 after US irrigators divert
**priority date of re-fill is one day junior to the most junior US irrigator
```

```
WRDV221A       0        20020702   1                                 REFILLTXANA
WSTEXANA  170300
**refill done
**
WRDV221A   34560        20020702   1   1     1.0    NOUT                INTURUP1
WSTEXANA  170300                            151919
WR  NOUT   34560        20020702   1   1                          2        INTURUP2INTURUPT
SO          2800  12000
WR  NOUT   99000        20020702   1   1     1.0  DV221A                 PAYBACK
** FINAL FILLUP FOR LAKE TEXANA
WRDV221A       0        20020702   1                                      REFILL
WSTEXANA  170300
** End Lake Texana
**
**AECOM modifies Stage II project to be subordinate to Lavaca OCR
**Change priority date from 19720515 to 20170102 (two days junior to OCR)
**Change storage capacity from 62454 to 52046 to agree with Reservoir Site Protection Study (TWDB,
2008)
**
**begin Stage 2 of Texana Project
**WR WQ002    7150       120170102   1   1    0.00                        61602095_3 TEXANA2
**WSSTAGE2   52046
**WR WQ002   22850       220170102   1   1    0.00                        61602095_4 TEXANA2
**WSSTAGE2   52046
**WR WQ002   18122  BAYES119931006   1   1     1.0   20955                    2095_5
**
**WR WQ002   18122  BAYES119931006   1   1     0.0                            2095_5
**end Stage 2 of Texana Project
WR DV201    0.01       219970424   1   2    0.00                         5584_5
**
**
********************************************************************************
**AECOM diversion for Lavaca OCR (using 200 MGD pumping / 50,000 AF capacity, per LNRA direction
10/22/19)
**
WRWQ002A       0       120161231   1   1                                  Fill  NEWOCR
** 50,000 ac-ft capacity
WSNEWOCR   50000  0.0218       1  969.85
SO                         WQ002
** 200 MGD (224,182 ac-ft/yr) pump stations diversion rate.  ML record in ac-ft/mo.
ML 19027 17339.2 19027.1 18413.3 19027.1 18413.3 19027.1 19027.1 18413.3 19027.1 18413.3 19027.1
**
**     Modeled as new WR with Priority Date set at 12/31/2016
WRWQ002A 50000.0       120161231   3   1                                NewWR1    9991
WSNEWOCR   50000
**end of diversion additions
********************************************************************************
**
** Lake Texana Area-Capacity Data
**
** area capacity of Texana based on revised table by TWDB from LNRA on March 14, 2001
** ELEVATION -13       0      10      13      18      24      30      36      39      43      44
45
**SVTEXANA  170300  161085  151919  118078   96096   60576   33860   14558    4634    1645      70
0
**SA         10484    9727    8974    7849    6824    5132    3820    2601    1354     634      23
0
SVTEXANA       0      70    1645    4634   14558   33860   60576   96096  118078  151919  161085
170300
SATEXANA       0      23     634    1354    2601    3820    5132    6824    7849    8974    9727
10484
**
****************************************************************************************************
***
```

```
** AECOM - Modify stage 2 reservoir to match Reservoir Site Protection Study (TWDB, 2008)
** area capacity of Stage 2 taken from HDR document to RPG dated 10/19/1999
**SVSTAGE2   62454   57676   40543   23475   11695    4980    1819     596     152       0
**SA          4887    4679    3888    2940    1774     914     352     138      40       0
** AECOM commented out
**SVSTAGE2       0     152     596    1819    4980   11695   23475   40543   57676   62454
**SASTAGE2       0      40     138     352     914    1774    2940    3888    4679    4887
**SVSTAGE2       0       5     161     507    1127    2927    8360   19182   35152   52046
**SA             0      16      49      92     159     609    1649    2725    3688    4564
**
****************************************************************************************************
********
** DROUGHT INDEX RECORDS for B&E when below 78.18% conservation
DI      1   0   1  TEXANA
IS      6       0   10000  100000  133140  133141  170300
IP            100     100     100     100       0       0
**
** DROUGHT INDEX RECORDS for B&E when above 78.18% conservation
DI      2   0   1  TEXANA
IS      6       0   10000  100000  133140  133141  170300
IP              0       0       0       0     100     100
**
** DROUGHT INDEX RECORDS water rights that have the 43 ft msl restriction.
DI      3   0   1  TEXANA
IS      6       0   10000  100000  151918  151919  170300
IP              0       0       0       0     100     100
**
** the following reservoirs are not associated with a water right
** and are included for possible future modeling needs
**WRTOS323       0       830000101
**WSTX5494     146    1.00   0.727    0.00
**WRTOS321       0       730000101
**WSTX3992     144    1.00   0.727    0.00
**WRTOS313       0       130000101
**WSTX3986     280    1.00   0.727    0.00
**WRTOS312       0       130000101
**WSTX3985     173    1.00   0.727    0.00
**WRTOS311       0       130000101
**WSTX3984     144    1.00   0.727    0.00
**WR OS623       0       730000101
**WSTX6176     296    1.00   0.727    0.00
**WRTOS554       0       830000101
**WSTX3929     278    1.00   0.727    0.00
**WROS1003       0       830000101
**WSTX1571     108    1.00   0.727    0.00
**WROS1052       0       130000101
**WSTX3928     336    1.00   0.727    0.00
**WROS1051       0       130000101
**WSTX3977     250    1.00   0.727    0.00
**WROS1033       0       130000101
**WSTX3971     112    1.00   0.727    0.00
** End of .dat data input file
**
ED
```

```
T1      WRAP MODEL
T2      Lavaca River Basin Water Availability Model - original from BR/LNRA modifications completed
by staff September 2001
T3      KA 09/02/2014 DRAFT SUBJECT TO REVISION - INCLUDES DRAFT REPRESENTATION OF ADOPTED
ENVIRONMENTAL FLOW STANDARDS
**
** AECOM Strategy Model to evaluate yield for LNRA DESALINATION 072219
**
** Run 3: full diversion amounts, authorized area capacity, no term permits, and one-hundred percent
reuse
JD    57    1940       1      -1      -1               5
RO    -1
**
** UC FOR COLLINS APPLICATION 5579
UC  5579       0       0       0      60     200     403
UC           403     200       0       0       0       0
UC     1  0.0700  0.0600  0.0700  0.0700  0.0800  0.1000
UC        0.1300  0.1200  0.0900  0.0800  0.0600  0.0700
UC     2   0.076   0.074   0.092   0.088   0.092   0.085
UC         0.079   0.087   0.083   0.086   0.082   0.077
UC     3   0.000   0.001   0.003   0.083   0.149   0.261
UC         0.333   0.154   0.008   0.005   0.002   0.000
UC     7  0.0833  0.0833  0.0833  0.0833  0.0833  0.0834
UC        0.0834  0.0834  0.0834  0.0833  0.0833  0.0833
UC     8  0.0833  0.0833  0.0833  0.0833  0.0833  0.0834
UC        0.0834  0.0834  0.0834  0.0833  0.0833  0.0833
UC IF214  0.0000  0.0000  0.0000  0.1595  0.1738  0.1595
UC        0.1738  0.1738  0.1595  0.0000  0.0000  0.0000
UC IF503  0.1117  0.1009  0.1117  0.1081  0.1117  0.1081
UC        0.0479  0.0479  0.0463  0.0479  0.0463  0.1117
UCIF1023  0.0768  0.0694  0.0768  0.0743  0.0768  0.1699
UC        0.0768  0.0768  0.0743  0.0768  0.0743  0.0768
UCIF1021  0.0770  0.0695  0.0770  0.0745  0.0770  0.1677
UC        0.0770  0.0770  0.0745  0.0770  0.0745  0.0770
UCIF1001  0.0565  0.0510  0.0565  0.0546  0.1129  0.1093
UC        0.1129  0.1129  0.1093  0.1129  0.0546  0.0565
UC IF816  0.0307  0.0278  0.0307  0.1192  0.1232  0.1192
UC        0.1232  0.1232  0.1192  0.1232  0.0297  0.0307
UC IF815  0.0242  0.0219  0.0242  0.1406  0.1454  0.1406
UC        0.1454  0.1454  0.1406  0.0242  0.0234  0.0242
UC IF814  0.0321  0.0291  0.0321  0.1183  0.1222  0.1183
UC        0.1222  0.1222  0.1183  0.1222  0.0311  0.0321
UC IF807  0.0557  0.0503  0.0557  0.0539  0.1254  0.1213
UC        0.1254  0.1254  0.1213  0.0557  0.0539  0.0557
UC IF887  0.0462  0.0417  0.0462  0.1341  0.1386  0.1341
UC        0.1386  0.1386  0.0447  0.0462  0.0447  0.0462
UC IF843  0.0630  0.0568  0.0630  0.1116  0.1154  0.1116
UC        0.1154  0.1154  0.0609  0.0630  0.0609  0.0630
UC    TA    3050    3040    3050    3050    4100    4100
UC          4100    4100    4100    3050    3050    3050
** UC for instream flow restriction for App 5168
UC  1018     254     253     254     253     253     253
UC           254     253     253     253     254     253
** UC for instream flow restriction for App. 5370
UC   916    60.2    60.2    60.2    60.2    60.2    60.3
UC          60.3    60.2    60.2    60.2    60.2    60.3
UCBAYEST    5196    7908    5337   48007   71897   70892
UC          7778   16337   61128   43551    4064    4876
UC   INT       0       0       0       0       0       0
UC             0       0       0       0       0   12000
UCBAYES1  0.0150  0.0228  0.0154  0.1384  0.2072  0.2043
UC        0.0224  0.0471  0.1762  0.1255  0.0117  0.0140
*** Start Eflows UC
** LE UCs
```

```
UC LESUB     523     476     615     595     615     595     =     4318
UC            80      80      71      74      71     523
UC LEDRY    1844    1681    1844    1785    1844    1785     =    18694
UC          1229    1229    1190    1229    1190    1844
UC LEAVG    3381    3081    3381    3272    3381    3272     =    33162
UC          2029    2029    1963    2029    1963    3381
UC LEWET    5778    5266    5778    5592    5778    5592     =    55929
UC          2951    2951    3450    3565    3450    5778
** SG UCs
UC SGSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC SGDRY     307     280     307     297     307     297     =     4831
UC           553     553     535     553     535     307
UC SGAVG     861     784     861     833     861     833     =    12265
UC          1291    1291    1249    1291    1249     861
UC SGWET    1844    1681    1844    1785    1844    1785     =    24458
UC          2397    2397    2320    2397    2320    1844
** WM UCs
UC WMSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC WMDRY     246     224     307     297     307     297     =     4237
UC           615     615     357     369     357     246
UC WMAVG     553     504     676     654     676     654     =     9011
UC          1107    1107     833     861     833     553
UC WMWET    1229    1120    1229    1190    1229    1190     =    17042
UC          1967    1967    1547    1598    1547    1229
** EM UCs
UC EMSUB      61      56      61      59      61      59     =      719
UC            61      61      59      61      59      61
UC EMDRY      61      56      61      59      61      59     =      843
UC           123     123      59      61      59      61
UC EMAVG     123     112     184     178     184     178     =     2236
UC           307     307     178     184     178     123
UC EMWET     369     336     369     357     369     357     =     4954
UC           492     492     476     492     476     369
**END E-FLOWS  UCs
** All 100, 200, 300 and 400 control point numbers are on the Lavaca River or one of its tributaries
** All 500 and 600 control point numbers are on the Navidad River or one of its tributaries
** All 700 control point numbers are on Mustang Creek or East Mustang Creek
** All 800 control point numbers are on West Mustang Creek
** All 900 and 1000 control point numbers are on the Sandy, West Sandy, or
** Middle Sandy Creek or one of their tributaries
** For the control point numbers T=Tributary, W=West, M=Middle, and E=East
** For the control point numbers DV=DiVersion, WW=Waste Water discharge,
** GS=Gage Station, CB=ComBine point, RF=Return Flow, OS=On Stream reservoir,
** WQ=Water Quality point, and EP=End Point
**      2       3       4       5       6       7       8       9      10
** COMPUTATIONAL CP FOR INTERRUPTIBLE WATER
CPINTER1     OUT                       2    NONE    NONE
CP DV402   WW401                       7           GS400      -1
CP WW401   GS400                       7           GS400      -1
CP GS400   CB330                       1
CPTDV333  TDV332                       7           GS300      -1
CPTDV332   CB330                       7           GS300      -1
CPTWW331   CB330                       7           GS300      -1
CP CB330   CB320                       7           GS300      -1
CPTOS323  TWW322                       7           GS300      -1
CPTWW322  TOS321                       7           GS300      -1
CPTOS321   CB320                       7           GS300      -1
CP CB320   CB310                       7           GS300      -1
CPTOS313   CB310                       7           GS300      -1
CPTOS312   CB310                       7           GS300      -1
CPTOS311   CB310                       7           GS300      -1
CP CB310   DV301                       7           GS300      -1
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CP DV301   GS300                       7           GS300      -1
**CP GS300   DV214                       1
CP GS300  LESUBS                       1
CPLESUBS  LEBASE                       2   GS300    NONE
CPLEBASE  LESPUL                       2   GS300    NONE
CPLESPUL  LELPUL                       2   GS300    NONE
CPLELPUL  LEAPUL                       2   GS300    NONE
CPLEAPUL   DV214                       2   GS300    NONE
**
**
CP DV214   DV215                       7           GS300      -2
CP DV215   DV216                       7           GS300      -2
CP DV216   DV213                       7           GS300      -2
CP DV213   WQ002                       7           GS300      -2
**CP WQ002   DV212                       5           GS300      -2
CP WQ002   20955                       7           GS300      -2
CP 20955   DV212                       7           GS300      -2
CP DV212   DV211                       7           GS300      -2
CP DV211   CB220                       7           GS300      -2
CPTWW217   CB220                       7           GS300      -1
CP CB220   CB210                       7           GS300      -2
CP OS623   CB620                       7           GS600      -1
CP WW622   CB620                       7           GS600      -1
CP WW621   CB620                       7           GS600      -1
CPTDV626   CB620                       7           GS600      -1
CP CB620   CB610                       7           GS600      -1
CP CB610   GS600                       7           GS600      -1
CP GS600   CB560                       1
CPTOS554   CB560                       7           GS550      -1
CP CB560   DV553                       7           GS550      -1
CP DV553   DV551                       7           GS550      -1
CP DV551   GS550                       7           GS550      -1
CP GS550   DV504                       1
CP DV504   DV503                       7           GS500      -1
CP RF505   DV503                       7           GS500      -1
CP DV503   RF502                       7           GS500      -1
CP RF502   DV501                       7           GS500      -1
CP WQ005   DV501                       7           GS500      -1
CP DV501   CB510                       7           GS500      -1
CPOS1052  CB1040                       7          GS1000      -1
CPOS1051  CB1040                       7          GS1000      -1
CPDV1042  CB1040                       7          GS1000      -1
CPCB1040  CB1010                       7          GS1000      -1
CPDV1034  OS1033                       7          GS1000      -1
CPOS1033  DV1031                       7          GS1000      -1
CPDV1031  CB1030                       7          GS1000      -1
CPCB1030  DV1023                       7          GS1000      -1
CPDV1023  DV1021                       7          GS1000      -1
CPDV1021  DV1020                       7          GS1000      -1
CPDV1020  DV1018                       7          GS1000      -1
CPDV1018  RF1017                       7          GS1000      -1
CPRF1017  RF1016                       7          GS1000      -1
CPRF1016  RF1015                       7          GS1000      -1
CPRF1015  RF1014                       7          GS1000      -1
CPRF1014  RF1012                       7          GS1000      -1
CPRF1012  RF1011                       7          GS1000      -1
CPRF1011  CB1010                       7          GS1000      -1
CPCB1010  DV1002                       7          GS1000      -1
CPDV1002  DV1001                       7          GS1000      -1
CPDV1001  CB1005                       7          GS1000      -1
CPOS1003  CB1005                       7          GS1000      -1
CPCB1005  GS1000                       7          GS1000      -1
**CPGS1000   CB910                       1
CPGS1000  SGSUBS                       1
```

```
CPSGSUBS  SGBASE                       2  GS1000    NONE
CPSGBASE  SGSPUL                       2  GS1000    NONE
CPSGSPUL  SGLPUL                       2  GS1000    NONE
CPSGLPUL  SGAPUL                       2  GS1000    NONE
CPSGAPUL   CB910                       2  GS1000    NONE
**
CP RF902   CB910                       7         GS1000      -1
CPTRF918  TDV916                       7         GS1000      -1
CPTDV916  TRF915                       7         GS1000      -1
CPTRF915  TRF914                       7         GS1000      -1
CPTRF914  TRF913                       7         GS1000      -1
** add control point for Application No. 5595
CPTRF913    5595                       7         GS1000      -1
CP  5595  TDV911                       7         GS1000      -1
**CPTRF913  TDV911                       4         GS1000      -1
CPTDV911   CB910                       7         GS1000      -1
CP CB910   CB905                       7         GS1000      -1
CPTDV901   CB905                       7         GS1000      -1
CP CB905   GS900                       7         GS1000      -1
CP GS900   CB510                       7         GS1000      -1
CP CB510   GS500                       7          GS500      -1
CP GS500   CB230                       1
CP WM824  WRF824                       7         WGS800      -1
CPWRF824  WCB825                       7         WGS800      -1
CPWRF823  WRF822                       7         WGS800      -1
CPWRF822  WCB825                       7         WGS800      -1
CPWCB825  WCB821                       7         WGS800      -1
CPWRF821  WCB821                       7         WGS800      -1
CP WM827  WCB821                       7         WGS800      -1
CPWRF828  WCB821                       7         WGS800      -1
CPWCB821  WCB820                       7         WGS800      -1
CPWDV818  WDV817                       7         WGS800      -1
CPWDV817  WDV816                       7         WGS800      -1
CPWDV816  WDV815                       7         WGS800      -1
CPWDV815  WDV814                       7         WGS800      -1
CPWDV814  WDV813                       7         WGS800      -1
CPWDV813  WDV811                       7         WGS800      -1
CPWDV812  WDV811                       7         WGS800      -1
CPWDV811  WDV810                       7         WGS800      -1
CPWDV810  WDV809                       7         WGS800      -1
CPWDV809  WDV808                       7         WGS800      -1
CPWDV808  WDV807                       7         WGS800      -1
CPWDV807  WRF805                       7         WGS800      -1
** change cp routing to add Brandl app. 5706
** CPWRF805  WDV804                      5         WGS800      -1
CPWRF805    5706                       7         WGS800      -1
CP  5706  WDV804                       7         WGS800      -1
CPWDV804  WDV803                       7         WGS800      -1
CPWDV803  WRF802                       7         WGS800      -1
CPWRF802  WCB840                       7         WGS800      -1
CPWDV887  WRF881                       7         WGS800      -1
CPWRF882  WRF881                       7         WGS800      -1
CPWRF881  WCB890                       7         WGS800      -1
CPWRF888  WCB890                       7         WGS800      -1
CPWCB890  WDV868                       7         WGS800      -1
CPWDV868  WCB880                       7         WGS800      -1
CPWCB880  WDV867                       7         WGS800      -1
CPWDV867  WRF866                       7         WGS800      -1
CPWRF866  WDV865                       7         WGS800      -1
CPWDV865  WRF864                       7         WGS800      -1
CPWRF864  WRF863                       7         WGS800      -1
CPWRF863  WDV862                       7         WGS800      -1
CPWDV862  WRF861                       7         WGS800      -1
CPWRF861  WCB860                       7         WGS800      -1
```

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CPWRF872  WDV871                        7          WGS800      -1
CPWDV871  WCB860                        7          WGS800      -1
CPWCB860  WCB850                        7          WGS800      -1
CPWRF857  WRF858                        7          WGS800      -1
CPWRF858  WRF856                        7          WGS800      -1
CPWRF856  WDV853                        7          WGS800      -1
CPWDV855  WDV853                        7          WGS800      -1
CPWDV853  WRF851                        7          WGS800      -1
CPWRF851  WCB845                        7          WGS800      -1
CPWRF852  WCB845                        7          WGS800      -1
** Collins Application 5579
** CPWCB845  WCB850                        4          WGS800      -1
CPWCB845  557901                        7          WGS800      -1
CP557901  WCB850                        7          WGS800      -1
**
CPWCB850  WRF844                        7          WGS800      -1
CPWRF844  WDV843                        7          WGS800      -1
CPWDV843  WRF842                        7          WGS800      -1
CPWRF842  WRF841                        7          WGS800      -1
CPWRF841  WCB840                        7          WGS800      -1
CPWCB840  WDV801                        7          WGS800      -1
CPWDV801  WCB830                        7          WGS800      -1
CPWRF832  WRF831                        7          WGS800      -1
CPWRF831  WCB830                        7          WGS800      -1
CPWCB830  WCB820                        7          WGS800      -1
CPWCB820  WGS800                        7          WGS800      -1
**CPWGS800  MCB710                        1
CPWGS800  WMSUBS                        1
CPWMSUBS  WMBASE                        2  WGS800    NONE
CPWMBASE  WMSPUL                        2  WGS800    NONE
CPWMSPUL  WMLPUL                        2  WGS800    NONE
CPWMLPUL  WMAPUL                        2  WGS800    NONE
CPWMAPUL  MCB710                        2  WGS800    NONE
**
CPERF728  EDV726                        7          WGS800      -1
CPEDV726  ERF725                        7          WGS800      -1
CPERF725  EDV724                        7          WGS800      -1
CPEDV724  EDV723                        7          WGS800      -1
CPEDV723  ERF722                        7          WGS800      -1
CPERF722  EDV721                        7          WGS800      -1
CPEDV721  ECB720                        7          WGS800      -1
CPEDV734  EDV733                        7          WGS800      -1
CPEDV733  EDV731                        7          WGS800      -1
CPEDV731  ECB720                        7          WGS800      -1
CPECB720  EDV712                        7          WGS800      -1
***** East Mustang Creek near Louise
**CPEDV712  ERF711                        7          WGS800      -1
CPEDV712  EMSUBS                        7          WGS800      -1
CPEMSUBS  EMBASE                        7          WGS800      -1
CPEMBASE  EMSPUL                        7          WGS800      -1
CPEMSPUL  EMLPUL                        7          WGS800      -1
CPEMLPUL  EMAPUL                        7          WGS800      -1
CPEMAPUL  ERF711                        7          WGS800      -1
**
**
CPERF711  MCB710                        7          WGS800      -1
CPMCB710   GS700                        7          WGS800      -2
CP GS700   CB230                        7          WGS800      -2
CP CB230  DV221A                        7           GS300      -2
CPDV221A  DV221B                        7           GS300      -2
CPDV221B  RSRTRN                        7           GS300      -2
CPRSRTRN   WQ004                        7           GS300      -2
CP WQ004   CB210                        7           GS300      -2
CP CB210   WQ003                        7           GS300      -1
```

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CP WQ003   GS200                      7           GS300      -1
CP GS200   DV201                      7           GS300      -1
CP DV201   GS100                      7           GS300      -1
CP GS100   WQ001                      7           GS300      -1
CP WQ001   EP000                      7           GS300      -1
CP EP000     OUT                      7           GS300      -1
**
** AECOM entered control points for off-channel reservoir
*******************CONTROL POINTS for OCR*********************************
**
CPWQ002A   20956                      5           GS300      -2
CP 20956  WQ002B                      5           GS300      -2
CPNEWOCR     OUT                      2    NONE   GS300      -3
CPWQ002B  WQ002C                      5            NONE      -2
CPWQ002C  WQ002D                      5            NONE      -2
CPWQ002D  WQ002E                      5            NONE      -2
CPWQ002E   DV212                      5            NONE      -2
**
**
**** AECOM entered control points for BSW diversion
**
**
CPDVBSW1   20957                      7           GS300      -2
CP 20957  WQ001A                      5           GS300      -2
CPNEWBSW     OUT                      2    NONE   GS300      -3
CPWQ001A  WQ001B                      5            NONE      -2
CPWQ001B  WQ001C                      5            NONE      -2
CPWQ001C  WQ001D                      5            NONE      -2
CPWQ001D   DV213                      5            NONE      -2
**
***********************************************************************************Off Channel
Reservoirs
CP537041     OUT                      2    ZERO  GS1000
CP397841     OUT                      2    ZERO   GS300
CP207741     OUT                      2    ZERO   GS550
CP391241     OUT                      2    ZERO   GS500
CP391041     OUT                      2    ZERO  GS1000
CP390541     OUT                      2    ZERO  GS1000
CP425241     OUT                      2    ZERO  GS1000
CP424141     OUT                      2    ZERO  WGS800
CP390941     OUT                      2    ZERO  WGS800
** fake CP for Texana's offchannel reservoir used to simulate interruptible water availability.
CP  NOUT     OUT                      2    ZERO    ZERO      -1
** end fake CP record
********************************************************
**---------Start Environmental Flows Dummy CPs------------------------------------------------
CPDAYSPY     OUT                      2    ZERO    ZERO
**** LE Base Flows CPS
CPLESEVT    OUT                      2    NONE    NONE
CPLESVD1    OUT                      2    NONE    NONE
CPLESVT2    OUT                      2    NONE    NONE
CPLESVT3    OUT                      2    NONE    NONE
CPLEBDRY    OUT                      2    NONE    NONE
CPLEBAVG    OUT                      2    NONE    NONE
CPLEBWET    OUT                      2    NONE    NONE
**
** LE Pulse CPS
CPLESPND     OUT                      2    ZERO    ZERO
CPLELPND     OUT                      2    ZERO    ZERO
CPLEAPND     OUT                      2    ZERO    ZERO
**
CPFKLE01     OUT                      2    NONE    NONE
CPFKLE02     OUT                      2    NONE    NONE
CPFKLE03     OUT                      2    NONE    NONE
```

```
CPFKLE04     OUT                              2    NONE    NONE
CPFKLE05     OUT                              2    NONE    NONE
CPFKLE06     OUT                              2    NONE    NONE
CPFKLE07     OUT                              2    NONE    NONE
CPFKLE08     OUT                              2    NONE    NONE
CPFKLE09     OUT                              2    NONE    NONE
CPFKLE10     OUT                              2    NONE    NONE
CPFKLE11     OUT                              2    NONE    NONE
CPFKLE12     OUT                              2    NONE    NONE
CPFKLE13     OUT                              2    NONE    NONE
CPFKLE14     OUT                              2    NONE    NONE
CPFKLE15     OUT                              2    NONE    NONE
CPFKLE16     OUT                              2    NONE    NONE
CPFKLE17     OUT                              2    NONE    NONE
CPFKLE18     OUT                              2    NONE    NONE
CPFKLE19     OUT                              2    NONE    NONE
CPFKLE20     OUT                              2    NONE    NONE
CPFKLE21     OUT                              2    NONE    NONE
CPFKLE22     OUT                              2    NONE    NONE
CPLEAPFA     OUT                              2    NONE    NONE
CPLEAPFB     OUT                              2    NONE    NONE
**
**** SG Base Flows CPS
CPSGSEVT    OUT                              2    NONE    NONE
CPSGSVD1    OUT                              2    NONE    NONE
CPSGSVT2    OUT                              2    NONE    NONE
CPSGSVT3    OUT                              2    NONE    NONE
CPSGBDRY    OUT                              2    NONE    NONE
CPSGBAVG    OUT                              2    NONE    NONE
CPSGBWET    OUT                              2    NONE    NONE
**
** SG Pulse CPS
CPSGSPND     OUT                              2    ZERO    ZERO
CPSGLPND     OUT                              2    ZERO    ZERO
CPSGAPND     OUT                              2    ZERO    ZERO
**
CPFKSG01     OUT                              2    NONE    NONE
CPFKSG02     OUT                              2    NONE    NONE
CPFKSG03     OUT                              2    NONE    NONE
CPFKSG04     OUT                              2    NONE    NONE
CPFKSG05     OUT                              2    NONE    NONE
CPFKSG06     OUT                              2    NONE    NONE
CPFKSG07     OUT                              2    NONE    NONE
CPFKSG08     OUT                              2    NONE    NONE
CPFKSG09     OUT                              2    NONE    NONE
CPFKSG10     OUT                              2    NONE    NONE
CPFKSG11     OUT                              2    NONE    NONE
CPFKSG12     OUT                              2    NONE    NONE
CPFKSG13     OUT                              2    NONE    NONE
CPFKSG14     OUT                              2    NONE    NONE
CPFKSG15     OUT                              2    NONE    NONE
CPFKSG16     OUT                              2    NONE    NONE
CPFKSG17     OUT                              2    NONE    NONE
CPFKSG18     OUT                              2    NONE    NONE
CPFKSG19     OUT                              2    NONE    NONE
CPFKSG20     OUT                              2    NONE    NONE
CPFKSG21     OUT                              2    NONE    NONE
CPFKSG22     OUT                              2    NONE    NONE
CPSGAPFA     OUT                              2    NONE    NONE
CPSGAPFB     OUT                              2    NONE    NONE
**** WM Base Flows CPS
CPWMSEVT    OUT                              2    NONE    NONE
CPWMSVD1    OUT                              2    NONE    NONE
CPWMSVT2    OUT                              2    NONE    NONE
```

```
CPWMSVT3    OUT                         2    NONE    NONE
CPWMBDRY    OUT                         2    NONE    NONE
CPWMBAVG    OUT                         2    NONE    NONE
CPWMBWET    OUT                         2    NONE    NONE
**
** WM Pulse CPS
CPWMSPND     OUT                         2    ZERO    ZERO
CPWMLPND     OUT                         2    ZERO    ZERO
CPWMAPND     OUT                         2    ZERO    ZERO
**
CPFKWM01     OUT                         2    NONE    NONE
CPFKWM02     OUT                         2    NONE    NONE
CPFKWM03     OUT                         2    NONE    NONE
CPFKWM04     OUT                         2    NONE    NONE
CPFKWM05     OUT                         2    NONE    NONE
CPFKWM06     OUT                         2    NONE    NONE
CPFKWM07     OUT                         2    NONE    NONE
CPFKWM08     OUT                         2    NONE    NONE
CPFKWM09     OUT                         2    NONE    NONE
CPFKWM10     OUT                         2    NONE    NONE
CPFKWM11     OUT                         2    NONE    NONE
CPFKWM12     OUT                         2    NONE    NONE
CPFKWM13     OUT                         2    NONE    NONE
CPFKWM14     OUT                         2    NONE    NONE
CPFKWM15     OUT                         2    NONE    NONE
CPFKWM16     OUT                         2    NONE    NONE
CPFKWM17     OUT                         2    NONE    NONE
CPFKWM18     OUT                         2    NONE    NONE
CPFKWM19     OUT                         2    NONE    NONE
CPFKWM20     OUT                         2    NONE    NONE
CPFKWM21     OUT                         2    NONE    NONE
CPFKWM22     OUT                         2    NONE    NONE
CPWMAPFA     OUT                         2    NONE    NONE
CPWMAPFB     OUT                         2    NONE    NONE
**
**---------Start Environmental Flows Dummy CPs For
EM---------------------------------------------**
**** EM Base Flows CPS
CPEMSEVT    OUT                         2    NONE    NONE
CPEMSVD1    OUT                         2    NONE    NONE
CPEMSVT2    OUT                         2    NONE    NONE
CPEMSVT3    OUT                         2    NONE    NONE
CPEMBDRY    OUT                         2    NONE    NONE
CPEMBAVG    OUT                         2    NONE    NONE
CPEMBWET    OUT                         2    NONE    NONE
**
** EM Pulse CPS
CPEMSPND     OUT                         2    ZERO    ZERO
CPEMLPND     OUT                         2    ZERO    ZERO
CPEMAPND     OUT                         2    ZERO    ZERO
**
CPFKEM01     OUT                         2    NONE    NONE
CPFKEM02     OUT                         2    NONE    NONE
CPFKEM03     OUT                         2    NONE    NONE
CPFKEM04     OUT                         2    NONE    NONE
CPFKEM05     OUT                         2    NONE    NONE
CPFKEM06     OUT                         2    NONE    NONE
CPFKEM07     OUT                         2    NONE    NONE
CPFKEM08     OUT                         2    NONE    NONE
CPFKEM09     OUT                         2    NONE    NONE
CPFKEM10     OUT                         2    NONE    NONE
CPFKEM11     OUT                         2    NONE    NONE
CPFKEM12     OUT                         2    NONE    NONE
CPFKEM13     OUT                         2    NONE    NONE
```

```
CPFKEM14      OUT                                2    NONE    NONE
CPFKEM15      OUT                                2    NONE    NONE
CPFKEM16      OUT                                2    NONE    NONE
CPFKEM17      OUT                                2    NONE    NONE
CPFKEM18      OUT                                2    NONE    NONE
CPFKEM19      OUT                                2    NONE    NONE
CPFKEM20      OUT                                2    NONE    NONE
CPFKEM21      OUT                                2    NONE    NONE
CPFKEM22      OUT                                2    NONE    NONE
CPEMAPFA      OUT                                2    NONE    NONE
CPEMAPFB      OUT                                2    NONE    NONE
**
**
************* START EFLOWS CIs*************************
CIDAYSPY       31   28.25      31      30      31      30
CI             31      31      30      31      30      31
**** Lavaca River near Edna BASE CIs
CILESEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILESVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** LE PULSE CIs
*** LE Pulse Duration
CILESPND        6       6       7       7       7       7
CI              4       4       5       5       5       6
CILELPND        7       7       7       7       7       7
CI              6       6       6       6       6       7
CILEAPND        7       7       7       7       7       7
CI              7       7       7       7       7       7
*** LE Pulse Calculation
CIFKLE01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
```

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CIFKLE13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKLE22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CILEAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**** Sandy Creek near Ganado BASE CIs
CISGSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** SG PULSE CIs
*** SG Pulse Duration
CISGSPND       6       6       6       6       6       6
CI             4       4       6       6       6       6
CISGLPND       8       8      10      10      10      10
CI             6       6       6       6       6       8
CISGAPND      10      10      10      10      10      10
CI            10      10      10      10      10      10
*** SG Pulse Calculation
CIFKSG01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG08 9999999 9999999 9999999 9999999 9999999 9999999
```

```
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKSG22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CISGAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**** West Mustange Creek near Ganado BASE CIs
CIWMSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** WM PULSE CIs
*** WM Pulse Duration
CIWMSPND       6       6       6       6       6       6
CI             4       4       6       6       6       6
CIWMLPND       8       8       8       8       8       8
CI             6       6       8       8       8       8
CIWMAPND       8       8       8       8       8       8
CI             8       8       8       8       8       8
*** WM Pulse Calculation
CIFKWM01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM04 9999999 9999999 9999999 9999999 9999999 9999999
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CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKWM22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIWMAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**** West Mustange Creek near Ganado BASE CIs
CIEMSEVT 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVD1 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVT2 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMSVT3 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBDRY 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBAVG 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMBWET 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
** EM PULSE CIs
*** EM Pulse Duration
CIEMSPND       5       5       7       7       7       7
CI             5       5       6       6       6       5
CIEMLPND       8       8       9       9       9       9
CI             6       6       7       7       7       8
CIEMAPND      10      10      10      10      10      10
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CI             10      10      10      10      10      10
*** EM Pulse Calculation
CIFKEM01 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM02 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM03 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM04 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM05 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM06 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM07 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM08 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM09 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM10 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM11 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM12 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM13 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM14 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM15 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM16 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM17 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM18 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM19 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM20 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM21 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIFKEM22 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMAPFA 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
CIEMAPFB 9999999 9999999 9999999 9999999 9999999 9999999
CI       9999999 9999999 9999999 9999999 9999999 9999999
**
**
*******************************************************
** Constant Inflow Cards  (based on monthly min of last 5 years of USBR's FAD cards).
**CIDV1034       0       0       0    1863    4478    6351
**CI         11107    6993   10627     145       0       0
**CITWW217      30      26      41      47      29      41
**CI            35      42      45      31      32      32
**CITWW322      53      52      54      55      57      50
**CI            53      54      55      56      55      52
**CITWW331      24      24      18       3      26      28
**CI            20      26      17      21      21      25
**CIWDV818       0       0       0     646    1552    2201
**CI          3849    2424    3683      50       0       0
```

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**CI WW401      36      31      35      34      35      38
**CI            37      39      38      36      34      34
**CI WW621       7       7       6       7       8       6
**CI             5       6       7       7       8       7
**CI WW622       7       7       6       7       8       6
**CI             5       6       7       7       8       7
**
**WR GS300 9999999  XMONTH20131231                                         TESTFLOWS
**WRGS1000 9999999  XMONTH20131231                                         TESTFLOWS
**WRWGS800 9999999  XMONTH20131231                                         TESTFLOWS
**WREDV712 9999999  XMONTH20131231                                         TESTFLOWS
*******
******* START E-FLOWS ***************
**Dry, Average or Wet Hydrologic Condition in HIS File.
**
*************START E-Flows Lavaca River near Edna
**Start Base LE
** During Severe Conditions set Sub or Base trigger
WRLESVD1   18694   LEDRY20110301                                         FKLESEVD1
WRLESEVT          XMONTH20110301                                        SEVTRIGGER
TO     2            ADD                     GS300                             CONT
TO     6            DIV                                        FKLESEVD1
**** Severe Condition Subsistence or Base
WRLESVT2   18694   LEDRY20110301                                         FKLESEVD2
TO    16            LIM        1       1  DV221A
FS     5  LESEVT       1       0       1 9999999   1
WRLESVT3    4318   LESUB20110301                                        FKLESEVSUB
TO    16            LIM        1       1  DV221A
FS     5  LESVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS file for Hydrologic conditions
WRLEBDRY   18694   LEDRY20110301                                          FKLEBASD
TO    16            LIM        2       2  DV221A
WRLEBAVG   33162   LEAVG20110301                                          FKLEBASM
TO    16            LIM        3       3  DV221A
WRLEBWET   55929   LEWET20110301                                          FKLEBASW
TO    16            LIM        4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFLEBASE              20110301   2                  LEBASEFIN
TO    13            ADD                                        FKLESEVSUB    CONT
TO    13            ADD                                         FKLESEVD2    CONT
TO    13            ADD                                          FKLEBASD    CONT
TO    13            ADD                                          FKLEBASM    CONT
TO    13            ADD                                          FKLEBASW
***
********** LE SMALL PULSE ***************************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE01          XMONTH20110301                                        BF-LEB-SP1
TO     2            ADD                    DAYSPY                             CONT
TO     2            SUB                    LESPND
WRFKLE01          XMONTH20110301                                        BF-LEB-SP2
TO     6            ADD                                        BF-LEB-SP1    CONT
TO     2            DIV                    DAYSPY
WRFKLE01          XMONTH20110301                                        BF-LEB-SP3
TO    13            ADD                                         LEBASEFIN    CONT
TO     6            MUL                                        BF-LEB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
WRFKLE04    8000  XMONTH20110301                                         FKLESPULW
TO     6            ADD                                        BF-LEB-SP3
WRFKLE05          XMONTH20110301                                        LEWINONOFF
TO     2            ADD                     GS300                             CONT
TO     6            DIV                                         FKLESPULW
```

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**
WRFKLE06   18400  XMONTH20110301                                               FKLESPUSP
TO     6            ADD                                                 BF-LEB-SP3
WRFKLE07          XMONTH20110301                                              LESPRONOFF
TO     2            ADD                   GS300                                     CONT
TO     6            DIV                                                  FKLESPUSP
**
WRFKLE08     370  XMONTH20110301                                               FKLESPULS
TO     6            ADD                                                 BF-LEB-SP3
WRFKLE09          XMONTH20110301                                              LESUMONOFF
TO     2            ADD                   GS300                                     CONT
TO     6            DIV                                                  FKLESPULS
**
WRFKLE10    6100  XMONTH20110301                                               FKLESPULF
TO     6            ADD                                                 BF-LEB-SP3
WRFKLE11          XMONTH20110301                                              LEFALONOFF
TO     2            ADD                   GS300                                     CONT
TO     6            DIV                                                  FKLESPULF
** ENGAGING  PULSE
IFLESPUL    8000  XMONTH20110301                              LESPULW1
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE05       1       0       1 9999999   2   1   2   2  12   2
IFLESPUL    8000  XMONTH20110301   3                          LESPULW2
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE05       1       0       1 9999999   2   1   2   0  12   2
IFLESPUL   18400  XMONTH20110301                              LESPUSP1
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE07       1       0       1 9999999   2   1   2   3   3   6
IFLESPUL   18400  XMONTH20110301   3                          LESPUSP2
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE07       1       0       1 9999999   2   1   2   0   3   6
IFLESPUL     370  XMONTH20110301                              LESPULS1
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE09       1       0       1 9999999   2   1   2   1   7   8
IFLESPUL     370  XMONTH20110301   3                          LESPULS2
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE09       1       0       1 9999999   2   1   2   0   7   8
IFLESPUL    6100  XMONTH20110301                              LESPULF1
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE11       1       0       1 9999999   2   1   2   2   9  11
IFLESPUL    6100  XMONTH20110301   3                          LESPULF2
TO     6            ADD                                                 BF-LEB-SP3
FS     5  FKLE11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLESPUL                20110301                               LESPFIN
TO    13            ADD                                                   LESPULW2    CONT
TO    13            ADD                                                   LESPUSP2    CONT
TO    13            ADD                                                   LESPULS2    CONT
TO    13            ADD                                                   LESPULF2
**
***********LE LARGE PULSE ************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE02          XMONTH20110301                                              BF-LEB-LP1
TO     2            ADD                  DAYSPY                                     CONT
TO     2            SUB                  LELPND
WRFKLE02          XMONTH20110301                                              BF-LEB-LP2
TO     6            ADD                                                 BF-LEB-LP1    CONT
TO     2            DIV                  DAYSPY
WRFKLE02          XMONTH20110301                                              BF-LEB-LP3
TO    13            ADD                                                  LEBASEFIN    CONT
TO     6            MUL                                                 BF-LEB-LP2
**
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** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
WRFKLE12   18400  XMONTH20110301                                               FKLELPULW
TO      6           ADD                                               BF-LEB-LP3
WRFKLE13          XMONTH20110301                                             LELWINONOFF
TO      2           ADD                    GS300                                     CONT
TO      6           DIV                                                FKLELPULW
**
WRFKLE14   18400  XMONTH20110301                                               FKLELPUSP
TO      6           ADD                                               BF-LEB-LP3
WRFKLE15          XMONTH20110301                                             LELSPRONOFF
TO      2           ADD                    GS300                                     CONT
TO      6           DIV                                                FKLELPUSP
**
WRFKLE16    1800  XMONTH20110301                                               FKLELPULS
TO      6           ADD                                               BF-LEB-LP3
WRFKLE17          XMONTH20110301                                             LELSUMONOFF
TO      2           ADD                    GS300                                     CONT
TO      6           DIV                                                FKLELPULS
**
WRFKLE18   18000  XMONTH20110301                                               FKLELPULF
TO      6           ADD                                               BF-LEB-LP3
WRFKLE19          XMONTH20110301                                             LELFALONOFF
TO      2           ADD                    GS300                                     CONT
TO      6           DIV                                                FKLELPULF
** ENGAGING  PULSE
IFLELPUL   18400  XMONTH20110301                        LELPULW1
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE13       1       0       1 9999999   2   1   1   2  12   2
IFLELPUL   18400  XMONTH20110301   3                    LELPULW2
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE13       1       0       1 9999999   2   1   1   0  12   2
IFLELPUL   18400  XMONTH20110301                        LELPUSP1
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE15       1       0       1 9999999   2   1   1   3   3   6
IFLELPUL   18400  XMONTH20110301   3                    LELPUSP2
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE15       1       0       1 9999999   2   1   1   0   3   6
IFLELPUL    1800  XMONTH20110301                        LELPULS1
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE17       1       0       1 9999999   2   1   1   1   7   8
IFLELPUL    1800  XMONTH20110301   3                    LELPULS2
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE17       1       0       1 9999999   2   1   1   0   7   8
IFLELPUL   18000  XMONTH20110301                        LELPULF1
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE19       1       0       1 9999999   2   1   1   2   9  11
IFLELPUL   18000  XMONTH20110301   3                    LELPULF2
TO      6           ADD                                               BF-LEB-LP3
FS      5  FKLE19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLELPUL                20110301                         LELPFIN
TO     13           ADD                                          LELPULW2    CONT
TO     13           ADD                                          LELPUSP2    CONT
TO     13           ADD                                          LELPULS2    CONT
TO     13           ADD                                          LELPULF2
***********************
***********LE Annual PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKLE03          XMONTH20110301                                              BF-LEB-AP1
TO      2           ADD                   DAYSPY                                     CONT
TO      2           SUB                   LELPND
WRFKLE03          XMONTH20110301                                              BF-LEB-AP2
```

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TO     6            ADD                                        BF-LEB-AP1    CONT
TO     2            DIV                   DAYSPY
WRFKLE03         XMONTH20110301                                                BF-LEB-AP3
TO    13            ADD                                         LEBASEFIN    CONT
TO     6            MUL                                        BF-LEB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS300 exceeded target
WRFKLE20   18400  XMONTH20110301                                                 FKLEAPUL
TO     6            ADD                                        BF-LEB-AP3
WRFKLE21         XMONTH20110301                                                LEANNONOFF
TO     2            ADD                    GS300                                     CONT
TO     6            DIV                                          FKLEAPUL
** ENGAGING  PULSE
IFLEAPFA   18400  XMONTH20110301                               LEAPLA1
TO     6            ADD                                        BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   5  1    6       1
IFLEAPFA   18400  XMONTH20110301   3                           LEAPLA2
TO     6            ADD                                        BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   0  1    6       1
IFLEAPFB   18400  XMONTH20110301                               LEAPLB1
TO     6            ADD                                        BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   5  7   12       1
IFLEAPFB   18400  XMONTH20110301   3                           LEAPLB2
TO     6            ADD                                        BF-LEB-AP3
FS     5  FKLE21       1       0       1 9999999   2   1   1   0  7   12       1
WRFKLE22               20110301                                                LEFRSTHALF
TO    13                                                          LEAPLA2
IFLEAPFB               20110301   3                            LEAPLB3
TO    13                                                          LEAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6       1      LEFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFLEAPUL               20110301                                LEAPFIN
TO    13            ADD                                           LEAPLA2    CONT
TO    13            ADD                                           LEAPLB3
***********************
****************** End E-FLOWS FOR GS300 Lavaca River near Edna
**
******************START E-Flows for Sandy Creek near Ganado
** Start BASE SG
** During Severe Conditions set Sub or Base trigger
WRSGSVD1    4831   SGDRY20110301                                                FKSGSEVD1
WRSGSEVT         XMONTH20110301                                                SEVTRIGGER
TO     2            ADD                   GS1000                                     CONT
TO     6            DIV                                        FKSGSEVD1
**** Severe Condition Subsistence or Base
WRSGSVT2    4831   SGDRY20110301                                                FKSGSEVD2
TO    16            LIM       1       1  DV221A
FS     5  SGSEVT       1       0       1 9999999   1
WRSGSVT3     719   SGSUB20110301                                               FKSGSEVSUB
TO    16            LIM       1       1  DV221A
FS     5  SGSVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiSG for Hydrologic conditions
WRSGBDRY    4831   SGDRY20110301                                                 FKSGBASD
TO    16            LIM       2       2  DV221A
WRSGBAVG   12265   SGAVG20110301                                                 FKSGBASM
TO    16            LIM       3       3  DV221A
WRSGBWET   24458   SGWET20110301                                                 FKSGBASW
TO    16            LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFSGBASE               20110301   2                         SGBASEFIN
TO    13            ADD                                        FKSGSEVSUB    CONT
TO    13            ADD                                         FKSGSEVD2    CONT
TO    13            ADD                                          FKSGBASD    CONT
TO    13            ADD                                          FKSGBASM    CONT
```

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TO    13             ADD                                         FKSGBASW
***
********* SG SMALL PULSE **********************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG01          XMONTH20110301                                     BF-SGB-SP1
TO     2             ADD                DAYSPY                             CONT
TO     2             SUB                SGSPND
WRFKSG01          XMONTH20110301                                     BF-SGB-SP2
TO     6             ADD                                   BF-SGB-SP1      CONT
TO     2             DIV                DAYSPY
WRFKSG01          XMONTH20110301                                     BF-SGB-SP3
TO    13             ADD                                    SGBASEFIN      CONT
TO     6             MUL                                   BF-SGB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at SG300 exceeded target
WRFKSG04    4000  XMONTH20110301                                      FKSGSPULW
TO     6             ADD                                   BF-SGB-SP3
WRFKSG05          XMONTH20110301                                     SGWINONOFF
TO     2             ADD                GS1000                             CONT
TO     6             DIV                                    FKSGSPULW
**
WRFKSG06    7300  XMONTH20110301                                      FKSGSPUSP
TO     6             ADD                                   BF-SGB-SP3
WRFKSG07          XMONTH20110301                                     SGSPRONOFF
TO     2             ADD                GS1000                             CONT
TO     6             DIV                                    FKSGSPUSP
**
WRFKSG08     500  XMONTH20110301                                      FKSGSPULS
TO     6             ADD                                   BF-SGB-SP3
WRFKSG09          XMONTH20110301                                     SGSUMONOFF
TO     2             ADD                GS1000                             CONT
TO     6             DIV                                    FKSGSPULS
**
WRFKSG10    3100  XMONTH20110301                                      FKSGSPULF
TO     6             ADD                                   BF-SGB-SP3
WRFKSG11          XMONTH20110301                                     SGFALONOFF
TO     2             ADD                GS1000                             CONT
TO     6             DIV                                    FKSGSPULF
** ENGAGING  PULSE
IFSGSPUL    4000  XMONTH20110301                         SGSPULW1
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG05       1       0       1 9999999   2   1   2   2  12   2
IFSGSPUL    4000  XMONTH20110301   3                     SGSPULW2
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG05       1       0       1 9999999   2   1   2   0  12   2
IFSGSPUL    7300  XMONTH20110301                         SGSPUSP1
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG07       1       0       1 9999999   2   1   2   3   3   6
IFSGSPUL    7300  XMONTH20110301   3                     SGSPUSP2
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG07       1       0       1 9999999   2   1   2   0   3   6
IFSGSPUL     500  XMONTH20110301                         SGSPULS1
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG09       1       0       1 9999999   2   1   2   1   7   8
IFSGSPUL     500  XMONTH20110301   3                     SGSPULS2
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG09       1       0       1 9999999   2   1   2   0   7   8
IFSGSPUL    3100  XMONTH20110301                         SGSPULF1
TO     6             ADD                                   BF-SGB-SP3
FS     5  FKSG11       1       0       1 9999999   2   1   2   2   9  11
IFSGSPUL    3100  XMONTH20110301   3                     SGSPULF2
TO     6             ADD                                   BF-SGB-SP3
```

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FS      5  FKSG11        1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGSPUL              20110301                        SGSPFIN
TO     13            ADD                                     SGSPULW2    CONT
TO     13            ADD                                     SGSPUSP2    CONT
TO     13            ADD                                     SGSPULS2    CONT
TO     13            ADD                                     SGSPULF2
**
***********SG LARGE PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG02          XMONTH20110301                                  BF-SGB-LP1
TO      2            ADD                DAYSPY                           CONT
TO      2            SUB                SGLPND
WRFKSG02          XMONTH20110301                                  BF-SGB-LP2
TO      6            ADD                                   BF-SGB-LP1    CONT
TO      2            DIV                DAYSPY
WRFKSG02          XMONTH20110301                                  BF-SGB-LP3
TO     13            ADD                                    SGBASEFIN    CONT
TO      6            MUL                                   BF-SGB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at GS1000 exceeded target
WRFKSG12   10000  XMONTH20110301                                   FKSGLPULW
TO      6            ADD                                   BF-SGB-LP3
WRFKSG13          XMONTH20110301                                 SGLWINONOFF
TO      2            ADD                GS1000                           CONT
TO      6            DIV                                    FKSGLPULW
**
WRFKSG14   12200  XMONTH20110301                                   FKSGLPUSP
TO      6            ADD                                   BF-SGB-LP3
WRFKSG15          XMONTH20110301                                 SGLSPRONOFF
TO      2            ADD                GS1000                           CONT
TO      6            DIV                                    FKSGLPUSP
**
WRFKSG16    1600  XMONTH20110301                                   FKSGLPULS
TO      6            ADD                                   BF-SGB-LP3
WRFKSG17          XMONTH20110301                                 SGLSUMONOFF
TO      2            ADD                GS1000                           CONT
TO      6            DIV                                    FKSGLPULS
**
WRFKSG18    9200  XMONTH20110301                                   FKSGLPULF
TO      6            ADD                                   BF-SGB-LP3
WRFKSG19          XMONTH20110301                                 SGLFALONOFF
TO      2            ADD                GS1000                           CONT
TO      6            DIV                                    FKSGLPULF
** ENGAGING  PULSE
IFSGLPUL   10000  XMONTH20110301                         SGLPULW1
TO      6            ADD                                   BF-SGB-LP3
FS      5  FKSG13        1       0       1 9999999   2   1   1   2  12   2
IFSGLPUL   10000  XMONTH20110301   3                     SGLPULW2
TO      6            ADD                                   BF-SGB-LP3
FS      5  FKSG13        1       0       1 9999999   2   1   1   0  12   2
IFSGLPUL   12200  XMONTH20110301                         SGLPUSP1
TO      6            ADD                                   BF-SGB-LP3
FS      5  FKSG15        1       0       1 9999999   2   1   1   3   3   6
IFSGLPUL   12200  XMONTH20110301   3                     SGLPUSP2
TO      6            ADD                                   BF-SGB-LP3
FS      5  FKSG15        1       0       1 9999999   2   1   1   0   3   6
IFSGLPUL    1600  XMONTH20110301                         SGLPULS1
TO      6            ADD                                   BF-SGB-LP3
FS      5  FKSG17        1       0       1 9999999   2   1   1   1   7   8
IFSGLPUL    1600  XMONTH20110301   3                     SGLPULS2
TO      6            ADD                                   BF-SGB-LP3
```

```
FS      5  FKSG17        1       0       1 9999999   2   1   1   0   7   8
IFSGLPUL    9200  XMONTH20110301                        SGLPULF1
TO      6            ADD                                      BF-SGB-LP3
FS      5  FKSG19        1       0       1 9999999   2   1   1   2   9  11
IFSGLPUL    9200  XMONTH20110301   3                    SGLPULF2
TO      6            ADD                                      BF-SGB-LP3
FS      5  FKSG19        1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGLPUL               20110301                          SGLPFIN
TO     13            ADD                                        SGLPULW2    CONT
TO     13            ADD                                        SGLPUSP2    CONT
TO     13            ADD                                        SGLPULS2    CONT
TO     13            ADD                                        SGLPULF2
***********************
**********SG Annual PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKSG03          XMONTH20110301                                      BF-SGB-AP1
TO      2            ADD                    DAYSPY                          CONT
TO      2            SUB                    SGLPND
WRFKSG03          XMONTH20110301                                      BF-SGB-AP2
TO      6            ADD                                      BF-SGB-AP1    CONT
TO      2            DIV                    DAYSPY
WRFKSG03          XMONTH20110301                                      BF-SGB-AP3
TO     13            ADD                                       SGBASEFIN    CONT
TO      6            MUL                                      BF-SGB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at SG300 exceeded target
WRFKSG20   12200  XMONTH20110301                                        FKSGAPUL
TO      6            ADD                                      BF-SGB-AP3
WRFKSG21          XMONTH20110301                                      SGANNONOFF
TO      2            ADD                    GS1000                          CONT
TO      6            DIV                                        FKSGAPUL
** ENGAGING  PULSE
IFSGAPFA   12200  XMONTH20110301                         SGAPLA1
TO      6            ADD                                      BF-SGB-AP3
FS      5  FKSG21        1       0       1 9999999   2   1   1   5  1    6       1
IFSGAPFA   12200  XMONTH20110301   3                     SGAPLA2
TO      6            ADD                                      BF-SGB-AP3
FS      5  FKSG21        1       0       1 9999999   2   1   1   0  1    6       1
IFSGAPFB   12200  XMONTH20110301                         SGAPLB1
TO      6            ADD                                      BF-SGB-AP3
FS      5  FKSG21        1       0       1 9999999   2   1   1   5  7   12       1
IFSGAPFB   12200  XMONTH20110301   3                     SGAPLB2
TO      6            ADD                                      BF-SGB-AP3
FS      5  FKSG21        1       0       1 9999999   2   1   1   0  7   12       1
WRFKSG22               20110301                                       SGFRSTHALF
TO     13                                                        SGAPLA2
IFSGAPFB               20110301   3                      SGAPLB3
TO     13                                                        SGAPLB2
FS     10                0       1       1 9999999   2   1   1  11  1    6       1      SGFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFSGAPUL               20110301                          SGAPFIN
TO     13            ADD                                         SGAPLA2    CONT
TO     13            ADD                                         SGAPLB3
***********************
***END E-Flows for Sandy Creek near Ganado ***********
**
*************START E-Flows for West Mustang Creek near Ganado
** During Severe Conditions set Sub or Base trigger
WRWMSVD1    4237   WMDRY20110301                                       FKWMSEVD1
WRWMSEVT          XMONTH20110301                                      SEVTRIGGER
TO      2            ADD                    WGS800                          CONT
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TO     6             DIV                                        FKWMSEVD1
**** Severe Condition Subsistence or Base
WRWMSVT2    4237   WMDRY20110301                                         FKWMSEVD2
TO    16             LIM       1       1  DV221A
FS     5  WMSEVT       1       0       1 9999999   1
WRWMSVT3     719   WMSUB20110301                                        FKWMSEVSUB
TO    16             LIM       1       1  DV221A
FS     5  WMSVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiGS for Hydrologic conditions
WRWMBDRY    4237   WMDRY20110301                                          FKWMBASD
TO    16             LIM       2       2  DV221A
WRWMBAVG    9011   WMAVG20110301                                          FKWMBASM
TO    16             LIM       3       3  DV221A
WRWMBWET   17042   WMWET20110301                                          FKWMBASW
TO    16             LIM       4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFWMBASE                20110301   2                 WMBASEFIN
TO    13             ADD                                        FKWMSEVSUB    CONT
TO    13             ADD                                         FKWMSEVD2    CONT
TO    13             ADD                                          FKWMBASD    CONT
TO    13             ADD                                          FKWMBASM    CONT
TO    13             ADD                                          FKWMBASW
***
********* WM SMALL PULSE ***********************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM01          XMONTH20110301                                        BF-WMB-SP1
TO     2             ADD                  DAYSPY                              CONT
TO     2             SUB                  WMSPND
WRFKWM01          XMONTH20110301                                        BF-WMB-SP2
TO     6             ADD                                        BF-WMB-SP1    CONT
TO     2             DIV                  DAYSPY
WRFKWM01          XMONTH20110301                                        BF-WMB-SP3
TO    13             ADD                                         WMBASEFIN    CONT
TO     6             MUL                                        BF-WMB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM04    2400  XMONTH20110301                                         FKWMSPULW
TO     6             ADD                                        BF-WMB-SP3
WRFKWM05          XMONTH20110301                                        WMWINONOFF
TO     2             ADD                  WGS800                              CONT
TO     6             DIV                                         FKWMSPULW
**
WRFKWM06    4400  XMONTH20110301                                         FKWMSPUSP
TO     6             ADD                                        BF-WMB-SP3
WRFKWM07          XMONTH20110301                                        WMSPRONOFF
TO     2             ADD                  WGS800                              CONT
TO     6             DIV                                         FKWMSPUSP
**
WRFKWM08     420  XMONTH20110301                                         FKWMSPULS
TO     6             ADD                                        BF-WMB-SP3
WRFKWM09          XMONTH20110301                                        WMSUMONOFF
TO     2             ADD                  WGS800                              CONT
TO     6             DIV                                         FKWMSPULS
**
WRFKWM10    2200  XMONTH20110301                                         FKWMSPULF
TO     6             ADD                                        BF-WMB-SP3
WRFKWM11          XMONTH20110301                                        WMFALONOFF
TO     2             ADD                  WGS800                              CONT
TO     6             DIV                                         FKWMSPULF
** ENGAGING  PULSE
IFWMSPUL    2400  XMONTH20110301                   WMSPULW1
TO     6             ADD                                        BF-WMB-SP3
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FS      5  FKWM05        1        0       1 9999999   2   1   2   2  12   2
IFWMSPUL     2400  XMONTH20110301   3                      WMSPULW2
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM05        1        0       1 9999999   2   1   2   0  12   2
IFWMSPUL     4400  XMONTH20110301                          WMSPUSP1
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM07        1        0       1 9999999   2   1   2   3   3   6
IFWMSPUL     4400  XMONTH20110301   3                      WMSPUSP2
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM07        1        0       1 9999999   2   1   2   0   3   6
IFWMSPUL      420  XMONTH20110301                          WMSPULS1
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM09        1        0       1 9999999   2   1   2   1   7   8
IFWMSPUL      420  XMONTH20110301   3                      WMSPULS2
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM09        1        0       1 9999999   2   1   2   0   7   8
IFWMSPUL     2200  XMONTH20110301                          WMSPULF1
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM11        1        0       1 9999999   2   1   2   2   9  11
IFWMSPUL     2200  XMONTH20110301   3                      WMSPULF2
TO      6           ADD                                          BF-WMB-SP3
FS      5  FKWM11        1        0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMSPUL              20110301                              WMSPFIN
TO     13           ADD                                            WMSPULW2    CONT
TO     13           ADD                                            WMSPUSP2    CONT
TO     13           ADD                                            WMSPULS2    CONT
TO     13           ADD                                            WMSPULF2
**
***********WM LARGE PULSE *************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM02           XMONTH20110301                                        BF-WMB-LP1
TO      2           ADD                 DAYSPY                                 CONT
TO      2           SUB                 WMLPND
WRFKWM02           XMONTH20110301                                        BF-WMB-LP2
TO      6           ADD                                          BF-WMB-LP1    CONT
TO      2           DIV                 DAYSPY
WRFKWM02           XMONTH20110301                                        BF-WMB-LP3
TO     13           ADD                                           WMBASEFIN    CONT
TO      6           MUL                                          BF-WMB-LP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM12     5600  XMONTH20110301                                         FKWMLPULW
TO      6           ADD                                          BF-WMB-LP3
WRFKWM13           XMONTH20110301                                       WMLWINONOFF
TO      2           ADD                 WGS800                                 CONT
TO      6           DIV                                           FKWMLPULW
**
WRFKWM14     5600  XMONTH20110301                                         FKWMLPUSP
TO      6           ADD                                          BF-WMB-LP3
WRFKWM15           XMONTH20110301                                       WMLSPRONOFF
TO      2           ADD                 WGS800                                 CONT
TO      6           DIV                                           FKWMLPUSP
**
WRFKWM16     1200  XMONTH20110301                                         FKWMLPULS
TO      6           ADD                                          BF-WMB-LP3
WRFKWM17           XMONTH20110301                                       WMLSUMONOFF
TO      2           ADD                 WGS800                                 CONT
TO      6           DIV                                           FKWMLPULS
**
WRFKWM18     5600  XMONTH20110301                                         FKWMLPULF
TO      6           ADD                                          BF-WMB-LP3
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WRFKWM19          XMONTH20110301                                         WMLFALONOFF
TO      2            ADD                   WGS800                               CONT
TO      6            DIV                                           FKWMLPULF
** ENGAGING  PULSE
IFWMLPUL     5600  XMONTH20110301                            WMLPULW1
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM13       1        0       1 9999999   2   1   1   2  12   2
IFWMLPUL     5600  XMONTH20110301   3                        WMLPULW2
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM13       1        0       1 9999999   2   1   1   0  12   2
IFWMLPUL     5600  XMONTH20110301                            WMLPUSP1
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM15       1        0       1 9999999   2   1   1   3   3   6
IFWMLPUL     5600  XMONTH20110301   3                        WMLPUSP2
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM15       1        0       1 9999999   2   1   1   0   3   6
IFWMLPUL     1200  XMONTH20110301                            WMLPULS1
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM17       1        0       1 9999999   2   1   1   1   7   8
IFWMLPUL     1200  XMONTH20110301   3                        WMLPULS2
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM17       1        0       1 9999999   2   1   1   0   7   8
IFWMLPUL     5600  XMONTH20110301                            WMLPULF1
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM19       1        0       1 9999999   2   1   1   2   9  11
IFWMLPUL     5600  XMONTH20110301   3                        WMLPULF2
TO      6            ADD                                         BF-WMB-LP3
FS      5  FKWM19       1        0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMLPUL                 20110301                             WMLPFIN
TO     13            ADD                                          WMLPULW2    CONT
TO     13            ADD                                          WMLPUSP2    CONT
TO     13            ADD                                          WMLPULS2    CONT
TO     13            ADD                                          WMLPULF2
***********************
**********WM Annual PULSE ***********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKWM03          XMONTH20110301                                          BF-WMB-AP1
TO      2            ADD                   DAYSPY                               CONT
TO      2            SUB                   WMLPND
WRFKWM03          XMONTH20110301                                          BF-WMB-AP2
TO      6            ADD                                         BF-WMB-AP1    CONT
TO      2            DIV                   DAYSPY
WRFKWM03          XMONTH20110301                                          BF-WMB-AP3
TO     13            ADD                                          WMBASEFIN    CONT
TO      6            MUL                                         BF-WMB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at WGS800 exceeded target
WRFKWM20     5600  XMONTH20110301                                           FKWMAPUL
TO      6            ADD                                         BF-WMB-AP3
WRFKWM21          XMONTH20110301                                          WMANNONOFF
TO      2            ADD                   WGS800                               CONT
TO      6            DIV                                            FKWMAPUL
** ENGAGING  PULSE
IFWMAPFA     5600  XMONTH20110301                             WMAPLA1
TO      6            ADD                                         BF-WMB-AP3
FS      5  FKWM21       1        0       1 9999999   2   1   1   5  1    6        1
IFWMAPFA     5600  XMONTH20110301   3                         WMAPLA2
TO      6            ADD                                         BF-WMB-AP3
FS      5  FKWM21       1        0       1 9999999   2   1   1   0  1    6        1
IFWMAPFB     5600  XMONTH20110301                             WMAPLB1
TO      6            ADD                                         BF-WMB-AP3
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FS     5  FKWM21       1       0       1 9999999   2   1   1   5  7   12       1
IFWMAPFB    5600  XMONTH20110301   3                    WMAPLB2
TO     6            ADD                                       BF-WMB-AP3
FS     5  FKWM21       1       0       1 9999999   2   1   1   0  7   12       1
WRFKWM22              20110301                                     WMFRSTHALF
TO    13                                                      WMAPLA2
IFWMAPFB              20110301   3                    WMAPLB3
TO    13                                                      WMAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6       1      WMFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFWMAPUL              20110301                        WMAPFIN
TO    13            ADD                                       WMAPLA2    CONT
TO    13            ADD                                       WMAPLB3
***********************
** END E-Flows for West Mustang Creek near Ganado
**
**START E-Flows for East Mustang Creek near Louise
** During Severe Conditions set Sub or Base trigger
WREMSVD1     843   EMDRY20110301                                     FKEMSEVD1
WREMSEVT          XMONTH20110301                                    SEVTRIGGER
TO     2            ADD                  EDV712                            CONT
TO     6            DIV                                       FKEMSEVD1
**** Severe Condition Subsistence or Base
WREMSVT2     843   EMDRY20110301                                     FKEMSEVD2
TO    16            LIM        1       1  DV221A
FS     5  EMSEVT       1       0       1 9999999   1
WREMSVT3     719   EMSUB20110301                                    FKEMSEVSUB
TO    16            LIM        1       1  DV221A
FS     5  EMSVT2       1       0       0       1   1
*** Dry, Average, Wet Conditions, see .HIS fiGS for Hydrologic conditions
WREMBDRY     843   EMDRY20110301                                      FKEMBASD
TO    16            LIM        2       2  DV221A
WREMBAVG    2236   EMAVG20110301                                      FKEMBASM
TO    16            LIM        3       3  DV221A
WREMBWET    4954   EMWET20110301                                      FKEMBASW
TO    16            LIM        4       4  DV221A
** COMBINE TO CREATE BASE FOR ENTIRE YEAR.
IFEMBASE              20110301   2                 EMBASEFIN
TO    13            ADD                                       FKEMSEVSUB    CONT
TO    13            ADD                                        FKEMSEVD2    CONT
TO    13            ADD                                         FKEMBASD    CONT
TO    13            ADD                                         FKEMBASM    CONT
TO    13            ADD                                         FKEMBASW
***
********** EM SMALL PULSE ****************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM01          XMONTH20110301                                    BF-EMB-SP1
TO     2            ADD                  DAYSPY                            CONT
TO     2            SUB                  EMSPND
WRFKEM01          XMONTH20110301                                    BF-EMB-SP2
TO     6            ADD                                       BF-EMB-SP1    CONT
TO     2            DIV                  DAYSPY
WRFKEM01          XMONTH20110301                                    BF-EMB-SP3
TO    13            ADD                                        EMBASEFIN    CONT
TO     6            MUL                                       BF-EMB-SP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
WRFKEM04     680  XMONTH20110301                                     FKEMSPULW
TO     6            ADD                                       BF-EMB-SP3
WRFKEM05          XMONTH20110301                                    EMWINONOFF
TO     2            ADD                  EDV712                            CONT
TO     6            DIV                                        FKEMSPULW
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**
WRFKEM06    1400  XMONTH20110301                                            FKEMSPUSP
TO     6            ADD                                             BF-EMB-SP3
WRFKEM07          XMONTH20110301                                           EMSPRONOFF
TO     2            ADD                   EDV712                                 CONT
TO     6            DIV                                               FKEMSPUSP
**
WRFKEM08     100  XMONTH20110301                                            FKEMSPULS
TO     6            ADD                                             BF-EMB-SP3
WRFKEM09          XMONTH20110301                                           EMSUMONOFF
TO     2            ADD                   EDV712                                 CONT
TO     6            DIV                                               FKEMSPULS
**
WRFKEM10     650  XMONTH20110301                                            FKEMSPULF
TO     6            ADD                                             BF-EMB-SP3
WRFKEM11          XMONTH20110301                                           EMFALONOFF
TO     2            ADD                   EDV712                                 CONT
TO     6            DIV                                               FKEMSPULF
** ENGAGING  PULSE
IFEMSPUL     680  XMONTH20110301                                EMSPULW1
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM05       1       0       1 9999999   2   1   2   2  12   2
IFEMSPUL     680  XMONTH20110301   3                            EMSPULW2
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM05       1       0       1 9999999   2   1   2   0  12   2
IFEMSPUL    1400  XMONTH20110301                                EMSPUSP1
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM07       1       0       1 9999999   2   1   2   3   3   6
IFEMSPUL    1400  XMONTH20110301   3                            EMSPUSP2
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM07       1       0       1 9999999   2   1   2   0   3   6
IFEMSPUL     100  XMONTH20110301                                EMSPULS1
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM09       1       0       1 9999999   2   1   2   1   7   8
IFEMSPUL     100  XMONTH20110301   3                            EMSPULS2
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM09       1       0       1 9999999   2   1   2   0   7   8
IFEMSPUL     650  XMONTH20110301                                EMSPULF1
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM11       1       0       1 9999999   2   1   2   2   9  11
IFEMSPUL     650  XMONTH20110301   3                            EMSPULF2
TO     6            ADD                                             BF-EMB-SP3
FS     5  FKEM11       1       0       1 9999999   2   1   2   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMSPUL               20110301                                  EMSPFIN
TO    13            ADD                                                 EMSPULW2    CONT
TO    13            ADD                                                 EMSPUSP2    CONT
TO    13            ADD                                                 EMSPULS2    CONT
TO    13            ADD                                                 EMSPULF2
**
***********EM LARGE PULSE **************************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM02          XMONTH20110301                                           BF-EMB-LP1
TO     2            ADD                   DAYSPY                                 CONT
TO     2            SUB                   EMLPND
WRFKEM02          XMONTH20110301                                           BF-EMB-LP2
TO     6            ADD                                             BF-EMB-LP1    CONT
TO     2            DIV                   DAYSPY
WRFKEM02          XMONTH20110301                                           BF-EMB-LP3
TO    13            ADD                                               EMBASEFIN    CONT
TO     6            MUL                                             BF-EMB-LP2
**
```

```
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
WRFKEM12    1700  XMONTH20110301                                             FKEMLPULW
TO      6            ADD                                            BF-EMB-LP3
WRFKEM13          XMONTH20110301                                          EMLWINONOFF
TO      2            ADD                  EDV712                                  CONT
TO      6            DIV                                              FKEMLPULW
**
WRFKEM14    3000  XMONTH20110301                                             FKEMLPUSP
TO      6            ADD                                            BF-EMB-LP3
WRFKEM15          XMONTH20110301                                          EMLSPRONOFF
TO      2            ADD                  EDV712                                  CONT
TO      6            DIV                                              FKEMLPUSP
**
WRFKEM16     310  XMONTH20110301                                             FKEMLPULS
TO      6            ADD                                            BF-EMB-LP3
WRFKEM17          XMONTH20110301                                          EMLSUMONOFF
TO      2            ADD                  EDV712                                  CONT
TO      6            DIV                                              FKEMLPULS
**
WRFKEM18    2100  XMONTH20110301                                             FKEMLPULF
TO      6            ADD                                            BF-EMB-LP3
WRFKEM19          XMONTH20110301                                          EMLFALONOFF
TO      2            ADD                  EDV712                                  CONT
TO      6            DIV                                              FKEMLPULF
** ENGAGING  PULSE
IFEMLPUL    1700  XMONTH20110301                        EMLPULW1
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM13       1       0       1 9999999   2   1   1   2  12   2
IFEMLPUL    1700  XMONTH20110301   3                    EMLPULW2
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM13       1       0       1 9999999   2   1   1   0  12   2
IFEMLPUL    3000  XMONTH20110301                        EMLPUSP1
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM15       1       0       1 9999999   2   1   1   3   3   6
IFEMLPUL    3000  XMONTH20110301   3                    EMLPUSP2
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM15       1       0       1 9999999   2   1   1   0   3   6
IFEMLPUL     310  XMONTH20110301                        EMLPULS1
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM17       1       0       1 9999999   2   1   1   1   7   8
IFEMLPUL     310  XMONTH20110301   3                    EMLPULS2
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM17       1       0       1 9999999   2   1   1   0   7   8
IFEMLPUL    2100  XMONTH20110301                        EMLPULF1
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM19       1       0       1 9999999   2   1   1   2   9  11
IFEMLPUL    2100  XMONTH20110301   3                    EMLPULF2
TO      6            ADD                                            BF-EMB-LP3
FS      5  FKEM19       1       0       1 9999999   2   1   1   0   9  11
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMLPUL                20110301                         EMLPFIN
TO     13            ADD                                      EMLPULW2    CONT
TO     13            ADD                                      EMLPUSP2    CONT
TO     13            ADD                                      EMLPULS2    CONT
TO     13            ADD                                      EMLPULF2
***********************
***********EM Annual PULSE **********************************************************
** DETERMINE NUMBER OF DAYS THAT ARE OUTSIDE OF THE VARIOUS VOLUMES, TO TAKE INTO ACCOUNT THAT
** PULSE VOLUME WAS FOR A PERIOD OF LESS THAN 1 MONTH. AND DETERMINE FACTORS TO
** BE APPLIED TO BASE FLOWS TO REPRESENT THE PERIOD OF THE MONTH OUTSIDE OF PULSE
WRFKEM03          XMONTH20110301                                           BF-EMB-AP1
TO      2            ADD                  DAYSPY                                  CONT
TO      2            SUB                  EMLPND
WRFKEM03          XMONTH20110301                                           BF-EMB-AP2
```

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TO     6             ADD                                         BF-EMB-AP1    CONT
TO     2             DIV                   DAYSPY
WRFKEM03          XMONTH20110301                                         BF-EMB-AP3
TO    13             ADD                                          EMBASEFIN    CONT
TO     6             MUL                                         BF-EMB-AP2
**
** Developing pulse+base flow targets, Determining if Reg Flow at EDV712 exceeded target
WRFKEM20    6000  XMONTH20110301                                           FKEMAPUL
TO     6             ADD                                         BF-EMB-AP3
WRFKEM21          XMONTH20110301                                         EMANNONOFF
TO     2             ADD                   EDV712                              CONT
TO     6             DIV                                           FKEMAPUL
** ENGAGING  PULSE
IFEMAPFA    6000  XMONTH20110301                            EMAPLA1
TO     6             ADD                                         BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   5  1    6        1
IFEMAPFA    6000  XMONTH20110301   3                        EMAPLA2
TO     6             ADD                                         BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   0  1    6        1
IFEMAPFB    6000  XMONTH20110301                            EMAPLB1
TO     6             ADD                                         BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   5  7   12        1
IFEMAPFB    6000  XMONTH20110301   3                        EMAPLB2
TO     6             ADD                                         BF-EMB-AP3
FS     5  FKEM21       1       0       1 9999999   2   1   1   0  7   12        1
WRFKEM22              20110301                                           EMFRSTHALF
TO    13                                                             EMAPLA2
IFEMAPFB              20110301   3                          EMAPLB3
TO    13                                                             EMAPLB2
FS    10               0       1       1 9999999   2   1   1  11  1    6        1      EMFRSTHALF
** COMBINE TO CREATE IF FOR ENTIRE YEAR.
IFEMAPUL              20110301                              EMAPFIN
TO    13             ADD                                             EMAPLA2    CONT
TO    13             ADD                                             EMAPLB3
***********************
** END E-Flows for East Mustang Creek near Louise
*********************************
*********************************
*********************************
** COLLINS APPLICATION 5579
WR557901     200    557920020703   1                                  3          5579_1
SO                                                                    1
** Add perpetual water right, Application No. 5595, gw as an alternate source
IF  5595    2316       720000927                             IF5595
WR  5595    1550       320000927   1                                  3          5595_1
SO                                                                    1
** Add perpetual water right, Application No. 5706, Brandl, gw as alternate source
IF  5706    1664       720001001                             IF5706
WR  5706   104.4       320001001   1                                  3          5706_1
SO                                                                    1
** Add perpetual water right, Application No. 4353, Permit #4085, term conv. perp., gw as alternate
source
IFTDV911    2316       719830418                            IF911_1
WRTDV911     500       319830418   1                                  3          4085_1
SO                                                                    1
**Add perpetual water right, Application No. 5168, term conv. perp., gw as alternate source
IFDV1018    3040    101819880202                           IF1018_1
WRDV1018    1092       319880202   1   1    0.00  DV1018       3          5168_1
WSON1018       2    1.00   0.727    0.00
SO                                                                    1
WRDV1018     651       719880202   1   1    0.00  DV1018       3          5168_2
WSHP1018     334    1.00   0.727    0.00
SO           531     651                                              1
**
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**Add perpetual water right, Application No. 5370, term conv. perp. gw as alternate source
IFTDV916   722.7     91619910701                         IF916_1
WR537041     900       319910701   1   1    0.00  TDV916       3          5370_1
WSTSO917     356    1.00   0.727    0.00
SO           660     900  TDV916                               1
**Term water right, App. 4374 - Term Expired 12/31/03
**IFWDV887    1331   IF88719830613       1
**WRWDV887     400       319830613   1   2    0.00                          4046_1
**WSWSO886      98    1.00   0.727    0.00
**SO           672      98
**App. 5263, term converted to perpetual water right
IFEDV723    2896       719891121       1                  IF5263
WREDV724     140       319891121   1   1    0.00               3          5263_1
SO                                                             1
**
WR DV402       0       719870424   1   1    0.00                          5130_1
WS OS402    6.08    1.00   0.727    0.00
WRTDV332      33       319610228   1   1    0.00                          2096_1
WS OS332    12.0    1.00   0.727    0.00
IF DV301    8688        19830103       1                  IF3978
WR397841    1800       319830103   1   1    0.00                          3978_1
WS SO301   480.0    1.00   0.727    0.00
SO         529.6    1800   DV301
WR DV214  226.25       319391117   1   1    0.00                        61602099
WR DV214   452.5       319391117   1   1    0.00                          2098_1
IF DV214  4598.7   IF21419821122       1                  IF2098
WR DV214   747.5       319821122   1   1    0.00                          2098_2
WR DV215  226.25       319391117   1   1    0.00                        61602100
WR DV216      95       319391117   1   1    0.00                        61602097
WR DV213    0.14       219970424   1   1    0.00                          5584_1
WR DV212    1000       319391128   1   1    0.00                        61602101
WR DV211    0.02       219970424   1   1    0.00                          5584_2
WRTDV626       4       319541231   1   1    0.00                        61602075
WSTOS627    1.75    1.00   0.727    0.00
WR DV551    61.0       319490228   1   1    0.00                          2077_1
WR207741     4.0       319561231   1   1    0.00                          2077_2
WS SO552    10.0    1.00   0.727    0.00
SO            99       4   DV551
IF DV504  7240.0        19820208       1                  IF3912
WR391241     340       319820208   1   1    0.00   RF505                  3912_1
WS SO507   100.0    1.00   0.727    0.00
SO         265.4     340   DV504
WR DV501    1138       319030930   1   1    0.00                          2078_1
WR DV501     450       319381210   1   1    0.00                          2078_2
WRDV1042       0       719631007   1   1    0.00                        61602079
WSOS1042   455.0    1.00   0.727    0.00
WRDV1034     248       319381231   1   1    0.00                        61602080
WRDV1031  683.27       319550430   1   1    0.00                        61602081
IFDV1023  2801.7  IF102319811116       1                  IF3910
WR391041    1000       319811116   1   1    0.00                          3910_1
WSSO1024    63.0    1.00   0.727    0.00
SO         410.6    1000  DV1023
IFDV1021  3193.3  IF102119811116       1                  IF3905
WR390541    1332       319811116   1   1    0.00                          3905_1
WS O1021      84    1.00   0.727    0.00
SO         624.6    1332  DV1021
WRDV1020     932       319290331   1   1    0.00                        61602082
WRDV1002     623       319480510   1   1    0.00                          2083_1
WRDV1002    2400       319691027   1   1    0.00                          2083_2
IFDV1001  5444.5  IF100119850416       1                  IF4252
WR425241    5500       319850416   1   1    0.00               3        11604252
WSWOS824     4.9    1.00   0.727    0.00
SO        2651.5    5500  DV1001                               1
WRTDV901   400.0       319501110   1   1    0.00                        61602084
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** diversions for this water right are assumed to be at the most downstream diversion point
WRWDV817      13        319621231   1   1    0.00                           2085_1
IFWDV816   998.6   IF81619811116        1                  IF3906
WRWDV816     140        319811116   1   1    0.00                         11603906
WSWOS816    20.0    1.00   0.727    0.00
IFWDV815  1269.3   IF81519811116        1                  IF3904
WRWDV815      60        319811116   1   1    0.00                         11603904
IFWDV814   956.1   IF81419811116        1                  IF3908
WRWDV814     279        319811116   1   1    0.00                         11603908
** This water right has two diversion points and was
** modeled to take water from the main stem backed up by diversions from the trib
WRWDV813     282        319550430   1   1    0.00                           2086_1
SO                        WDV812
WRWDV811      84        319460430   1   1    0.00                         61602087
WSWOS811    20.0    1.00   0.727    0.00
WRWDV810      45        319240430   1   1    0.00                         61602088
WRWDV809      48        319660531   1   1    0.00                         61602089
WRWDV808     527        319560331   1   1    0.00                         61602090
IF DV503 11561.5   IF50319830222        1                  IF4102
WR DV503      57        319830222   1   1    0.00   RF502        3        11604102
SO                                                               1
IFWDV807  4413.3   IF80719850430        1                  IF4241
WR424141  272.63        319850430   1   1    0.00  WRF805        3        11604241
WSWSO806    25.2    1.00   0.727    0.00
SO         420.7  272.63  WDV807                                 1
WRWDV804     290        319530331   1   1    0.00                         61602091
IFWDV803  1448.0         19790129       1                  IF3665
WRWDV803     211        319790129   1   1    0.00                         11603665
WRWDV868     990        319450330   1   1    0.00                         61602092
IFWDV865   724.0         19800121       1                  IF3725
WRWDV865     420        319800121   1   1    0.00  WRF866                 11603725
IFWDV862   724.0         19810518       1                IF3876_1
IFWDV871     362         19810518       1                IF3876_2
**this water right has been modified to allow diversions from Porter's Creek with a backup from
Lookout Creek
WRWDV862     626        319810518   1   1    0.00  WRF863                   3876_1
WRWDV871                319810518   1   1    0.00  WRF863                   3876_2
BU
** this water right has been modified to allow diversions from the reservoir backed up by diversions
** from CPWDV855
IFWDV853   362.0         19811207       1                  IF3911
WRWDV853     400        319811207   1   1    0.00  WRF851                   3911_1
WSWOS854     2.4    1.00   0.727    0.00
SO                        WDV855
IFWDV843  2929.5   IF84319810526        1                  IF3836
WRWDV843     550        319810526   1   1    0.00  WRF844                   3836_1
WRWDV801    1750        319640731   1   1    0.00                         61602093
IFEDV726  3403.0         19811116       1                  IF3909
WR390941     350        319811116   1   1    0.00  ERF728                 11603909
WSWSO727    45.0    1.00   0.727    0.00
SO         148.8     350  EDV726
IFEDV723  2896.0         19800121       1                  IF3727
WREDV723     913        319800121   1   1    0.00  ERF722                 11603727
IFEDV721  3620.0         19811116       1                IF3907_1
WREDV721     640        319811116   1   1    0.00                           3907_1
WSEOS721     1.5    1.00   0.727    0.00
WREDV734   398.7        319520430   1   1    0.00                           2094_1
WREDV733   241.3        319520430   1   1    0.00                           2094_2
IFEDV731  3620.0         19811116       1                IF3907_2
WREDV731     520        319811116   1   1    0.00                           3907_2
WSEOS732     1.5    1.00   0.727    0.00
IFEDV712  1448.0         19811116       1                  IF3903
WREDV712     800        319811116   1   1    0.00  ERF711                 11603903
**
```

```
** Start Lake Texana (Navidad River)(no assumed return flows for Texana in BR's run1)
IFDV221B    3570        19720515       1       1             IF2
IFDV221A  346972  BAYEST19720515       1       2             IF1
WRDV221A   74500      TA19720515   1   1                                  C2095_1 TEXANA1
WSTEXANA  151919
**refill Texana to 45 after US irrigators divert
**priority date of re-fill is one day junior to the most junior US irrigator
WRDV221A       0        20020702   1                                  REFILLTXANA
WSTEXANA  170300
**refill done
**
WRDV221A   34560        20020702   1   1     1.0    NOUT               INTURUP1
WSTEXANA  170300                           151919
WR  NOUT   34560        20020702   1   1                       2        INTURUP2INTURUPT
SO           2800  12000
WR  NOUT   99000        20020702   1   1     1.0  DV221A                PAYBACK
** FINAL FILLUP FOR LAKE TEXANA
WRDV221A       0        20020702   1                                     REFILL
WSTEXANA  170300
** End Lake Texana
**
**AECOM comments out Stage II project
**Change priority date from 19720515 to 20170102 (two days junior to OCR)
**Change storage capacity from 62454 to 52046 to agree with Reservoir Site Protection Study (TWDB,
2008)
**
**begin Stage 2 of Texana Project
**WR WQ002    7150       120170102   1   1    0.00                        61602095_3 TEXANA2
**WSSTAGE2   52046
**WR WQ002   22850       220170102   1   1    0.00                        61602095_4 TEXANA2
**WSSTAGE2   52046
**WR WQ002   18122  BAYES119931006   1   1     1.0   20955                    2095_5
**
**WR WQ002   18122  BAYES119931006   1   1     0.0                          2095_5
**end Stage 2 of Texana Project
WR DV201    0.01       219970424   1   2    0.00                         5584_5
**
**
********************************************************************************
**AECOM diversion for Lavaca OCR (using storage/pumping recommended in 2011 Lavaca River Water
Supply
**Project Feasibility Study for LNRA)
**
WRWQ002A       0       120161231   1   1                                    Fill  NEWOCR
** 50,000 ac-ft capacity
WSNEWOCR   50000  0.0218       1  969.85
SO                         WQ002
** 200 MGD (224,182 ac-ft/yr) pump stations diversion rate.  ML record in ac-ft/mo.
ML 19027 17339.2 19027.1 18413.3 19027.1 18413.3 19027.1 19027.1 18413.3 19027.1 18413.3 19027.1
**
**     Modeled as new WR with Priority Date set at 12/31/2016
WRWQ002A 50000.0       120161231   3   1                                  NewWR1    9991
WSNEWOCR   50000
**end of diversion additions
********************************************************************************
********************************************************************************
**AECOM diversion for LNRA Brackish Surface Water (BSW) Diversion
**
**
**WRDVBSW1       0       120170101   1   1                                    Fill  NEWBSW
WRDVBSW1   25000       120170101   1   1                                  NewWR2
** 25,000 ac-ft capacity
**WSNEWBSW   25000  0.0024       1  969.85
**SO                        DVBSW1
```

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** 50 MGD (56,045 ac-ft/yr) pump stations diversion rate.  ML record in ac-ft/mo.
**ML 19027 17339.2 19027.1 18413.3 19027.1 18413.3 19027.1 19027.1 18413.3 19027.1 18413.3 19027.1
ML4756.8  4334.8 4756.76 4603.32 4756.77 4603.32 4756.77 4756.77 4603.32 4756.77 4603.32 4756.77
**
**     Modeled as new WR with Priority Date set at 01/01/2017
**WRDVBSW1 25000.0       120170101   3   1                                  NewWR2    9992
**WSNEWABSW   25000
**end of diversion additions
*************************************************************************************
**
** Lake Texana Area-Capacity Data
**
** area capacity of Texana based on revised table by TWDB from LNRA on March 14, 2001
** ELEVATION -13       0      10      13      18      24      30      36      39      43      44
45
**SVTEXANA  170300  161085  151919  118078   96096   60576   33860   14558    4634    1645      70
0
**SA         10484    9727    8974    7849    6824    5132    3820    2601    1354     634      23
0
SVTEXANA       0      70    1645    4634   14558   33860   60576   96096  118078  151919  161085
170300
SATEXANA       0      23     634    1354    2601    3820    5132    6824    7849    8974    9727
10484
**
****************************************************************************************************
***
** AECOM - Modify stage 2 reservoir to match Reservoir Site Protection Study (TWDB, 2008)
** area capacity of Stage 2 taken from HDR document to RPG dated 10/19/1999
**SVSTAGE2   62454   57676   40543   23475   11695    4980    1819     596     152       0
**SA          4887    4679    3888    2940    1774     914     352     138      40       0
** AECOM commented out
**SVSTAGE2       0     152     596    1819    4980   11695   23475   40543   57676   62454
**SASTAGE2       0      40     138     352     914    1774    2940    3888    4679    4887
**SVSTAGE2       0       5     161     507    1127    2927    8360   19182   35152   52046
**SA             0      16      49      92     159     609    1649    2725    3688    4564
**
****************************************************************************************************
********
** DROUGHT INDEX RECORDS for B&E when below 78.18% conservation
DI     1   0   1  TEXANA
IS     6       0   10000  100000  133140  133141  170300
IP           100     100     100     100       0       0
**
** DROUGHT INDEX RECORDS for B&E when above 78.18% conservation
DI     2   0   1  TEXANA
IS     6       0   10000  100000  133140  133141  170300
IP             0       0       0       0     100     100
**
** DROUGHT INDEX RECORDS water rights that have the 43 ft msl restriction.
DI     3   0   1  TEXANA
IS     6       0   10000  100000  151918  151919  170300
IP             0       0       0       0     100     100
**
** the following reservoirs are not associated with a water right
** and are included for possible future modeling needs
**WRTOS323       0       830000101
**WSTX5494     146    1.00   0.727    0.00
**WRTOS321       0       730000101
**WSTX3992     144    1.00   0.727    0.00
**WRTOS313       0       130000101
**WSTX3986     280    1.00   0.727    0.00
**WRTOS312       0       130000101
**WSTX3985     173    1.00   0.727    0.00
**WRTOS311       0       130000101
```

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**WSTX3984     144    1.00   0.727    0.00
**WR OS623       0        730000101
**WSTX6176     296    1.00   0.727    0.00
**WRTOS554       0        830000101
**WSTX3929     278    1.00   0.727    0.00
**WROS1003       0        830000101
**WSTX1571     108    1.00   0.727    0.00
**WROS1052       0        130000101
**WSTX3928     336    1.00   0.727    0.00
**WROS1051       0        130000101
**WSTX3977     250    1.00   0.727    0.00
**WROS1033       0        130000101
**WSTX3971     112    1.00   0.727    0.00
** End of .dat data input file
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Chapter 6 – Impacts of the Regional Water Plan

6.1 Scope of Work

The overall project scope consists of preparing a regional water supply plan for the Lavaca Regional Water Planning Group (LRWPG), representing all of Lavaca and Jackson Counties as well as the Precinct 3 and El Campo portions of Wharton County. LRWPG is one of 16 state water supply planning groups defined by TWDB. Regional Water Plans (RWP) prepared by each Regional Water Planning Group (RWPG) will be combined into a comprehensive state water plan.

This activity is part of a consensus-based planning effort to include local concerns in the statewide water supply planning process. This chapter presents the results of Task 6 of the Project Scope, which addresses:

- Evaluation of the estimated cumulative impacts of the RWP, for example on groundwater levels, spring discharges, bay and estuary inflows, and instream flows.
- Description of the impacts of the RWP regarding:
    - Agricultural resources;
    - Other water resources of the State including other water management strategies and groundwater and surface water interrelationships;
    - Threats to agricultural and natural resources;
    - Third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas;
    - Major impacts of recommended water management strategies on key parameters of water quality, and;
    - Effects on navigation.
- Summarization of the identified water needs that remain unmet by the RWP and the socioeconomic impacts of not meeting the identified water needs.

6.2 Cumulative Impacts of the Regional Water Plan

The cumulative impacts of the recommended water management strategies are discussed in this section. Overall, the recommended strategies keep the groundwater levels at a sustainable level and have no impact on spring flows. Instream flows and bay and estuary inflows are slightly reduced during times of drought as a result of drought management, conservation, and reuse strategies being implemented.

The cumulative impacts to the Lavaca Bay from the recommended strategies are shown in the following tables. Specifically, the Lavaca Off-Channel Reservoir and LNRA Desalination strategies were modeled. Because the locations of the two strategies are downstream of all of the instream flow measurement points, only the impacts to Lavaca Bay were evaluated.

Impacts to Lavaca Bay are evaluated by looking at four different inflow level conditions for three separate periods of the year. The first period is Spring, which includes three consecutive months starting in any month from January to May. The second period is Fall, which includes three consecutive months starting in any month from August to October. The third period is the Intervening Six Months that counts the months not used for the Spring and Fall periods. *Table 6-1* shows the target inflow goals in acre-feet for Subsistence, Base Dry, Base Average, and Base Wet conditions, and the associated target frequency goals.

Table 6-1 Lavaca Bay Freshwater Inflow Targets (acre-feet)

INFLOW LEVEL	STUDY TARGET FREQUENCY	SPRING (3 MONTH TOTAL)	FALL (3 MONTH TOTAL)	INTERVENING (6 MONTH TOTAL)
SUBSISTENCE	96%	13,500	9,600	6,900
BASE DRY	82%	55,080	39,168	28,152
BASE AVG	46%	127,980	91,080	65,412
BASE WET	28%	223,650	158,976	114,264

Table 6-2 shows how often the SB3 environmental flow standards are met for both the unmodified base TCEQ model (no strategies) and a model with the water management strategies included. The last column shows the impact the strategies have on the frequency with which the environmental flow standards are met.

Table 6-2 SB3 Environmental Flow Standard Frequency Attainment

SPRING ONSET FLOW CRITERIA MET (3 CONSECUTIVE MONTHS BEGINNING JAN-MAY)						
CRITERIA	TARGET	TCEQ BASE MODEL		STRATEGY MODEL		DIFFERENCE
	(AC-FT)	#YEARS	%	#YEARS	%	%
SUBSISTENCE	13,500	52	91%	52	91%	0.0%
BASE DRY	55,080	49	86%	49	86%	0.0%
BASE AVG	127,980	43	75%	42	74%	-1.8%
BASE WET	223,650	33	58%	32	56%	-1.8%

FALL ONSET FLOW CRITERIA MET (3 CONSECUTIVE MONTHS BEGINING AUG-OCT)						
CRITERIA	TARGET	TCEQ BASE MODEL		STRATEGY MODEL		DIFFERENCE
	(AC-FT)	#YEARS	%	#YEARS	%	%
SUBSISTENCE	9,600	49	86%	49	86%	0.0%
BASE DRY	39,168	41	72%	42	74%	1.8%
BASE AVG	91,080	28	49%	28	49%	0.0%
BASE WET	158,976	24	42%	24	42%	0.0%

INTERVENING SIX MONTHS FLOW CRITERIA MET						
CRITERIA	TARGET	TCEQ BASE MODEL		STRATEGY MODEL		DIFFERENCE
	(AC-FT)	#YEARS	%	#YEARS	%	%
SUBSISTENCE	6,900	53	93%	53	93%	0.0%
BASE DRY	28,152	48	84%	48	84%	0.0%
BASE AVG	65,412	36	63%	36	63%	0.0%
BASE WET	114,264	29	51%	27	47%	-3.5%

Note: Intervening Six Months includes the remaining Spring Onset and Fall Onset months that are not used for the 3 consecutive month calculation.

The two tables above show that the recommended strategies cause a small reduction in the number of times the flow targets are met under Base Average and Base Wet conditions (Springtime Onset and Intervening Six Months), although the frequency goals as shown in *Table 6-1* continue to be met for those conditions. The recommended strategies show a small positive impact to the number of times the flow targets are met under Base Dry conditions (Fall Onset). There are no impacts to Subsistence conditions.

6.3 Impacts of Water Management Strategies on Agricultural Resources, Water Resources, and Natural Resources

The LRWPG balanced meeting water needs with good stewardship of the water, agricultural, and natural resources within the Region. However, the LRWPG recognized the importance of recommending water management strategies that were of a realistic cost to Irrigation, the major water user in the region, and the category expected to experience all potential water shortages.

The general categories of the strategies examined include: Drought Management, Conservation, Off-Channel Reservoir, Expanded Aquifer Use, Effluent Reuse, Groundwater and Surface Water Desalination, Aquifer Storage and Recovery, and Dredging. Not all of these strategies were recommended in the plan. The effects of the recommended water management strategies on specific resources are discussed in further detail within this Section.

6.3.1 Agricultural

The Lavaca Regional Water Planning Area (LRWPA) currently has nearly 97,000 acres of irrigated agricultural land that requires a projected 175,636 ac-ft/yr of water for irrigation under Drought-of-Record (DOR) conditions. This demand is expected to remain relatively constant through 2070. The majority of this water is used for growing rice and represents the greatest water demand in the area. Due to the strong dependency of rice production on water supplies, Irrigation demand will be the most significant driver of water demands for the Region over the next 50 years.

The water management strategies introduced in *Chapter 5* of this RWP were created to meet the needs of all WUGs including agricultural needs. Due to the strong dependency of rice production on water supplies and the sensitivity of agriculture to increased costs in water, the LRWPG focused on economical and practical strategies for meeting water demands under DOR conditions.

The water management strategy Expanded Use of the Gulf Coast Aquifer would increase the availability of water for irrigation purposes, which would reduce the threat to agriculture. This strategy would be the most favorable for agriculture. However, the Expanded Use of the Gulf Coast Aquifer strategy is currently not recommended due to Modeled Available Groundwater (MAG) restrictions, but is included as an Alternative strategy in the RWP.

The water management strategies recommended by the LRWPG to meet irrigation needs are water Irrigation Conservation (On-farm) and Irrigation Conservation (Tail Water Recovery). On-farm conservation methods such as land leveling, well meters, conversion of irrigation ditches to pipelines, and others would reduce demand for irrigation water while supporting agriculture. Tail Water Recovery from irrigation field return flows may be cost prohibitive to agriculture.

The Lavaca Off-Channel Reservoir and LNRA Desalination strategies would have minimal impacts on agriculture given that the projects would remove only a small portion of land from agricultural production relative to the large quantity of agricultural land in the area.

Drought Management and Conservation for municipal water user groups would have very little positive impact to the amount of water available to meet irrigation needs in Wharton County. Conservation for Manufacturing would have no impact on agriculture. Reuse by El Campo could potentially reduce the return flows that downstream irrigators could use.

6.3.2 Other Water Resources of the State including Groundwater and Surface Water Interrelationships

Water resources available by basin within the LRWPA are discussed in further detail below. Note that the surface water basins listed below do not necessarily coincide with groundwater divides but are used for accounting purposes in the RWP.

6.3.2.1 Colorado River Basin

The Colorado River Basin contains a portion of the Gulf Coast Aquifer that is shared with Region K. The amount of water available from this source is sufficient to meet the municipal demands of a portion of El Campo located in this basin. This basin in Region K is also the source of water for a portion of the Garwood Irrigation Division in the Lavaca Region, located in Wharton County.

6.3.2.2 Colorado-Lavaca Coastal River Basin

The sustainable yield of the portion of the Gulf Coast Aquifer located in the Colorado-Lavaca River Basin of Wharton County was found to be sufficient to meet the demands of irrigators under DOR conditions. During drought conditions, the irrigation return flows from groundwater irrigation will provide an important resource for stream habitat.

The recommended conservation strategies for Irrigation in this basin would help to extend water supplies from the Gulf Coast aquifer during times of drought.

The only contracted surface water supply used within the LRWPA is up to 10,627 ac-ft/yr contract from LNRA for manufacturing use within the Colorado-Lavaca River Basin. This water is supplied from Lake Texana and represents the only water supply allocated within this basin and the entire region that does not originate from the Gulf Coast Aquifer.

6.3.2.3 Lavaca River Basin

Groundwater resources were found to be inadequate to meet the demands of irrigation WUGs in Wharton County. Expanding the use of the aquifer during times of drought was not recommended as a strategy in this planning cycle but is included as an alternative strategy in the plan. During drought conditions, the irrigation return flows from groundwater irrigation will provide an important resource for stream habitat. During average conditions, the reduced usage of groundwater would allow aquifer conditions to recover to normal levels.

The recommended conservation strategies for Irrigation in this basin would help to extend water supplies from the Gulf Coast aquifer during times of drought.

Lake Texana has a firm yield of 79,000 ac-ft/yr in 2020, or 74,500 ac-ft/yr after 4,500 ac-ft/yr of environmental flows are accounted for. This firm yield decreases to 73,290 ac-ft/yr (after 4,500 ac-ft/yr of environmental flows) by 2070. Approximately 31,000 ac-ft of this volume continues to be an important supply for the City of Corpus Christi in the Coastal Bend Region. Contracts to manufacturing users make up close to an additional 43,000 ac-ft/yr. The manufacturing contracts mentioned above in the Colorado-Lavaca River Basin are included in these contracts.

The recommended Lavaca Off-Channel Reservoir and LNRA Desalination strategies would increase the available surface water in the region for use by LNRA customers.

6.3.2.4 Lavaca-Guadalupe Coastal Basin

The Lavaca-Guadalupe Coastal Basin has sufficient water supplies in the Gulf Coast Aquifer to meet the municipal, agricultural, and industrial demands of the basin.

6.3.2.5 Guadalupe River Basin

A small portion of the Guadalupe River Basin is present within Lavaca County. The minor domestic and agricultural demands in this basin are met with groundwater supplies from the Gulf Coast Aquifer.

6.3.3 Natural Resources

The water management strategies recommended in this RWP are intended to protect natural resources while still meeting the projected water needs of the region. The quantitative environmental impacts of the individual water management strategies discussed in *Chapter 5* varied from positive impact to minimal or no impact to negative impact. A discussion of the individual environmental impacts can be found in *Chapter 5*.

The most common impact for the conservation strategies is reduced stream flow from irrigation return flows and a possible reduction of habitat of migratory birds. In addition, implementation of some of these strategies will reduce reliance on groundwater pumping which will alleviate stress on the groundwater in the area.

The Lavaca Off-Channel Reservoir would capture a portion of pulse flows. While the SB3 environmental flow requirements are implemented, the LRWPG acknowledges that the reservoir would have some impact in the pulse flow volume of water reaching the bay. A permitted freshwater release schedule would provide an opportunity to return water to creeks during times of drought, benefitting wildlife habitat. Although siting of the project will remove a portion of total agricultural land from production, it is minimal given the large quantity of agricultural land in the area. In addition, the reservoirs would provide wildlife habitat.

Effluent Reuse by El Campo would reduce the amount of water being returned to the stream. During dry times when there is little flow, this strategy would have a greater impact.

LNRA Desalination would require increased permitting and would remove a portion of total agricultural land in the area, but the groundwater and treated brackish surface water may ultimately make it into the river and bay as return flows.

6.3.4 Third-party Social and Economic Impacts resulting from Voluntary Redistributions of Water

The 2021 Lavaca Regional Water Plan has no water management strategies involving voluntary redistributions of water.

6.3.4.1 Moving Water from Rural and Agricultural Areas

Water demand is generally constant over the planning period with estimated water usage for rural (livestock) and agricultural representing 89% of the total water used in the LRWPA in 2070.

The potential impacts of moving water from rural and agricultural areas are mainly associated with socio-economic impacts to these third parties. As noted previously, much of the water demand for Irrigation in the LRWPA is associated with rice production. While other crops, such as corn, cotton, milo, and similar row crops can be grown either with or without irrigation, no such option exists for rice. In addition, the type of land that is suitable for rice is such that it is often difficult for rice producers to find an alternative crop for those years when the land is being rested from rice production. This results in more intensive economic pressure, since the production from this land for any other crop is marginal at best.

In much of the LRWPA, the marginal quality land has already been forced out of rice production because of economic conditions. It is further noted that for most agricultural commodities, the price is highly variable. For this reason, the farmers need the flexibility to plant additional acreages during periods of higher than normal prices to try to recover from years with marginal economics. If the water needed to produce additional acreage is no longer there because it has been sold to a municipality, the economics of farming is further impacted.

One additional area of concern from an economic standpoint is the current decline in the infrastructure to support the rice industry. Further decreases in rice production of even a temporary nature further threaten the economic picture for the support industries of milling, hauling, etc. Once infrastructure for milling is taken out of service, it increases the cost of doing business for the remaining producers in the area.

6.4 Impacts of Water Management Strategies on Key Parameters of Water Quality

The potential impacts that water management strategies (WMS) may have on water quality are discussed in this section, including the identified water quality parameters which are deemed important to the use of the water resources within the LRWPA.

Under the Clean Water Act, the State of Texas must define designated uses for all major water bodies and, consequently, the water quality standards that are appropriate for that designated water use.

Key water parameters identified within the LRWPA are:

- Bacteria
- pH
- Dissolved Oxygen (DO)
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Chlorides
- Nutrients (nitrogen, phosphorus)
- Salinity

The water quality parameters and water management strategies selected by the LRWPG were evaluated to determine the impacts on water quality as a result of these recommended strategies. This evaluation used the data available to compare current conditions to future conditions with the recommended water management strategies in place.

For the LRWPA, the predominant water use is for agricultural purposes, with 89 percent of the water used for irrigation and livestock watering. As a result of the predominance of agricultural water use, the Lavaca Region is very price sensitive, and the review of water management strategies tends to focus heavily on cost. If the price is too high, the strategy will not be implemented because the users will be unable to afford it.

6.4.1 Water Quality Overview

Water quality records were obtained from the TWDB for wells completed in the Chicot, Evangeline, and Jasper Aquifers in the LRWPA, as part of previous regional water planning efforts. Records available from the TWDB include water quality data dating back to the 1930s through 2005, with limited data available for 2009. Updates for this cycle showed some additional data for 2013 and 2017. Of the key water parameters identified in the LRWPA, the TWDB includes records for pH, TDS, and chloride for groundwater. Irrigation, domestic, municipal, manufacturing, and steam-electric supplies are the main uses for water in the LRWPA.

The most recent TWDB water chemistry results available are from 2017. Data from the TWDB show that the groundwater in the Lavaca Region continues to be of generally good quality and that the quality has not changed significantly throughout the years. Recent data indicate TDS levels generally range from about 300 to 900 mg/L in wells within the Lavaca Region. The principal constituents are generally bicarbonate with smaller amounts of calcium, sodium, chloride, and sulfate. The chloride values generally range from about 30 to 350 mg/L in wells sampled in 2017. This range has expanded somewhat since the last planning cycle. The pH of the water ranges from 6.6 to 7.7 in the samples taken in 2017.

Analysis of the TWDB water quality data does not indicate substantial areas where the groundwater quality is changing. There are a few industrial wells located in the very southern part of Jackson County along SH 35 that have chloride levels that have increased some over the years. The wells are located near Carancahua Bay where there is a limited thickness of fresh groundwater.

Comparison of available water quality records for periods of high use in the LRWPA during the 1980s to the recent 2017 TWDB water quality records do not indicate a significant change in the water quality. Available data for wells sampled in the 1980s and more recent years have water quality constituents with mostly similar values with only some minor differences noted. Samples taken from wells in 2017 that are located near wells sampled in the late 1970s through late 1990s also tend to have similar reported values for the water quality constituents.

Chemical analyses available for wells within the LRWPA portion of Wharton County show TDS that averaged about 495 mg/L in the period of the early 1980s and averaged about 596 mg/L for samples collected in 2017. The data shows a small increase in the overall mineralization of the water over this time period. The Chicot and Evangeline Aquifers provide a prolific water source within most of the LRWPA, and the Jasper Aquifer provides groundwater in the northern and central parts of Lavaca County.

6.4.2 Conservation Impacts

While conservation strategies are recommended in this plan for meeting Irrigation needs, it should be noted that there may be implementation issues. Conservation works well as a strategy for those farms which are family owned and operated and for as long as matching grants are available through EQIP. EQIP provides funding for conservation in the rice industry through grants for precision leveling and multiple inlets as well as canal lining. Additional support to further reduce the out-of-pocket costs to the farmer is also needed to ensure more widespread implementation of water conserving practices. While the EQIP grants are helpful, it is still difficult for farmers to justify the expense of the remaining 50 percent matching share. SWIFT funding from the TWDB may be an option for farmers, by providing low-interest loans for funding conservation measures, although a political subdivision would need to apply for the funds on their behalf.

It is also noted that much of the region relies upon tenant farmers who have only a year-to-year contract with a landowner. Typically, tenant farmers are unwilling to put up any money for conservation purposes since they may not be able to gain the benefit of the improvements beyond the year in which they are built. In addition, since there is an agricultural shortage and not a municipal shortage in the region, there is not an incentive for any of the municipalities to pay for on-farm conservation in exchange for the water saved. Whoever pays for the conservation will have to take less water than the amount of water saved in order for there to be any additional water for resolving the shortages.

Water conservation, including municipal, industrial, and agricultural, can have a positive impact on water quality under some conditions but a negative impact during other conditions. Conventional municipal and industrial wastewater treatment plants are strictly regulated with regard to suspended solids and oxygen demanding materials. A wastewater treatment plant that provides lower flows with the same limits on suspended solids and oxygen demanding materials will put fewer pounds of these materials in the waters of the state. However, these plants face much less regulation on dissolved solids in the effluent if, in fact, dissolved solids are regulated at all. Municipal and industrial conservation will likely cause increases in dissolved solids concentrations because the dilution with freshwater is less. As a result, discharge of more concentrated effluent from a dissolved solids standpoint during dry weather conditions may have a negative effect on water quality.

Water that is applied to irrigated acreage carries nutrients, sediments, salts, and other pollutants from the farmland. While it is intuitive that reduced flow could have a positive impact on water quality, it is possible that the same dissolved solids loadings noted above could also provide a potential negative impact. In the case of irrigation return flows, however, the discharge of these flows tends to occur during low streamflow conditions, and the water from this discharge provides additional needed streamflow for environmental purposes during these times.

A review of the TCEQ Water Availability Model (WAM) for the Lavaca River Basin identified a number of stream segments that have no streamflow during the driest months of prolonged drought. Since all of the municipal water, some of the manufacturing water, and 80 percent or more of the irrigation water is derived from groundwater, the reduction of the return flows through conservation will have a negative impact on stream flows during the DOR.

Municipal and manufacturing return flows are returned to the stream throughout the year, except for the surface water that is sent to water users outside of the region, but they are more or less constant in both the wetter and drier months depending upon the condition of the individual wastewater collection systems. The agricultural return flows occur primarily in early spring and then again in July. The July return flows are particularly important since July is a historically dry month, and the return flows can often be the only flow moving in a stream reach at that time.

Dry land agriculture would also have a similar effect on stream habitat by denying return flows to stream segments in the lower basin. The land in the LRWPA is also of such a type that makes it of limited value for economically producing large volumes of crops other than rice, and the infrastructure in place for rice production could not be easily converted for other crops.

6.4.3 Impacts of the Recommended Management Strategies

The water quality parameters and water management strategies were evaluated to determine the impacts on water quality as a result of these recommended strategies. This evaluation used the data available to compare current conditions to future conditions with management strategies in place. The recommended management strategies, as described in Chapter 5 and used in this evaluation, are:

- Drought Management (Municipal Utilities Only)
- Irrigation Conservation (On-farm and Tail Water Recovery)
- Municipal Conservation
- Manufacturing Conservation
- Reuse of Municipal Effluent (El Campo)
- Lavaca Off-Channel Reservoir
- LNRA Desalination

The following paragraphs discuss the impacts of each management strategy on the chosen water quality parameters.

Drought Management (Municipal Utilities Only), would have little to no impact on other water sources of the State.

Irrigation, Municipal, and Manufacturing Conservation can have both positive and negative impacts on water quality. Water that is being processed through a wastewater treatment plant typically has acquired additional dissolved solids prior to discharge to the waters of the State. Conventional wastewater treatment reduces suspended solids but does not reduce dissolved solids in the effluent. Water conservation measures will reduce the volume of water passing through the wastewater treatment plants without reducing the mass loading rates (a 1.6-gallon flush carries the same waste mass to the treatment plant that a 6-gallon flush once carried). This may result in increased constituent loads to the wastewater treatment plants. In the event that, over time, water conservation causes changes to wastewater concentrations, treatment processes may need to be adjusted to maintain permitted discharge parameters. It should be noted that during low flow conditions, the wastewater effluent in a stream may represent water that helps to augment and maintain the minimum stream flows.

For irrigation conservation, there will be reduced stream flow from irrigation return flows which may reduce habitat for migratory birds. Tail water may carry nutrients, sediments, salts, and other pollutants from the farmland. This return flow can have a negative impact on water quality, and by implementing conservation measures which reduce tail water losses, the nutrient and sediment loading can be reduced. However, this return flow tends to be introduced into the receiving stream during normally dry periods so it may have a net beneficial effect in terms of maintaining minimum stream flow conditions.

Reuse of Municipal Effluent (El Campo) is a strategy to help meet future growth and subsequent water supply shortages. The yield amounts are relatively low, so impacts would be low. The municipality anticipates using direct reuse with piping to move water to the location of shortage. However, reusing the treated effluent rather than discharging it to the creek would reduce return flows to the local creeks.

Lavaca Off-Channel Reservoir potentially will have a positive impact on water quality since it will operate as a "scalping reservoir." The water that is diverted and stored in reservoirs would allow some sediment to settle out, so that water released from the reservoir would be of higher quality. However, instream flows along with bay and estuary freshwater inflows would slightly decrease. A schedule for freshwater releases would be established during permitting of the project to meet TCEQ environmental flow standards. In general, increased return flows will occur in this Region as demands increase, and this increase in return flows will continue to occur during low flow events, thus, potentially increasing instream flows during DOR conditions.

LNRA Desalination will provide a usable water supply with a level of dissolved solids low enough for multi-use purposes. A significant side effect of this strategy is the disposal of wastes generated from the desalination process. A permit would be required for disposing the brine. LNRA customers are currently surface water users, so the increased use from groundwater would increase return flows to the streams.

6.5 Impacts of Water Management Strategies on Navigation

Due to the nature of the strategies recommended in the 2021 Lavaca Regional Water Plan, there are no anticipated impacts to navigation.

The conservation, drought management, and reuse strategies recommended in the RWP may reduce some return flows to the streams but should not impact navigation. The Lavaca Off-Channel Reservoir that is recommended in the RWP will not impact navigation as it is off-channel.

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Chapter 7– Drought Response Information, Activities and Recommendations

This chapter presents all necessary requirements for drought management and contingency plans, as well as a summary of information provided by water systems in the Lavaca Regional Water Planning Area regarding drought, including preparations and response throughout the Region.

Drought Definitions

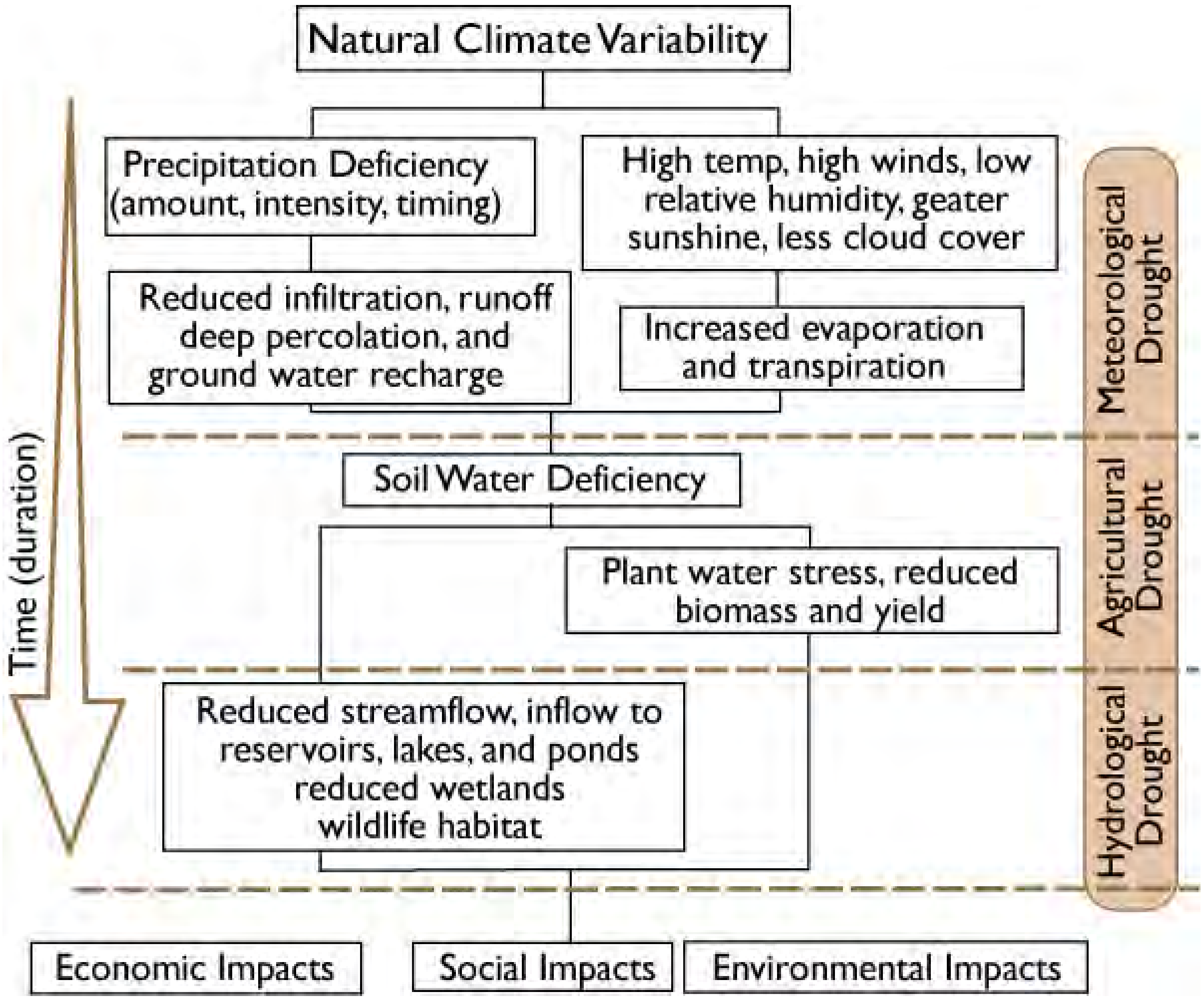
Drought is often referred to as a slow-moving emergency. The impact of droughts can be far-reaching but can be challenging to define due to the gradual and sometimes subtle progression of severity, as well as the tendency for temporal and geographic variations as isolated rain events shift perception of the drought severity. The types of droughts are sometimes characterized as meteorological, agricultural, and hydrological, which are leading events to the recognized socioeconomic impacts of drought. These drought terms are integrated and ordered such that as one type of drought intensifies it may lead to the development of another category of drought. The following definitions of categories of drought are taken from the State of Texas Drought Preparedness Plan and are further reflected in *Figure 7-1* on the next page:

- A meteorological drought is often defined as a period of substantially diminished precipitation duration and/or intensity that persists long enough to produce a significant hydrologic imbalance. The commonly used definition of meteorological drought is an interval of time, generally of the order of months or years, during which the actual moisture supply of a given place consistently falls below the climatologically-appropriate moisture supply.
- Agricultural drought occurs when there is inadequate precipitation and/or soil moisture to sustain crop or forage production systems. The water deficit results in serious damage and economic loss to plant or animal agriculture. Agricultural drought usually begins after meteorological drought but before hydrological drought and can also affect livestock and other agricultural operations.
- Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow, and as lake, reservoir, and groundwater levels. There is usually a time lag between a lack of rain or snow and less measureable water in streams, lakes, and reservoirs, making hydrological measurements not the earliest indicator of drought.
- Socioeconomic drought occurs when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product.

Determining if a dry weather pattern substantiates a meteorological drought requires an area-specific analysis that is first typically signified by dry meteorological patterns. Short intervals of dry patterns are considered within the norm of meteorological variation (seasonally and annually), so it is important to note that a true meteorological drought is dependent on the area in which it occurs.

In areas where surface and/or groundwater supplies are full at the start of a dry pattern there is often minimal impact in residential lifestyle or economic and agricultural activity. However, as dry pattern intensities deepen and duration of the meteorological drought continues and water supplies are stressed, the impacts of meteorological drought transition and begin to indicate other drought categories.

Figure 7-1 Categories of Drought and Natural Climate Variability



Source: National Drought Mitigation Center website "What is Drought?"

7.1 Drought of Record in Regional Water Planning Area

The definition of Drought of Record is "the period of time when historical records indicate that natural hydrological conditions would have provided the least amount of water supply," per TAC Title 31, Part 10, Chapter 357, Subchapter A, Rule 357.10.

Hydrological droughts are established using Water Availability Models (WAM) developed by the TCEQ. The Lavaca River Basin WAM is the model used for determining the Drought of Record in the Lavaca Region.

7.1.1 Current Drought of Record

Within the Lavaca Regional Water Planning Area, the Drought of Record (DOR) is most specifically associated with the hydrologic conditions of the Lake Texana. While Lake Texana was not yet constructed in the 1950s, the lake's performance under a repeat of Drought of Record conditions can be analyzed using the TCEQ Lavaca River Basin WAM. The current DOR for Lake Texana is defined as beginning in December 1952 and lasting through April 1957.

7.1.2 Potential New Drought of Record

While the recent year 2011 was an extremely dry year throughout the State and the lake levels in Lake Texana fell dramatically, the region recovered in such a way as to remove the potential for a new drought of record.

7.2 Current Drought Preparations and Response

In addition to regional or statewide droughts, entities may be subject to localized drought conditions or loss of existing water supplies due to infrastructure failure, temporary water quality impairment, or other unforeseen conditions. Loss of existing supplies, while relatively uncommon, is particularly challenging to address as the causes are often difficult to anticipate. Numerous entities within the Lavaca Region have DCPs which include an emergency response stage and corresponding measures for droughts exceeding the DOR or for other emergency water supply conditions.

Drought contingency plans were obtained from the municipal water providers in LRWPA during the last planning cycle to serve as a summary of existing drought planning within LRWPA. The majority of drought contingency plans for municipal water providers are included in their city ordinances. Those ordinances were reviewed again this cycle for any changes. El Campo approved a 2019 version of their Drought Contingency Plans. The drought contingency plan for the only MWP in the region, LNRA, was also compiled into this regional summary. During the last planning cycle, attempts were made to survey all of the municipal water providers by phone in order to assess what types of drought measures had been enacted during the earlier part of the planning cycle, including 2011, which was the year the municipal demand projections are based from. Survey results showed that drought conditions in the region had not been severe enough to cause the municipal water providers to enact any drought response measures. Drought measures have not been implemented during this cycle either, as conditions have been milder.

The Drought Contingency Plans show that a variety of triggers have been specified by the different water supplies as initiators of water shortage conditions. These triggers include a threshold level of total water use, well levels, and conditions caused by mechanical failure of water service systems. Strategies planned for dealing with drought conditions included restrictions on water use for irrigation, vehicle washing, and construction. The amount of water saved for each drought response conditions varied by community. The RWPG did not identify any unnecessary or counterproductive variations in specific drought response strategies that may confuse the public or otherwise impede drought response efforts.

Table 7-1 provides the drought triggers for a Severe Water Shortage and the Critical/Emergency Water Shortage for water users in the region, as available from the Drought Contingency Plans. The water reduction goals for the triggers are also included. Municipal water users exclusively rely on the Gulf Coast aquifer. Some manufacturing water users in Jackson County follow LNRA's triggers.

Table 7-1 Summary of Current Drought Triggers in the Lavaca Region

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
EDNA	JACKSON	LAVACA	GULF COAST AQUIFER	Total daily water demand >= 1.75 MGD for 3 consecutive days or 2.0 MGD for 1 day	Total demand reduction of 15%	Total daily water demand >= 2.0 MGD for 3 consecutive days or 2.25 MGD for 1 day	Total demand reduction of 20%
GANADO	JACKSON	LAVACA	GULF COAST AQUIFER	Water supply is equal or less than 70% of storage; pumping in wells is equal or less than 370 feet in Well #4 or 180 feet in Well #5; total daily demand equals or exceeds 250,000 gallons for 3 days or 500,000 gallons on a single day	Total demand reduction of 20%	Mayor determines the existence of a water supply shortage or water pressure deficit.	Limited lawn watering schedules or the elimination of all lawn watering
COUNTY-OTHER	JACKSON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
COUNTY-OTHER	JACKSON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
COUNTY-OTHER	JACKSON	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
MANUFACTURING	JACKSON	COLORADO-LAVACA	TEXANA LAKE/ RESERVOIR	Reservoir Conservation Pool elevation equal to or less than 33.58 feet msl, in accordance with the LNRA DCP; or, the LNRA Board declares a drought worse than the Drought of Record or other water supply emergency and orders the mandatory curtailment of firm water supplies; or, upon notification from LNRA that it is implementing Stage 3 of the LNRA DCP.	Pro-rata water use reduction based on reservoir capacity: 50% capacity - 10% reduction; 40% capacity - 20% reduction; 30% capacity - 35% reduction; 20% capacity - 50% reduction	Contamination of water supply source; or catastrophic event causing failure or damage to structures; or causing emergency evacuation of reservoir; or any other emergency conditions determined by LNRA Board	Pro-rata water use reduction based on reservoir capacity: 50% capacity - 10% reduction; 40% capacity - 20% reduction; 30% capacity - 35% reduction; 20% capacity - 50% reduction
MANUFACTURING	JACKSON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	JACKSON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	JACKSON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	JACKSON	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
IRRIGATION	JACKSON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
IRRIGATION	JACKSON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
IRRIGATION	JACKSON	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	JACKSON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	JACKSON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	JACKSON	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
HALLETTSVILLE	LAVACA	LAVACA	GULF COAST AQUIFER	When pumpage of the City wells is equal to or greater than 1.5 mgd per day for 3 consecutive days.	30% reduction in total water use.	When pumpage of the City wells is equal to or greater than 1.75 mgd per day for 3 consecutive days.	40% reduction in total water use.
MOULTON	LAVACA	LAVACA	GULF COAST AQUIFER	Static water level in well #1, 2 drops to 250 ft below ground level; well #3 drops to 205 ft below ground level; well #4 drops to 165 ft below ground level and/or capacity of pumpage output is <= 70% of original capacity and/or loss of two or more wells due to mechanical failure	Total demand reduction of 20%	Static water level in well #1, 2 drops to 260 ft below ground level; well #3 drops to 215 ft below ground level; well #4 drops to 175 ft below ground level and/or capacity of pumpage output is <= 60% of original capacity and/or loss of two or more wells due to mechanical failure	Total demand reduction of 25%

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
SHINER	LAVACA	LAVACA	GULF COAST AQUIFER	Emergency Water Demand Management Program, based on weather conditions or 90% of City's plant capacity.	Limit all consumption by citizens either using a fixed percentage of prior month usage or a maximum number of gallons per meter per week.	Emergency Water Demand Management Program, based on weather conditions or 90% of City's plant capacity.	Limit all consumption by citizens either using a fixed percentage of prior month usage or a maximum number of gallons per meter per week.
YOAKUM	LAVACA	LAVACA	GULF COAST AQUIFER	Daily usage equals or exceeds 3.42 mgd, or 100% of the current safe production capacity of the water system for 2 consecutive days.	Achieve 30 percent reduction in total water use.	Daily usage equals or exceeds 3.6 mgd, or 95% of the current safe production capacity of the water system for 2 consecutive days.	Achieve 40 percent reduction in total water use.
COUNTY-OTHER	LAVACA	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
COUNTY-OTHER	LAVACA	GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
MANUFACTURING	LAVACA	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	LAVACA	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	LAVACA	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
IRRIGATION	LAVACA	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	LAVACA	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	LAVACA	LAVACA-GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	LAVACA	GUADALUPE	GULF COAST AQUIFER	NA	NA	NA	NA
EL CAMPO	WHARTON	COLORADO	GULF COAST AQUIFER	Total daily demand equals or exceeds 4.5 MGD for 3 consecutive days or 5.0 MGD on a single day	Achieve a 15% reduction in daily water pumpage	Total daily demand equals or exceeds 5.0 MGD for 3 consecutive days or 5.5 MGD on a single day	Achieve a 20% reduction in daily water pumpage
EL CAMPO	WHARTON	COLORADO-LAVACA	GULF COAST AQUIFER	Total daily demand equals or exceeds 4.5 MGD for 3 consecutive days or 5.0 MGD on a single day	Achieve a 15% reduction in daily water pumpage	Total daily demand equals or exceeds 5.0 MGD for 3 consecutive days or 5.5 MGD on a single day	Achieve a 20% reduction in daily water pumpage
EL CAMPO	WHARTON	LAVACA	GULF COAST AQUIFER	Total daily demand equals or exceeds 4.5 MGD for 3 consecutive days or 5.0 MGD on a single day	Achieve a 15% reduction in daily water pumpage	Total daily demand equals or exceeds 5.0 MGD for 3 consecutive days or 5.5 MGD on a single day	Achieve a 20% reduction in daily water pumpage
WHARTON COUNTY WCID 1	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
COUNTY-OTHER	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MANUFACTURING	WHARTON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
MINING	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
IRRIGATION	WHARTON	COLORADO-LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
IRRIGATION	WHARTON	COLORADO-LAVACA	LCRA - GARWOOD (ROR)	NA	NA	NA	NA
IRRIGATION	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
LIVESTOCK	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA
STEAM-ELECTRIC*	WHARTON	LAVACA	GULF COAST AQUIFER	NA	NA	NA	NA

*Steam-Electric responses to drought may be subject to the Electric Reliability Council of Texas (ERCOT) requirements.

7.3 Existing and Potential Emergency Interconnects

The guidance provided by the Texas Water Development Board states that "RWPGs will collect information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water. RWP shall include a description of the RWPG methodology used to collect emergency interconnects information and the number of existing and potential emergency interconnects in the RWPA, including who is connected to whom. Detailed emergency interconnect information must be kept confidential in accordance with TWC 16.053(r) and should be provided separately and confidentially to the EA of the TWDB. Any information regarding the location or descriptions of facilities should be excluded from the plan."

During the last planning cycle, in order for the Lavaca Regional Water Planning Group to comply with this requirement, a request letter was mailed to seven major water infrastructure facilities within the region. The intent of the letter was to obtain information on whether the facilities' water system currently have access to, or the ability to provide, an emergency water supply through an interconnect with another water system.

The RWPG received six responses to the seven request letters. Each response stated that the municipality had no emergency interconnect.

In order to confirm there have been no updates since the last planning cycle, this cycle the Region P consultant submitted an information request to the TCEQ for information on emergency interconnects within the counties in Region P. The data that the TCEQ provided showed no interconnects within the Lavaca Regional Water Planning Area.

As no emergency interconnect data exists within the region, no data was passed along confidentially to the TWDB Executive Administrator. As no emergency interconnects exist in the region, there was no mention of emergency interconnects in the various Drought Contingency Plans that were reviewed.

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

Emergency preparedness is of particular importance for entities that rely on a sole-source of water for supply purposes. In instances where water systems rely exclusively on a single source, the State of Texas has identified a need to develop emergency preparedness protocols should source availability be significantly and suddenly reduced for any reason, including drought, equipment failure, or accidental or deliberate source contamination.

The Texas Administrative Code (31 TAC §357.42) requires that regional planning groups evaluate potential emergency responses to drought conditions or loss of existing water supplies for municipal Water User Groups (WUGs) with a 2010 population of less than 7,500 and with a sole-source of water, as well as all county-other WUGs.

A list of identified single-source WUGs with population of less than 7,500 and all county-other WUGs is included in *Table 7-2*, with potential emergency supply options and implementation requirements identified as applicable. Due to limited water sources, individual rural well owners, and large distances between municipalities in the region, the emergency supply options are reduced to trucking in water and drilling a new well.

Table 7-2 Potential Emergency Supplies for Sole-Source Municipal WUGs under 7,500 in Population and all County-Other

Entity					**Potential Emergency Water Supply Source(s)**								**Implementation Requirements**				
Water User Group Name	County	2010 Census Population	2020 Population	2020 Demand (AF/year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	Type of infrastructure required	Entity providing supply	Other local entities required to participate/ coordinate	Emergency agreements/ arrangements already in place?	other
EDNA	**JACKSON**	5,499	5,747	891			X					X	well				
GANADO	**JACKSON**	2,003	2,080	270			X					X	well				
COUNTY-OTHER	**JACKSON**	6,573	6,779	695			X					X	well				
HALLETTSVILLE	**LAVACA**	2,550	2,820	669			X					X	well				
MOULTON	**LAVACA**	886	874	180			X					X	well				
SHINER	**LAVACA**	2,069	2,054	480			X					X	well				
YOAKUM	**LAVACA**	3,677	3,701	662			X					X	well				
COUNTY-OTHER	**LAVACA**	10,081	9,814	1,208			X					X	well				
WHARTON COUNTY WCID 1	**WHARTON**	1,014	1,076	177			X					X	well				
COUNTY-OTHER	**WHARTON**	4,085	3,448	447			X					X	well				

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

7.5.1 Region-Specific Drought Response Recommendations

The Lavaca Regional Water Planning Group (LRWPG) acknowledges that the Drought Contingency Plan for the Lavaca-Navidad River Authority (LNRA) is the best drought management tool for surface water supplies in the Lavaca Region. LNRA uses multiple triggers at each stage that include water surface elevations of the lake as well as a broad trigger that allows for any additional scenario that would cause the LNRA to notify its customers that a drought stage has been triggered. Please see *Table 7-1* for severe and critical/emergency triggers and responses associated with LNRA customers.

The majority of the region uses groundwater as their main source of supply. Throughout the region, the Drought Contingency Plans for groundwater users are developed specifically to their use and location. Aquifer properties can vary across the region and it can be difficult to require the same triggers for all users of a particular groundwater source that covers several counties. The LRWPG acknowledges that the municipalities that use groundwater have the best knowledge to develop their Drought Contingency Plan triggers and responses. Please see *Table 7-1* for severe and critical/emergency triggers and responses associated with groundwater users in the region. Even so, the LRWPG encourages ongoing coordination between groundwater users, Groundwater Conservation Districts, and the Groundwater Management Areas to monitor local conditions for necessary modifications to the Drought Contingency Plans.

7.5.2 Region-Specific Model Drought Contingency Plans

Model Drought Contingency Plans addressing the requirements of 30 TAC §288(b) were developed for the Lavaca Region and are available in *Appendix 7A*. Model plans were developed for wholesale water providers, water utilities, and irrigation users. The Drought Preparedness Council recommendations included developing a region-specific model drought contingency plan for all water use categories in the region that account for more than 10 percent of water demands in any decade over the 50-year planning horizon. The only water use category that meets that requirement in Region P is the Irrigation water use category. The model plans were developed by starting with the TCEQ's template and making modifications to the template to acknowledge coordination with the Lavaca Regional Water Planning Group and to make the template more source-specific to the region.

7.6 Drought Management Strategies

Drought management can be implemented as a water management strategy to reduce water demands during times of drought. While there were no identified municipal or manufacturing water needs in the region, drought management was considered by the RWPG as a potential strategy based on identified water reduction goals in the Drought Contingency Plans. For the WUGs in the region with identified water needs, which included Irrigation in Wharton County, it was determined that reducing water demands during times of drought could potentially help meet those needs. This was done by looking at rolling out polypipe temporarily to reduce water use during times of drought. See *Chapter 5* for additional details.

7.6.1 Recommended Drought Management Strategies

Drought Management is recommended as a strategy for the municipal utility WUGs in the region. While no water needs exist, the LRWPG supports municipalities following their Drought Contingency Plans and the responses to the various drought triggers identified in their Drought Contingency Plans. Drought Management is recommended for Edna, Ganado, Hallettsville, Moulton, Shiner, Yoakum, El Campo, and Wharton County WCID 1.

7.6.2 Alternative Drought Management Strategies

Drought Management is included as an alternative strategy for Manufacturing in Jackson County. This strategy identifies that there is a portion of the manufacturing sector in Jackson County that purchases surface water from the Lavaca-Navidad River Authority (LNRA). Under drought conditions, LNRA may pose restrictions on surface water use, based on its Drought Contingency Plan. If the manufacturing sector is unable to find additional water to meet its manufacturing demands, it may be forced to cut back, and having to do so will likely have impacts economically.

7.6.3 Potential Drought Management Strategies Considered

Drought Management was considered and evaluated as a potentially feasible water management strategy for those municipal utility WUGs with a Drought Contingency Plan (see *Section 7.6.1*), for Manufacturing in Jackson County, and for Irrigation in Wharton County, as it had a water need. See *Appendix 5B* in *Chapter 5* for additional details.

7.7 Other Drought Recommendations

Housed within the Office of Emergency Management within the Texas Department of Public Safety, the Drought Preparedness Council was authorized and established by the 76th legislature (HB-2660) in 1999, subsequent to the establishment of the Drought Monitoring and Response Committee (75th legislature, SB1). The Council is composed of representatives of state agencies and appointees by the governor. As defined by the Texas Water Code, the Council is responsible for the monitoring and assessing drought conditions and advising elected and planning officials about drought-related topics.

The Lavaca Regional Water Planning Group (LRWPG) reviewed and considered recommendations from the Drought Preparedness Council with regards to developing region-specific model drought contingency plans for water use categories in the region with more than 10 percent of water demands, as well as following the outline template provided by the Texas Water Development Board, 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. The LRWPG currently has no drought preparation and response recommendations regarding the Drought Preparedness Council and the State Drought Preparedness Plan.

The Lavaca Regional Water Planning Group recognizes that the most valuable contingency will be completed at a local level. Further guidance and regional cooperation would be valuable in producing meaningful plans with clear trigger definition and implementation guidance. Communication of these between state, regional and local levels would also further facilitate necessary emergency responses when drought measures need to be implemented. The following recommendations are made to support development and implementation of meaningful Drought Contingency Plans during times of drought:

- Coordination by water providers with local Groundwater Conservation Districts, in order to consider more uniform triggers and responses from a particular source within the district, as applicable.

- Coordination with wholesale providers regarding drought conditions and potential implementation of drought stages, particularly during times of limited precipitation.

- Communication with customers during times of decreased supply or precipitation in order to facilitate potential implementation of drought measures and reinforce the importance of compliance with any voluntary measures.

- Designation of appropriate resources to allow for consistent application of enforcement procedures as established in the Drought Contingency Plans.

APPENDIX 7A

Region-Specific Model Drought Contingency Plans

Model Lavaca Region Drought Contingency Plan Template

Utility/Water Supplier

Model Drought Contingency Plan Template (Utility / Water Supplier)

Brief Introduction and Background

Include information such as

- Name of Utility
- Address, City, Zip Code
- CCN#
- PWS #s

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ___________________ (name of your water supplier) hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance/or resolution.

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the ______________ (name of your water supplier) by means of ________________ (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; for example, scheduling and providing public notice of a public meeting to accept input on the Plan).

Section III: Public Education

The ______________ (name of your water supplier) will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of __________________ (describe methods to be used to provide information to the public about the Plan; for example, public events, press releases or utility bill inserts).

Section IV: Coordination with the Lavaca Regional Water Planning Group

The service area of the _____________ (name of your water supplier) is located within the Lavaca Regional Water Planning Area and ___________ (name of your water supplier) has provided a copy of this Plan to the Lavaca Regional Water Planning Group.

Section V: Authorization

The ___________________ (designated official; for example, the mayor, city manager, utility director, general manager, etc.), or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _______________, (designated official) or his/her designee shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the __________________ (name of your water supplier). The terms person and customer as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan**,** the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by _________________ (name of your water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;

(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The ________________ (designated official) or his/her designee shall monitor water supply and/or demand conditions on a __________ (example: daily, weekly, monthly) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified triggers are reached.

The triggering criteria described below are based on _____________________________________ ____ (*provide a brief description of the rationale for the triggering criteria; for example, triggering criteria / trigger levels based on a statistical analysis of the vulnerability of the water source under drought of record conditions, or based on known system capacity limits*).

Stage 1 Triggers -- MILD Water Shortage Conditions

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII Definitions, when ____ (*Describe triggering criteria / trigger levels; see examples below*).

Following are examples of the types of triggering criteria that might be used in one or more successive stages of a drought contingency plan. One or a combination of such criteria must be defined for each drought response stage, but usually not all will apply. Select those appropriate to your system:

Example 1: *Annually, beginning on May 1 through September 30.*

Example 2: *When the water supply available to the _______ (name of your water supplier) is equal to or less than _______ (acre-feet, percentage of storage, etc.).*

Example 3: *When, pursuant to requirements specified in the _____________(name of* ***your*** *water supplier) wholesale water purchase contract with ____________ (name of your wholesale water supplier), notification is received requesting initiation of Stage 1 of the Drought Contingency Plan.*

Example 4: *When flows in the _______ (name of stream or river) are equal to or less than ____cubic feet per second.*

Example 5: *When the static water level in the ____________ (name of your water supplier) well(s) is equal to or less than _____ feet above/below mean sea level.*

Example 6: *When the specific capacity of the __________________ (name of your water supplier) well(s) is equal to or less than _____ percent of the well's original specific capacity.*

Example 7: *When total daily water demand equals or exceeds ______ million gallons for ___consecutive days of ____ million gallons on a single day (example: based on the "safe" operating capacity of water supply facilities).*

Example 8: *Continually falling treated water reservoir levels which do not refill above __ percent overnight (example: based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria which are tailored to its system.

Requirements for termination
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g. 3) consecutive days.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when ____________ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Triggers -- SEVERE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when ____________ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for initiation

Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when ____________ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 4, Stage 3 becomes operative.

Stage 5 Triggers -- EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when ____________ (designated official), or his/her designee, determines that 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 the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

Stage 6 Triggers -- WATER ALLOCATION

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 5 of this Plan when ____________ (describe triggering criteria, see examples in Stage 1).

Requirements for termination - Water allocation may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

> *Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (example: supply source contamination and system capacity limitations).*

Section IX: Drought Response Stages

The _______________ (designated official), or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency or water shortage condition exists and shall implement the following notification procedures:

Notification
Notification of the Public:
The ________ (designated official) or his/ her designee shall notify the public by means of:

Examples:
publication in a newspaper of general circulation,
direct mail to each customer,
public service announcements,
signs posted in public places
take-home fliers at schools.

Additional Notification:
The __________ (designated official) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

Examples:
Mayor / Chairman and members of the City Council / Utility Board
Fire Chief(s)
City and/or County Emergency Management Coordinator(s)
County Judge & Commissioner(s)
State Disaster District / Department of Public Safety
TCEQ *(required when* mandatory *restrictions are imposed)*
Major water users
Critical water users, i.e. hospitals
Parks / street superintendents & public facilities managers

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Stage 1 Response -- MILD Water Shortage Conditions

Target: Achieve a voluntary ___ percent reduction in __________(example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

D*escribe additional measures, if any, to be implemented directly by (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes.*

Voluntary Water Use Restrictions for Reducing Demand :

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of midnight and 10:00 a.m. and 8:00 p.m. to midnight on designated watering days.

(b) All operations of the ______________ (name of your water supplier) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response -- MODERATE Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rises. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or Jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to fire fighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the ___________________ (name of your water supplier).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight. However, if the golf course utilizes a water source other than that provided by the _______________ (name of your water supplier), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. use of water for dust control;
4. flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response -- SEVERE Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
All requirements of Stage 2 shall remain in effect during Stage 3 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the ____________________ (name of your water supplier).

(c) The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

Stage 4 Response -- CRITICAL Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand: All requirements of Stage 2 and 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10 p.m.

(c) The filling, refilling, or adding of water to swimming pools, wading pools, and Jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response -- EMERGENCY Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand. All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the __________________ (name of your water supplier) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by _____________(designated official), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction shall be punished by a fine of not less than _______ dollars ($__) and not more than ______ dollars ($__). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the _____________ (designated official) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $______, and any other costs incurred by the ___________________ (name of your water supplier) in discontinuing service. In addition, suitable assurance must be given to the ________________ (designated official) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the ______________ (name of your water supplier), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person♣s property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that a violation, committed by a child, occurred on property within the parents♣ control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

d) Any employee of the _______________ (name of your water supplier), police officer, or other _____ employee designated by the ___________ (designated official), may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the _____________ (example: municipal court) on the date shown on the citation for which the date shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator’s immediate family or is a resident of the violator’s residence. The alleged violator shall appear in _________ (example: municipal court) to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in __________ (example: municipal court), a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in __________ (example: municipal court) before all other cases.

Section XI: Variances

The ________________ (designated official), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the __________________ (name of your water supplier) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the ___________ (designated official), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

EXAMPLE RESOLUTION FOR ADOPTION OF A

DROUGHT CONTINGENCY PLAN

RESOLUTION NO. __________

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE __________________ (name of water supplier) ADOPTING A DROUGHT CONTINGENCY PLAN.

WHEREAS, the Board recognizes that the amount of water available to the ____________ (name of water supplier) and its water utility customers are limited and subject to depletion during periods of extended drought;

WHEREAS, the Board recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes;

WHEREAS, Section 11.1272 of the *Texas Water Code* and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the _________________ (name of water supply system), the Board deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE _________________ (name of water supplier):

SECTION 1. That the Drought Contingency Plan attached hereto as Exhibit "A" and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the ________________ (name of water supplier).

SECTION 2. That the _______________ (e.g., general manager) is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3.

Tha

t this resolution shall take effect immediately upon its passage.

DULY PASSED BY THE BOARD OF DIRECTORS OF THE _______________, ON THIS __ day of ______________, 20__.

____

President, Board of Directors
ATTESTED TO:

____
Secretary, Board of Directors

Model Lavaca Region Drought Contingency Plan Template

Irrigation Uses

Model Drought Contingency Plan Template (Irrigation Uses)

DROUGHT CONTINGENCY PLAN
FOR
(Name of irrigation district)
(Address)
(Date)

Section I: Declaration of Policy, Purpose, and Intent

The Board of Directors of the ___________________ (name of irrigation district) deems it to be in the interest of the District to adopt Rules and Regulations governing the equitable and efficient allocation of limited water supplies during times of shortage. These Rules and Regulations constitute the District's drought contingency plan required under Section 11.1272, Texas Water Code, *Vernon's Texas Codes Annotated*, and associated administrative rules of the Texas Commission on Environmental Quality (Title 30, Texas Administrative Code, Chapter 288).

Section II: User Involvement

Opportunity for users of water from the _________________ (name of irrigation district) was provided by means of ________________ (describe methods used to inform water users about the preparation of the plan and opportunities for input; for example, scheduling and providing notice of a public meeting to accept user input on the plan).

Section III: User Education

The _____________ (name of irrigation district) will periodically provide water users with information about the Plan, including information about the conditions under which water allocation is to be initiated or terminated and the district's policies and procedures for water allocation. This information will be provided by means of ______________ (e.g. describe methods to be used to provide water users with information about the Plan; for example, by providing copies of the Plan and by posting water allocation rules and regulations on the district's public bulletin board).

Section IV: Authorization

The ______________ (e.g., general manager) is hereby authorized and directed to implement the applicable provision of the Plan upon determination by the Board that such implementation is necessary to ensure the equitable and efficient allocation of limited water supplies during times of shortage.

Section V: Application

The provisions of the Plan shall apply to all persons utilizing water provided by the _______________ (name of irrigation district). The term "person" as used in the Plan includes individuals, corporations, partnerships, associations, and all other legal entities.

Section VI: Initiation of Water Allocation for Severe or Critical/Emergency Conditions

The __________ (designated official) shall monitor water supply conditions on a __________ (e.g. weekly, monthly) basis and shall make recommendations to the Board regarding irrigation of water allocation. Upon approval of the Board, water allocation will become effective when _________________ (describe the criteria and the basis for the criteria):

Below are examples of the types of triggering criteria that might be used; singly or in combination, in an irrigation district's drought contingency plan:

Example 1: **Water in storage in the ___________ (name of reservoir) is equal to or less than _____________ (acre-feet and/or percentage of storage capacity).**

Example 2: **Combined storage in the _________________ (name or reservoirs) reservoir system is equal to or less than _____________ (acre-feet and/or percentage of storage capacity).**

Example 3: **Flows as measured by the U.S. Geological Survey gage on the ______________ (name of reservoir) near _________________ ______________, Texas reaches ____ cubic feet per second (cfs).**

Example 4: **The storage balance in the district's irrigation water rights account reaches ______ acre-feet.**

Example 5: **The storage balance in the district's irrigation water rights account reaches an amount equivalent to _______ (number) irrigations for each flat rate acre in which all flat rate assessments are paid and current.**

Example 6: **The ____________ (name of entity supplying water to the irrigation district) notifies the district that water deliveries will be limited to ___________ acre-feet per year (i.e. a level below that required for unrestricted irrigation).**

Example 7: **Water levels in the Gulf Coast Aquifer fall to ____feet or lower.**

Section VII: Termination of Water Allocation

The district's water allocation policies will remain in effect until the conditions defined in Section IV of the Plan no longer exist and the Board deems that the need to allocate water no longer exists.

Section VIII: Notice

Notice of the initiation of water allocation will be given by notice posted on the District's public bulletin board and by mail to each ________ (e.g. landowner, holders of active irrigation accounts, etc.).

Section IX: Water Allocation

(a) In identifying **specific, quantified targets** for water allocation to be achieved during periods of water shortages and drought, each irrigation user shall be allocated _____ irrigations or ________ acre-feet of water each flat rate acre on which all taxes, fees, and charges have been paid. The water allotment in each irrigation account will be expressed in acre-feet of water.

Include explanation of water allocation procedure. For example, in the Lower Rio Grande Valley, an "irrigation" is typically considered to be equivalent to eight (8) inches of water per irrigation acre; consisting of six (6) inches of water per acre applied plus two (2) inches of water lost in transporting the water from the river to the land. Thus, three irrigations would be equal to 24 inches of water per acre or an allocation of 2.0 acre-feet of water measured at the diversion from the river.

(b) As additional water supplies become available to the District in an amount reasonably sufficient for allocation to the District's irrigation users, the additional water made available to the District will be equally distributed, on a pro rata basis, to those irrigation users having ________________.

Example 1: **An account balance of less than ______ irrigations for each flat**

rate acre (i.e. ____ acre-feet).

Example 2: **An account balance of less than _____ acre-feet of water for each flat rate acre.**

Example 3: **An account balance of less than _ ___ acre-feet of water.** (c) The amount of water charged against a user's water allocation will be ____ (e.g. eight inches) per irrigation, or one allocation unit, unless water deliveries to the land are metered. Metered water deliveries will be charges based on actual measured use. In order to maintain parity in charging use against a water allocation between non-metered and metered deliveries, a loss factor of ____ percent of the water delivered in a metered situation will be added to the measured use and will be charged against the user's water allocation. Any metered use, with the loss factor applied, that is less than eight (8) inches per acre shall be credited back to the allocation unit and will be available to the user. It shall be a violation of the Rules and Regulations for a water user to use water in excess of the amount of water contained in the users irrigation account.

(d) Acreage in an irrigation account that has not been irrigated for any reason within the last two (2) consecutive years will be considered inactive and will not be allocated water. Any landowner whose land has not been irrigated within the last two (2) consecutive years, may, upon application to the District expressing intent to irrigate the land, receive future allocations. However, irrigation water allocated shall be applied only upon the acreage to which it was allocated and such water allotment cannot be transferred until there have been two consecutive years of use.

Section X: Transfers of Allotments

(a) A water allocation in an active irrigation account may be transferred within the boundaries of the District from one irrigation account to another. The transfer of water can only be made by the landowner's agent who is authorized in writing to act on behalf of the landowner in the transfer of all or part of the water allocation from the described land of the landowner covered by the irrigation account.

(b) A water allocation may not be transferred to land owned by a landowner outside the District boundaries.

or

A water allocation may be transferred to land outside the District's boundaries by paying the current water charge as if the water was actually delivered by the District to the land covered by an irrigation account. The amount of water allowed to be transferred shall be stated in terms of acre-feet and deducted from the landowner's current allocation balance in the irrigation account. Transfers of water outside the District shall not affect the allocation of water under Section VII of these Rules and Regulations.

(c) Water from outside the District may not be transferred by a landowner for use within the District.

or

Water from outside the District may be transferred by a landowner for use within the District. The District will divert and deliver the water on the same basis as District water is delivered, except that a ___ percent conveyance loss will be charged against the amount of water transferred for use in the District as the water is delivered.

Section XI: Penalties

Any person who willfully opens, closes, changes or interferes with any headgate or uses water in violation of these Rules and Regulations, shall be considered in violation of Section 11.0083, Texas Water Code, *Vernon's Texas Codes Annotated*, which provides for punishment by fine of not less than $10.00 nor more than $200.00 or by confinement in the county jail for not more than thirty (30) days, or both, for each violation, and these penalties provided by the laws of the State and may by enforced by complaints filed in the appropriate court jurisdiction in ______ County, all in accordance with Section 11.083; and in addition, the District may pursue a civil remedy in the way of damages and/or injunction against the violation of any of the foregoing Rules and Regulations.

Section XII: Severability

It is hereby declared to be the intention of the Board of Directors of the _____________ (name of irrigation district) that the sections, paragraphs, sentences, clauses, and phrases of this Plan shall be declared unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs, and sections of this Plan, since the same would not have been enacted by the Board without the incorporation into this Plan of any such unconstitutional phrase, clause, sentence, paragraph, or section.

Section XIII: Authority

The foregoing rules and regulations are adopted pursuant to and in accordance with Sections 11.039, 11.083, 11.1272; Section 49.004; and Section 58.127-130 of the Texas Water Code, *Vernon's Texas Codes Annotated.*

Section XIV: Effective Date of Plan

The effective date of this Rule shall be five (5) days following the date of Publication hereof and ignorance of the Rules and Regulations is not a defense for a prosecution for enforcement of the violation of the Rules and Regulations.

EXAMPLE RESOLUTION FOR ADOPTION OF A DROUGHT CONTINGENCY PLAN

RESOLUTION NO. __________

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE __________________ (name of water supplier) ADOPTING A DROUGHT CONTINGENCY PLAN.

WHEREAS, the Board recognizes that the amount of water available to the ____________ (name of water supplier) and its water utility customers is limited and subject to depletion during periods of extended drought;

WHEREAS, the Board recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes;

WHEREAS, Section 11.1272 of the Texas Water Code and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the _________________(name of water supply system), the Board deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE _________________ (name of water supplier):

SECTION 1. That the Drought Contingency Plan attached hereto as Exhibit A and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the ________________ (name of water supplier).

SECTION 2. That the _______________ (e.g., general manager) is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.

DULY PASSED BY THE BOARD OF DIRECTORS OF THE _______________, ON THIS __ day of ______________, 20__.

____
President, Board of Directors

ATTESTED TO:

____
Secretary, Board of Director

Model Lavaca Region Drought Contingency Plan Template

Wholesale Water Providers

Model Drought Contingency Plan Template (**Wholesale Public Water Suppliers**)

DROUGHT CONTINGENCY PLAN
FOR THE
(Name of wholesale water supplier)
(address)
(CCN)
(PWS)
(Date)

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and/or to protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ___________________ (name of your water supplier) adopts the following Drought Contingency Plan (the Plan).

Section II: Public Involvement

Opportunity for the public and wholesale water customers to provide input into the preparation of the Plan was provided by _____________ (name of your water supplier) by means of ______________ (describe methods used to inform the public and wholesale customers about the preparation of the plan and opportunities for input; for example, scheduling and proving public notice of a public meeting to accept input on the Plan).

Section III: Wholesale Water Customer Education

The ____________ (name of your water supplier) will periodically provide wholesale water customers with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of __________________ (e.g., describe methods to be used to provide customers with information about the Plan; for example, providing a copy of the Plan or periodically including information about the Plan with invoices for water sales).

Section IV: Coordination with the Lavaca Regional Water Planning Group

The service area of the _____________ (name of your water supplier) is located within the Lavaca Regional Water Planning Area and ___________ (name of your water supplier) has provided a copy of this Plan to the Lavaca Regional Water Planning Group.

Section V: Authorization

The ___________________ (designated official; for example, the general manager or executive director), or his/her designee, is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _______________, or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all customers utilizing water provided by the __________________ (name of your water supplier). The terms ■person• and ■customer• as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Criteria for Initiation and Termination of Drought Response Stages

The ____________ (designated official), or his/her designee, shall monitor water supply and/or demand conditions on a (e.g., weekly, monthly) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan. Customer notification of the initiation or termination of drought response stages will be made by mail or telephone. The news media will also be informed.

The triggering criteria described below are based on:

____

____ (provide a brief description of the rationale for the triggering criteria; for example, triggering criteria are based on a statistical analysis of the vulnerability *of the water source under drought of record conditions).*

Stage 1 Triggers -- MILD Water Shortage Conditions

<u>Requirements</u> <u>for</u> <u>initiation</u>: The _____________ (name of your water supplier) will recognize that a mild water shortage condition exists when______________(*describe triggering criteria, see examples below).*

> ***Below are examples of the types of triggering criteria that might be used in a wholesale water supplier▴s drought contingency plan. One or a combination of such criteria may be defined for each drought response stage:***
>
> ***Example 1:*** ***Water in storage in the _________ (name of reservoir) is equal to or less than _______ (acre-feet and/or percentage of storage capacity).***
>
> ***Example 2:*** ***When the combined storage in the __________ (name of reservoirs) is equal to or less than ______ (acre-feet and/or percentage of storage capacity).***
>
> ***Example 3:*** ***Flows as measured by the U.S. Geological Survey gage on the ________ (name of river) near ________, Texas reaches ___ cubic feet per second (cfs).***
>
> ***Example 4:*** ***When total daily water demand equals or exceeds ______ million gallons for ___consecutive days or ____ million gallons on a single day.***
>
> ***Example 5:*** ***When total daily water demand equals or exceeds ___ percent of the safe operating capacity of ____________ million gallons per day for ___consecutive days or ___ percent on a single day.***

<u>Requirements</u> <u>for</u> <u>termination:</u> Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g., 30) consecutive days. The

_________ (name of water supplier) will notify its wholesale customers and the media of the termination of Stage 1 in the same manner as the notification of initiation of Stage 1 of the Plan.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

Requirements for initiation: The _____________ (name of your water supplier) will recognize that a moderate water shortage condition exists when______________(describe triggering criteria).

Requirements for termination**:** Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g., 30) consecutive days. Upon termination of Stage 2, Stage 1 becomes operative. The _________ (name of your water supplier) will notify its wholesale customers and the media of the termination of Stage 2 in the same manner as the notification of initiation of Stage 1 of the Plan.

Stage 3 Triggers -- SEVERE Water Shortage Conditions

Requirements for initiation: The _____________ (name of your water supplier) will recognize that a severe water shortage condition exists when______________(*describe triggering criteria; see examples in Stage 1*).

Requirements for termination**:** Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g., 30) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative. The _________ (name of your water supplier) will notify its wholesale customers and the media of the termination of Stage 2 in the same manner as the notification of initiation of Stage 3 of the Plan.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for initiation - The _____________ (name of your water supplier) will recognize that an emergency water shortage condition exists when______________(*describe triggering criteria*; *see examples below*).

Example 1. ***Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or***

Example 2. ***Natural or man-made contamination of the water supply source(s).***

Requirements for termination**:** Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g., 30) consecutive days. The _________ (name of your water supplier) will notify its wholesale customers and the media of the termination of Stage 4.

Section VIII: Drought Response Stages

The _________ (designated official), or his/her designee, shall monitor water supply and/or demand conditions and, in accordance with the triggering criteria set forth in Section VI, shall determine that mild, moderate, or severe water shortage conditions exist or that an emergency condition exists and shall implement the following actions:

Stage 1 Response -- MILD Water Shortage Conditions

Target: Achieve a voluntary __ percent reduction in __________ (e.g., total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

(a) The ________________ (designated official), or his/her designee(s), will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate voluntary measures to reduce water use (e.g., implement Stage 1 of the customer♣s drought contingency plan).

(b) The _________________ (designated official), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 2 Response -- MODERATE Water Shortage Conditions

Target: Achieve a ___ percent reduction in __________ (e.g., total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

(a) The ________________ (designated official), or his/her designee(s), will initiate weekly contact with wholesale water customers to discuss water supply and/or demand conditions and the possibility of pro rata curtailment of water diversions and/or deliveries.

(b) The ________________ (designated official), or his/her designee(s), will request wholesale water customers to initiate mandatory measures to reduce non-essential water use (e.g., implement Stage 2 of the customer♣s drought contingency plan).

(c) The _________________ (designated official), or his/her designee(s), will initiate preparations for the implementation of pro rata curtailment of water diversions and/or deliveries by preparing a monthly water usage allocation baseline for each wholesale customer according to the procedures specified in Section VI of the Plan.

(d) The _________________ (designated official), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 3 Response -- SEVERE Water Shortage Conditions

<u>Target:</u> Achieve a ___ percent reduction in __________ (e.g., total water use, daily water demand, etc.).

<u>Best Management Practices for Supply Management</u>:

Describe additional measures, if any, to be implemented directly by ____________ (designated official), or his/her designee(s), to manage limited water supplies and/or reduce water demand. Examples include modifying reservoir operations procedures, interconnection with another water system, and use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:

(a) The ________________ (designated official), or his/her designee(s), will contact wholesale water customers to discuss water supply and/or demand conditions and will request that wholesale water customers initiate additional mandatory measures to reduce non-essential water use (e.g., implement Stage 2 of the customer•s drought contingency plan).

(b) The _________________ (designated official), or his/her designee(s), will initiate pro rata curtailment of water diversions and/or deliveries for each wholesale customer according to the procedures specified in Section VI of the Plan.

(c) The _________________ (designated official), or his/her designee(s), will provide a weekly report to news media with information regarding current water supply and/or demand conditions, projected water supply and demand conditions if drought conditions persist, and consumer information on water conservation measures and practices.

Stage 4 Response -- EMERGENCY Water Shortage Conditions

Whenever emergency water shortage conditions exist as defined in Section VII of the Plan, the _______________ (designated official) shall:

1. Assess the severity of the problem and identify the actions needed and time required to solve the problem.

2. 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 (e.g., notification of the public to reduce water use until service is restored).

3. If appropriate, notify city, county, and/or state emergency response officials for assistance.

4. Undertake necessary actions, including repairs and/or clean-up as needed.

5. Prepare a post-event assessment report on the incident and critique of emergency response procedures and actions.

Section IX: Pro Rata Water Allocation

In the event that the triggering criteria specified in Section VII of the Plan for Stage 3 Severe Water Shortage Conditions have been met, the ____________ (designated official) is hereby authorized initiate allocation of water supplies on a pro rata basis in accordance with Texas Water Code Section 11.039.

Section X: Enforcement

During any period when pro rata allocation of available water supplies is in effect, wholesale customers shall pay the following surcharges on excess water diversions and/or deliveries:

____ times the normal water charge per acre-foot for water diversions and/or deliveries in excess of the monthly allocation up through 5 percent above the monthly allocation.

____ times the normal water charge per acre-foot for water diversions and/or deliveries in excess of the monthly allocation from 5 percent through 10 percent above the monthly allocation.

____ times the normal water charge per acre-foot for water diversions and/or deliveries in excess of the monthly allocation from 10 percent through 15 percent above the monthly allocation.

____ times the normal water charge per acre-foot for water diversions and/or deliveries more than 15 percent above the monthly allocation.

The above surcharges shall be cumulative.

Section XI: Variances

The ________________ (designated official), or his/her designee, may, in writing, grant a temporary variance to the pro rata water allocation policies provided by this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the public health, welfare, or safety and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.

(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Plan shall file a petition for variance with the _________________ (designated official) within 5 days after pro rata allocation has been invoked. All petitions for variances shall be reviewed by the __________ (governing body), and shall include the following:

(a) Name and address of the petitioner(s).

(b) Detailed statement with supporting data and information as to how the pro rata allocation of water under the policies and procedures established in the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.

(c) Description of the relief requested.

(d) Period of time for which the variance is sought.

(e) Alternative measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.

(f) Other pertinent information.

Variances granted by the ___________________ (governing body) shall be subject to the following conditions, unless waived or modified by the ____________ (governing body) or its designee:

(a) Variances granted shall include a timetable for compliance.

(b) Variances granted shall expire when the Plan is no longer in effect, unless the petitioner has failed to meet specified requirements.

No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section XII: Severability

It is hereby declared to be the intention of the ________________ (governing body of your water supplier) that the sections, paragraphs, sentences, clauses, and phrases of this Plan are severable and, if any phrase, clause, sentence, paragraph, or section of this Plan shall be declared unconstitutional by the valid judgment or decree of any court of competent jurisdiction, such unconstitutionality shall not affect any of the remaining phrases, clauses, sentences, paragraphs, and sections of this Plan, since the same would not have been enacted by the ____________________ (governing body of your water supplier) without the incorporation into this Plan of any such unconstitutional phrase, clause, sentence, paragraph, or section.

EXAMPLE RESOLUTION FOR ADOPTION OF A

DROUGHT CONTINGENCY PLAN

RESOLUTION NO. __________

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE ___________________ (name of water supplier) ADOPTING A DROUGHT CONTINGENCY PLAN.

WHEREAS, the Board recognizes that the amount of water available to the ____________ (name of water supplier) and its water utility customers is limited and subject to depletion during periods of extended drought;

WHEREAS, the Board recognizes that natural limitations due to drought conditions and other acts of God cannot guarantee an uninterrupted water supply for all purposes;

WHEREAS, Section 11.1272 of the *Texas Water Code* and applicable rules of the Texas Commission on Environmental Quality require all public water supply systems in Texas to prepare a drought contingency plan; and

WHEREAS, as authorized under law, and in the best interests of the customers of the _________________(name of water supply system), the Board deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought and other water supply emergencies;

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE _________________ (name of water supplier):

SECTION 1. That the Drought Contingency Plan attached hereto as “Exhibit A” and made

part hereof for all purposes be, and the same is hereby, adopted as the official policy of the ________________ (name of water supplier).

SECTION 2. That the _______________ (e.g., general manager) is hereby directed to implement, administer, and enforce the Drought Contingency Plan.

SECTION 3. That this resolution shall take effect immediately upon its passage.

DULY PASSED BY THE BOARD OF DIRECTORS OF THE _______________, ON THIS __ day of ______________, 20__.

____

President, Board of Directors

ATTESTED TO:

____

Secretary, Board of Directors

Contents

List of Appendices

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Chapter 8 – Unique Stream Segments, Reservoir Sites, and Legislative Recommendations

The LRWPG has made the following recommendations regarding unique ecological stream segments (USS) and unique reservoir sites (URS.) Additionally, the group has considered the creation of regulatory entities in accordance with legislative and regional water policy issues.

8.1 Unique Stream Segments and Reservoir Sites

In 1999, the Texas Parks and Wildlife Department (TPWD) identified Ecologically Significant Stream Segments for the Lavaca Regional Water Planning Area using criteria in accordance with TWDB rules.

The LRWPG may recommend these ecologically significant segments or other identified segments to be classified as unique in the RWP. When recommending these segments, the RWPG may develop special provisions to ensure no unintended consequences occur from designation. Once recommended, the TPWD provides a written evaluation of the recommendation. The recommendation is then sent to Texas State Legislature for approval.

A planning group may also recommend a site as unique for reservoir construction based upon several criteria:

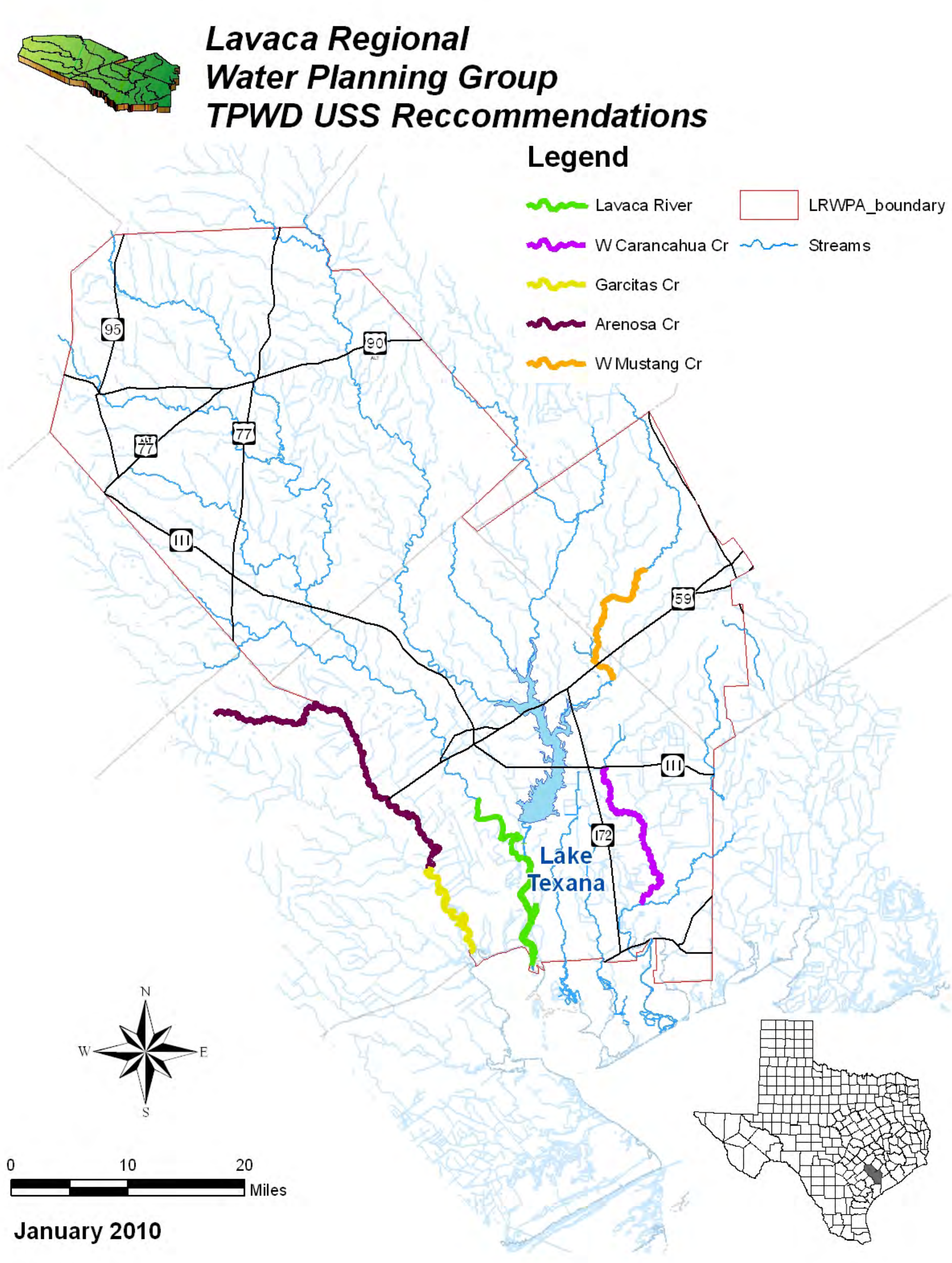
- site-specific reservoir development is recommended as a specific water management strategy or in an alternative long-term scenario in an adopted regional water plan
- location; hydrology; geology; topography; water availability; water quality; environmental, cultural, and current development characteristics; or other pertinent factors make the site
- uniquely suited for: (a) reservoir development to provide water supply for the current planning period; or (b) to meet needs beyond the 50-year planning period

The proposed Palmetto Bend Stage II Reservoir had been designated as a unique reservoir site (URS). It was one of 19 sites (17 major and 2 minor) recommended by the 2007 SWP and designated by the 80th Texas Legislature as sites of unique value. The designation of this unique reservoir site ended on September 1, 2015, as LNRA made the decision not to move forward with construction expenditures or permitting by that time. No other unique reservoir sites have been recommended by the LRWPG.

LNRA is currently evaluating an off-channel option as the desired future treatment of the Lavaca River. Development of an off-channel alternative would necessitate alteration of the Certificate of Adjudication or cancellation of the Certificate and development and application for a new water right.

Appendix 8A includes information from TPWD concerning potential USSs within the LRWPA from the 2006 RWP. TPWD-recommended segments are illustrated in *Figure 8-1*. Note that subsequent to the publication of TPWD recommendations, conditions along stream segments in the LRWPA may have changed. Since the TPWD study, much of West Carancahua Creek has been channelized for drainage improvement. The LRWPG has elected not to recommend any USS for the current round of regional water planning.

Figure 8-1
Major Surface Water Sources



8.2 Proposed Regulatory Changes or Resolutions

The primary concern of the LRWPG has been the protection of existing groundwater sources to maintain agricultural production because of its direct economic impact to the area. As a result of the planning process, the LRWPG considered and approved several policy resolutions as presented in the 2006 RWP. These policy recommendations and rationales for the proposals are detailed below and have been modified as needed for the current round of planning. *Section 8.2.2* addresses the HB 807 requirement regarding regional water planning process improvements. See *Section 9.3* in Chapter 9 for recommendations related to financing.

8.2.1 Environmental Issues

LRWPG has developed a water plan to address projected water demands within LRWPA. The construction of the Palmetto Bend Stage II reservoir was considered as a potential management strategy to meet shortages in the 2001 and 2006 RWPs for LRWPA. Currently, LNRA has designated an off-channel option in its Management Plans as the desired future treatment of the Lavaca River. The LRWPG has recommended this off-channel reservoir option in this regional water plan. An off-channel reservoir would negate many of the environmental issues related to an on-channel impoundment. The LRWPG understands that any water development strategy can have potentially threatening environmental consequences and fully supports efforts to identify and mitigate environmental impacts to the extent feasible.

8.2.2 Ongoing Regional Water Planning Activities

LRWPG recommends that the Texas Legislature establish funding through TWDB for the continued existence of the regional planning groups. Duties would include the monitoring of ongoing research needed for planning, environmental flows issues, processing of any amendments to the plan, and monitoring the implementation of new crop varieties and other improvements to the area's primary water user. Provision of funding to pursue the above activities will allow LRWPG to continue to perform a vital role as a focal point for communications with the various user groups concerning development of and amendments to the Plan.

8.2.3 Inter-Regional Coordination

LRWPG recognizes the importance of inter-regional coordination efforts in order to maintain consistency among regional plans in situations where activities in one region may impact water availability or project needs in other regions. As population growth and other development activities increase over time for much of the state, multi-regional issues and the ability of regions to cooperatively use resources will be of increasing importance. The LRWPG supports the creation of the Interregional Planning Council established by House Bill 807 from the 86th Legislative Session.

8.2.4 Conservation Policy

LRWPG supports existing and continued efforts of agricultural producers to practice good stewardship of surface and groundwater resources of the state of Texas. The group recognizes the economic impact that a voluntary conservation effort has on the viability of agricultural operations on the area. The group also supports state and federally funded programs administered by NRCS, State Soil and Water Conservation Board, and local soil and water conservation districts. These programs provide technical and financial assistance to agricultural producers to install, manage, and maintain structural and vegetative measures for increased irrigation efficiency and overall water conservation. They are important in successfully implementing the regional water plan.

8.2.5 Sustainable Yield of the Gulf Coast Aquifer

LRWPG supports the use of the sustainable yield of the Gulf Coast aquifer as the amount of water that should be included in the State Water Plan for areas using the Gulf Coast aquifer. While the Gulf Coast aquifer has significant amounts of water in storage, the aquifer levels impact regional agricultural, municipal, and manufacturing users directly. Mining of significant quantities of water over and above the sustainable annual yield will result in increasing pumping costs for all users. Increased pumping costs will have the most detrimental effect on agricultural production in the area.

8.2.6 Support of the Rule of Capture

LRWPG supports the Rule of Capture as the means of allocating groundwater in the state of Texas. The group also supports TWDB in its monitoring activities with regard to well static-water levels and groundwater pumpage in the state.

8.2.7 Groundwater Conservation Districts

LRWPG supports the control of groundwater resources through local control by GCDs. The group supported the creation of the Coastal Bend GCD in Wharton County and the Texana GCD in Jackson County. The primary focus of the districts is to preserve and protect groundwater supplies in their respective counties for future generations. The management plans for the Coastal Bend and Texana districts were certified by TWDB on September 28, 2004. The Coastal Bend GCD management plan was updated most recently on April 10, 2018, and the Texana GCD management plan was updated most recently on February 18, 2016. The group supports the further efforts of these districts as a tool in protecting water resources in the Lavaca Regional Water Planning Area.

8.2.8 Establishment of Fees for Groundwater Export

LRWPG supports the use of the sustainable yield of the Gulf Coast aquifer as the limit for water development and the use of groundwater conservation and management districts as the appropriate method of retaining local control of groundwater. LRWPG understands large-scale groundwater mining of the Gulf Coast aquifer is in direct opposition to the concept of sustainable yield for aquifer management. While local entities are encouraged to conserve groundwater for the use of local citizens with attendant impacts on the local economy, the citizens of large municipalities at great distances from the Lavaca area are relatively insulated from the impacts of increasing depth to the water table for the Lavaca area. Use of an export fee may help offset the negative impacts of transferring water out of the basin to other areas of the state. The transfer of water by export would be permitted provided the transfer would not present the possibility of unreasonable interference with the production of water from exempt, existing, or previously permitted wells. This could potentially be administered by the local GCDs through their regulations.

8.2.9 Limits for Groundwater Conservation Districts

LRWPG recommends that the sustainable yield of the aquifer be used for all GCDs in the region as the upper limit of groundwater available for all uses. For this region, there is no overall surplus of groundwater and any use of groundwater contemplated outside the region must be subject to the same rules for protection of the basin of origin as interbasin transfers of surface water.

APPENDIX 8A

TPWD Ecologically Significant Stream Segments

Area Study: Jackson, Lavaca, and Wharton Counties

Evaluation of Natural Resources in Lavaca Water Planning Area (Region P)

Wetlands in Lake Texana State Park (D.W. Moulton)

TEXAS PARKS & WILDLIFE

RESOURCE PROTECTION DIVISION:
WATER RESOURCES TEAM

Evaluation of Natural Resources in Lavaca Water Planning Area (Region P)

By: Albert El-Hage
Peter D. Sorensen
Daniel W. Moulton

October 1999

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FIGURES

Acknowledgments

The authors wish to thank those individuals who cooperated in providing information on the selected natural resources in the study area. Additional thanks are given to those individuals whose comments and proofreading allowed us to produce this report. We appreciate and acknowledge the help and expertise of Gordon Linam, Cindy Loeffler, and David Bradsby.

EXECUTIVE SUMMARY

The study area is located in the mid-coastal region of Texas and includes Jackson and Lavaca counties, and part of Wharton County. It is located within the Lavaca, Colorado-Lavaca, Guadalupe, and Lavaca-Guadalupe river basins.

Drainage of the study area is by the Lavaca and Navidad rivers and their tributaries. Elevations range from sea level in Jackson County to about 503 feet in Lavaca County. The study area is entirely within the Upland Prairie and Woods natural subregion. The land surface of the area is generally rolling to prairie.

The economy of the area consists primarily of petroleum production and operations, agribusiness and tourism. Agricultural production is varied. It consists of cattle, poultry, corn, cotton, and rice with rice being the principal crop for Wharton County. The market value for the agriculture in the study area is around $192.4 million. Outdoor recreational facilities also contribute to the area's economy. The Lavaca-Navidad estuary, the estuarine wetlands along the east side of Garcitas Creek and Lake Texana provide opportunities for bird watching, fishing, waterfowl hunting, boating, and other water sports. All these areas are located in Jackson County.

The natural regions of Texas were delineated largely on the basis of soil types and major vegetation types. Soils in the study area vary from alluvial, sandy soils with loamy surface to black waxy soils with loamy or sandy surface. Most of the region is on the Beaumont and Lissie Geological Formations.

There are seven major vegetation types found in the study area (Figure 4). The main vegetation types are Crops, and Post Oak Woods/Forest, followed closely by Post Oak Woods, Forest and Grassland Mosaic. The Pecan-Elm Forest, Other Native or Introduced Grasses, Bluestem Grassland, and Marsh/Barrier Island types are also found with decreasing distributions, respectively, in the study area.

Region P has a variety of valuable aquatic, wetland, riparian, and estuarine habitats. The estuary of the Lavaca and Navidad Rivers, in Jackson County, provides habitats for economically important marine and estuarine animals as well as for freshwater and terrestrial animals.

The region has 5 rivers or stream segments that satisfy one or more of the criteria defined in Senate Bill 1 for ecologically unique river and stream segments. These are in Jackson and Wharton Counties.

INTRODUCTION

Location and Extent

The study area is located in the mid-coastal region of Texas and includes Jackson and Lavaca counties, and part of Wharton County (Figure 1). It is located within the Lavaca, Colorado-Lavaca, Guadalupe, and Lavaca-Guadalupe river basins (Figure 2).

Geography and Ecology

Drainage of the study area is by the Lavaca and Navidad rivers and their tributaries. Elevations range from about sea level in Jackson County to about 503 feet in Lavaca County (Dallas Morning News 1997). The study area includes the Uplands Prairie and Woods natural subregion (Lyndon B. Johnson School of Public Affairs 1978). The land surface of the area is generally rolling to prairie (Dallas Morning News 1997).

Long, hot summers and short, mild winters characterize the study area's climate. The average daily minimum temperature for January is about 41.5?F and the average daily maximum temperature for July is about 93.7?F. The average annual precipitation is 40 inches (Dallas Morning News 1997).

Population

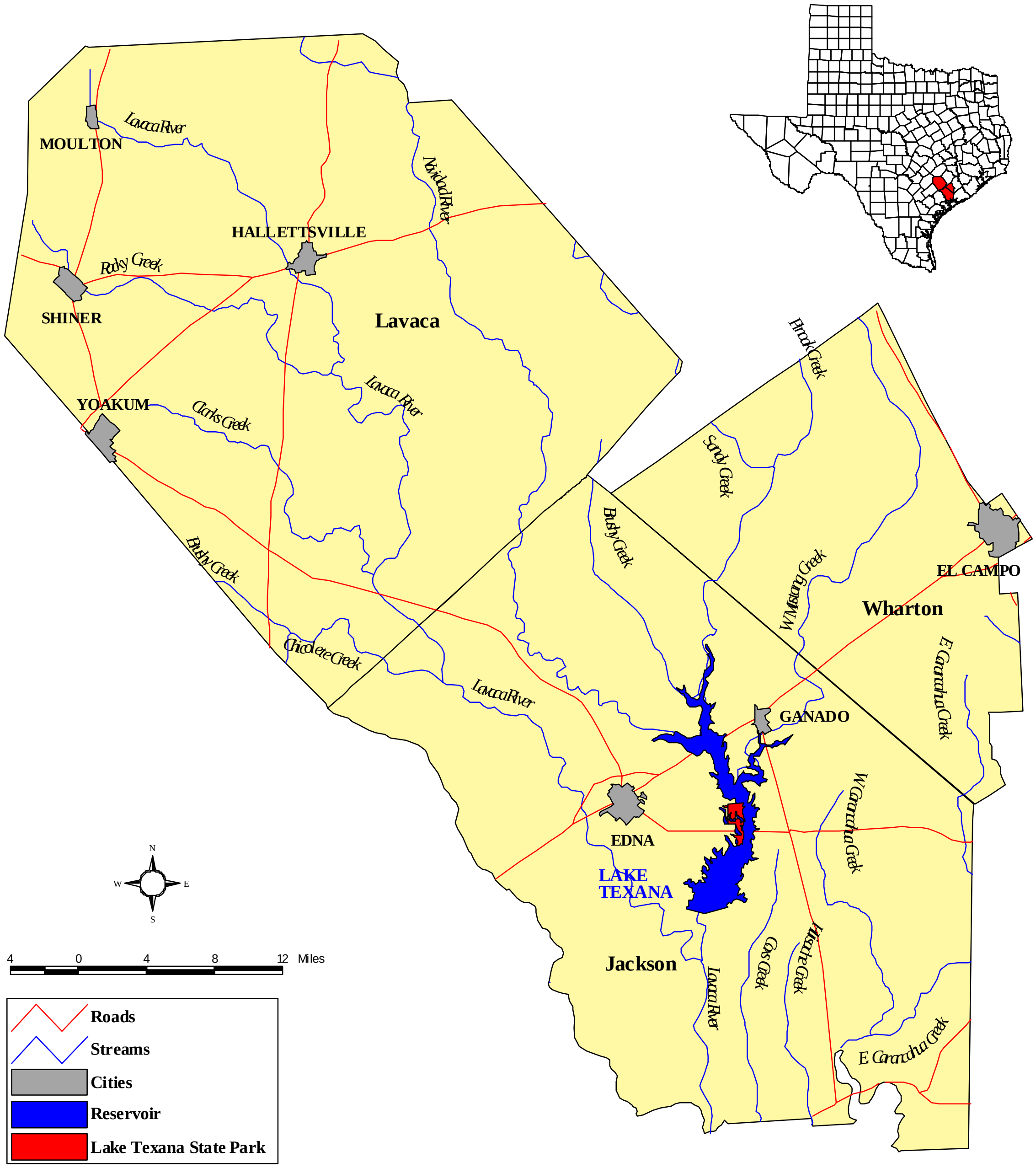
The 1990 census estimated the population of the study area to be 45,039 (Table 1, TWDB 1998). TWDB (1998) predicted a 2050 population of 58,958. Moderate increase in population is projected for all three counties, Jackson, Lavaca, and Wharton.

Table 1. Projections for Population Growth in the Study Area (TWDB 1998)

County ?	**Year** ? **City** ?	**1990**	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
Jackson		13,039	14,748	14,984	15,040	15,058	15,076	15,085
Jackson	Edna	5,343	6,193	6,324	6,355	6,365	6,375	6,385
Jackson	Ganado	1,701	1,892	1,922	1,928	1,930	1,932	1,934
Jackson	County-other	5,995	6,663	6,738	6,757	6,763	6,769	6,766
Lavaca		18,690	20,764	21,507	22,193	23,264	24,398	25,648
Lavaca	Hallettsville	2,718	3,052	3,257	3,413	3,626	3,828	4,041
Lavaca	Moulton	923	936	950	963	977	991	1,005
Lavaca	Shiner	2,074	2,348	2,432	2,510	2,631	2,759	2,901
Lavaca	Yoakum (P)	3,457	3,919	4,059	4,188	4,390	4,604	4,840
Lavaca	County-other	9,518	10,509	10,809	11,119	11,640	12,216	12,861
Wharton	(P)	13,310	13,830	14,615	15,501	16,325	17,241	18,225
Wharton	El Campo	10,511	10,851	11,355	11,961	12,486	13,100	13,744
Wharton	County-other	2,799	2,979	3,260	3,540	3,839	4,141	4,481
	Total	45,039	49,342	51,106	52,734	54,647	56,715	58,958

**P- partial*

Figure 1. Location of the Study Area

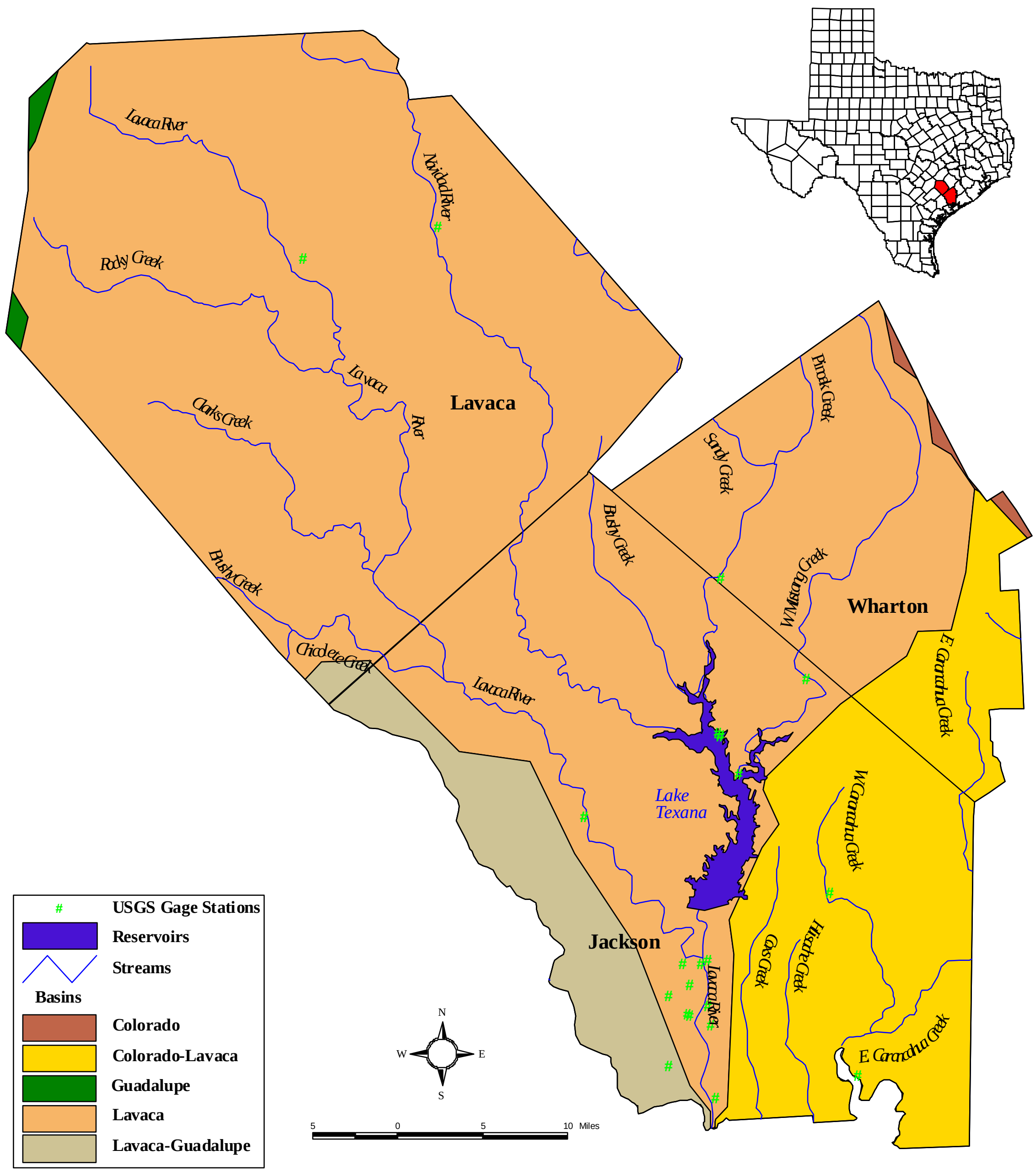


TEXAS PARKS & WILDLIFE

Produced by the TPWD Water Resources Team, June 1999. No claims are made to the accuracy of the data or the suitability of the data for a particular use.

Sources:
TPWD GIS lab archives 1998.
Texas Water Development Board
Texas Natural Resources Information System
Projection:
Texas Statewide Projection

Figure 2. Water Resources of the Study Area



Produced by the TPWD Water Resources Team, June 1999. No claims are made to the accuracy of the data or the suitability of the data for a particular use.

Sources:
TPWD GIS Lab archives data 1998.
Texas Water Development Board
EPA-823-C-98-008
Projection:
Texas Statewide Projection

Economy and Land Use

The economy of the area consists primarily of petroleum production and operation, agribusiness and tourism. Agricultural production is varied. It consists of cattle, poultry, corn, cotton, and rice, with rice being the principal crop for Wharton County. The market value for the agriculture in the study area is around $192.4 million (Dallas Morning News 1997).

Outdoor recreational facilities also contribute to the area's economy. Lake Texana, the estuarine areas of the Lavaca River, and Garcitas Creek provide opportunities for bird watching, fishing, waterfowl hunting, boating, and other water sports. All these areas are located in Jackson County.

The Texana Loop of the Great Texas Coastal Birding Trail (Central Texas Coast) includes 9 sites (Sites 17-25), all in Jackson County, on Lake Texana, the Lavaca/Navidad estuary, and on Arenosa/Garcitas Creek. Lake Texana SP alone contributes $ 5-6 million per year to the local economy in Jackson County (see Appendix B).

SELECTED NATURAL RESOURCES

Soils

The natural regions of Texas were delineated largely on the basis of soil types and major vegetation types. Soils in the study area vary from alluvial, sandy soils with loamy surface to black waxy soils with loamy or sandy surface (Godfrey et al. 1973). Soil associations found in the area are described as follows:

1. Level soils of the coast Prairie and Marsh

    (a) Somewhat poorly to moderatly well drained cracking clayey soils; and mostly poorly drained soils with loamy surface layers and cracking clayey subsoils: Vertisols.
    (b) Cracking clayey soil and friable loamy soils of the Brazos and Colorado River flood plains: Mollisols.
    (c) Soils with loamy surface layers and mottled clayey or mottled to gray loamy subsoils: Alfisols.

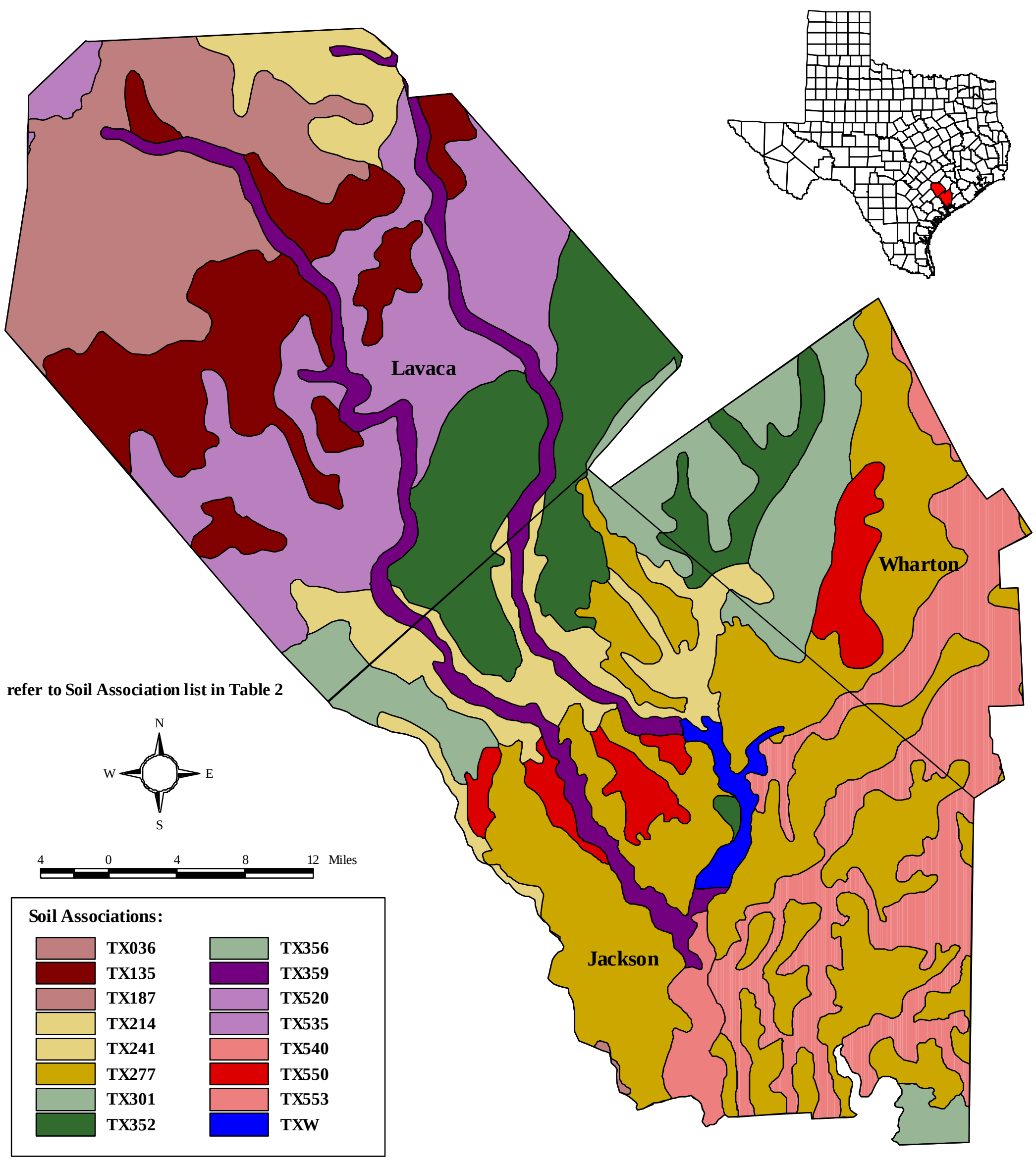
2. Undulating alkaline to slightly acid soils of the Blackland Prairie

    (a) Slightly acid soils with loamy surface layers and cracking clayey subsoils; and noncalcareous cracking clayey soils: Alfisols
    (b) Noncalcareous and calcareous cracking clayey soils; and slightly acid soils with loamy surface layers: Vertisols.
    (c) Soils with loamy surface layers and mottled gray and red or yellow cracking clayey subsoils: Alfisols.

Table 2. Soil Associations of the study area

Soil Association	Soil Name
TX036	Austwell-Aransas-Placedo
TX135	Denhawken-Elmendorf-Hallettsville
TX187	Frelsburg-Carbengle-Hallettsville
TX214	Hallettsville-Dubina-Straber
TX241	Inez-Milby-Kuy
TX277	Lake Charles-Dacosta-Contee
TX301	Livia-Palacios-Francitas
TX352	Morales-Cieno-Inez
TX356	Nada-Telferner-Cieno
TX359	Lavaca-Navidad-Ganado
TX520	Singleton-Burlewash-Shiro
TX535	Straber-Tremona-Catilla
TX540	Swan-Aransas-Placedo
TX550	Telferner-Edna-Cieno
TX553	Texana-Edna-Cieno
TXW	Water

Figure 3. Soil Types of the Study Area



TEXAS PARKS & WILDLIFE

Produced by the TPWD Water Resources Team, June 1999. No claims are made to the accuracy of the data or the suitability of the data for a particular use.

Source:
TPWD Gis lab archives data 1998.
Projection:
Texas Statewide Projection

Vegetation

As stated in the introduction, the study area includes parts of the following natural subregions: Blackland Prairie, and the Upland Prairies and Woods subregions (Lyndon B. Johnson School of Public Affairs 1978).

There are seven major vegetation types found in the study area (Figure 4). The main vegetation types are Crops, and Post Oak Woods/Forest, followed closely by Post Oak Woods, Forest and Grassland Mosaic, Pecan-Elm Forest, Other Native or Introduced Grasses, Bluestem Grassland, and Marsh/Barrier Island are also found with decreasing distributions, respectively, in the study area. The scientific names for the plants mentioned below can be found in Appendix A (McMahan et al. 1984).

Commonly associated plants of the Crops type are: cultivated cover crops or row crops providing food and/or fiber for either man or domestic animals. This type also includes grassland associated with crop rotation.

Commonly associated plants of the Post Oak Woods/Forest, and Post Oak Woods, Forest, and Grassland Mosaic vegetation types are: Post oak, blackjack oak, eastern redcedar, mesquite, black hickory, live oak, sandjack oak, cedar elm, hackberry, yaupon, poison oak, American beautyberry, hawthorn, supplejack, trumpet creeper, dewberry, coral-berry, little bluestem, silver bluestem, sand lovegrass, beaked panicum, three-awn, sprangle-grass, and tickclover. These vegetation types are most apparent on the sandy soils of the Post Oak Savannah.

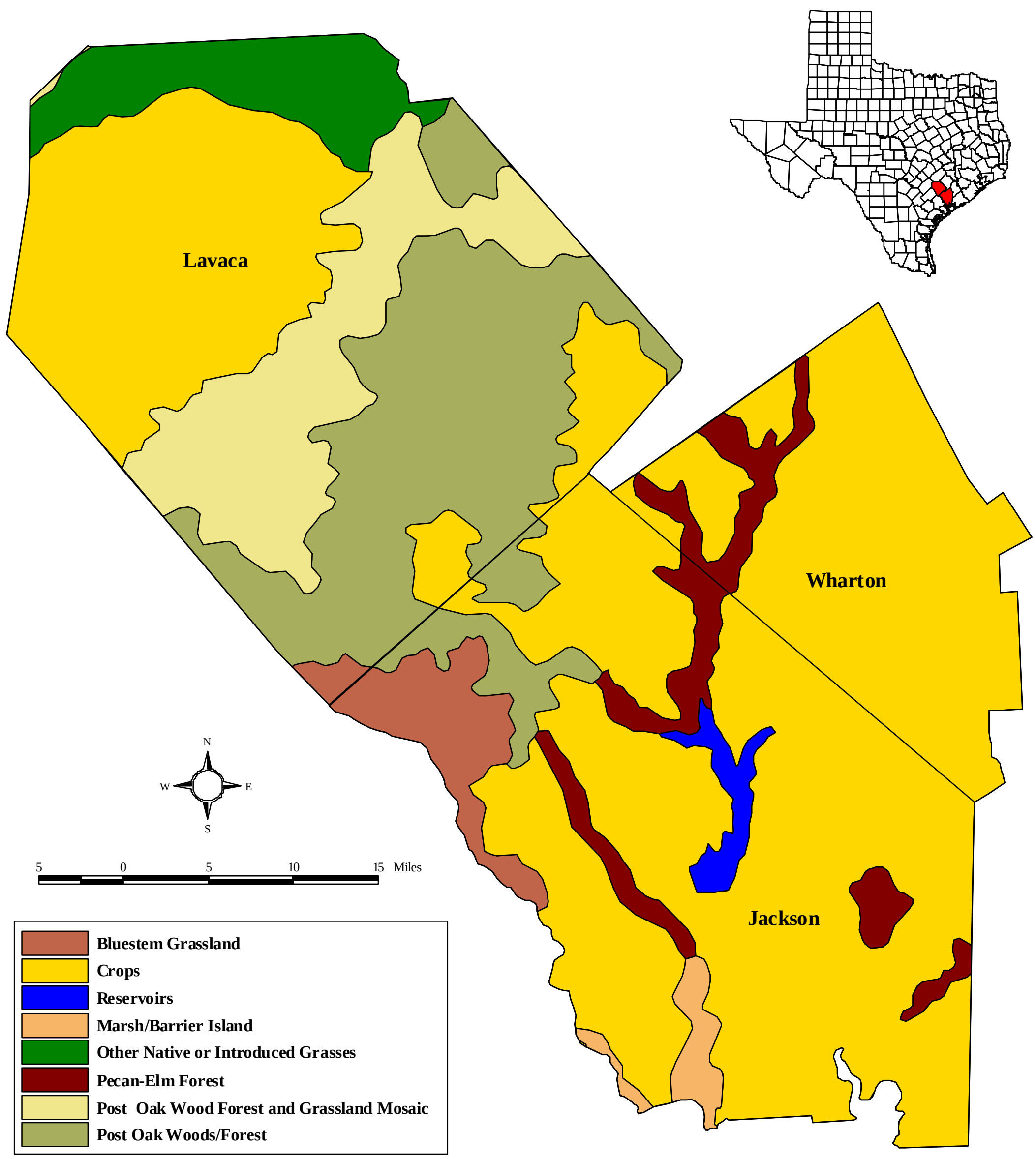
Pecan-Elm Forest includes: Pecan, American elm, cedar elm, cottonwood, sycamore, black willow, live oak, green ash, bald cypress, water oak, hackberry, virgin's bower, yaupon, greenbrair, mustang grape, poison oak, Johnsongrass, Virginia wildrye, Canada wildrye, rescuegrass, frostweed, and western ragweed.

Other Native or Introduced Grasses include: mixed native or introduced grasses and forbs on grassland sites or mixed herbaceous communities resulting from the clearing of woody vegetation. This type is associated with the clearing of forests and may portray early stages of Young Forest.

Bluestem Grassland includes: bushy bluestem, slender bluestem, little bluestem, silver bluestem, three-awn, buffalograss, bermudagrass, brownseed paspalum, single-spike paspalum, smutgrass, Gulf cordgrass, windmillgrass, southern dewberry, live oak, mesquite, huisache, baccharis, and Macartney rose.

Marsh/Barrier Island includes: marshhay cordgrass, Olney's bulrush, saltmarsh bulrush, widgeongrass, California bulrush, seashore paspalum, Gulf cordgrass, and common reed.

Figure 4. Vegetation Types of the Study Area



TEXAS PARKS & WILDLIFE

Produced by the TPWD Water Resources Team, June 1999. No claims are made to the accuracy of the data or the suitability of the data for a particular use.

Source: TPWD GIS lab archives. The vegetation represents a general summary of previously produced larger scale maps. Delineation of the vegetation occurs only where the actuall vegetation exhibit adequate resolution for delineation.
Projection:
Texas Statewide Projection

Rivers and Reservoirs

The study area includes four river basins: Lavaca, Colorado-Lavaca, Guadalupe, and Lavaca-Guadalupe river basins (Figure 2). Two major rivers run through the study area (Figure 1): the Lavaca River, in the northwest portion of the study area, and the Navidad River, in the northeast portion of the study area. The Navidad River flows into Lake Texana, the only lake in the study area. Lake Texana covers 11,000 surface acres, with approximately 125 miles of shoreline.

Texas Parks and Wildlife Department drafted a list (See Appendix C for Region P List) of Texas streams and rivers (Figure 2) satisfying at least one of the criteria (See Appendix D) for ecologically unique river and stream segments. Four (Table 3); streams met the high water quality/exceptional aquatic life/high aesthetic value criteria, while the threatened or endangered species/unique communities criteria was met by 2 streams (Table 4). Two stream segments, the Lavaca River and Garcitas Creek, were found to meet the biological function criteria (Appendix C).

Table 3. Streams that meet the high water quality/exceptional aquatic life/high aesthetic value criteria (31 TAC §357.8 (b) (4)); (Bayer et al. 1992; Davis, J.R. 1998) Refer to Appendix C.

River or Stream Segment	County	Criteria
Arenosa Creek	Jackson	Ecoregion Stream; Benthic macroinvertebrates
Garcitas Creek	Jackson	Ecoregion Stream, Dissolved oxygen; Benthic macroinvertebrates
West Carancahua Creek	Jackson	Ecoregion Stream, Dissolved oxygen; Benthic macroinvertebrates
West Mustang Creek	Jackson	Ecoregion Stream; Benthic macroinvertebrates
West Mustang Creek	Wharton	Ecoregion Stream; Benthic macroinvertebrates

Table 4. Streams that meet the threatened or endangered species/unique community criteria (31 TAC §357.8 (b) (5); (Ortego, B. 1999))

River or Stream Segment	County	Threatened/endangered species
Garcitas Creek	Jackson	Texas palmetto; Diamondback terrapin
Lavaca River	Jackson	Diamondback terrapin

Wetlands

The study area has significant wetland resources. There are extensive forested wetlands (pecan-elm bottomland forests) occurring along the Lower Lavaca River in Jackson County (Figure 4); north of Lake Texana along Sandy Creek and its tributaries in Jackson and western Wharton counties, along the Navidad River west of Lake Texana; and along West and East Carancahua Creeks in southeastern Jackson County.

Rather extensive estuarine wetlands occur in southwestern Jackson County (Figures 4 & 5). The Lavaca/Navidad estuary wetlands extend from the juncture of the two rivers at FM 616 about 10 miles downstream to Lavaca Bay. The lakes, marshes, and flats of this area (Figure 5) provide habitat for estuarine fish and shellfish, freshwater river fishes, birds, mammals, reptiles, and amphibians. The same is true for the estuarine wetlands along Garcitas Creek, which forms part of the western Jackson County line.

Lake Texana supports fringing freshwater wetlands including emergent marshes, pecan-elm bottomlands, and beds of floating aquatic plants. Lake Texana State Park (575 acres), located on the west-central shore of the lake, has all these wetland types (See cover photo).

There are nine sites on the Great Texas Coastal Birding Trail (the Texana Loop) in Jackson County. Six of these are associated with forested riparian habitats fringing Lake Texana as well as the Lake itself. The other three are associated with the estuarine and riparian habitats of the Lavaca/Navidad estuary and Garcitas/Arenosa Creeks.

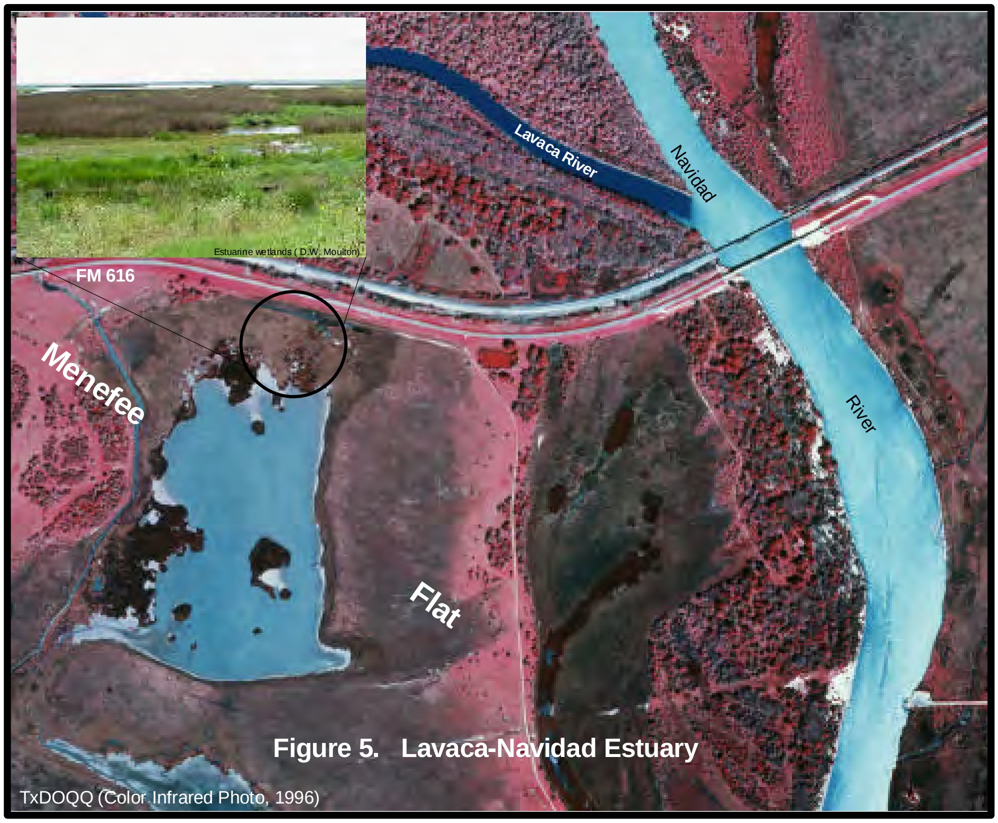


Figure 5. Lavaca-Navidad Estuary

Springs

The distribution and size, as of 1980, of springs and seeps in the area are given by county, in Table 5 (Brune 1981). Brune conducted most of the fieldwork, which produced the following information, during the period of February 11-17, 1977. Information on Lavaca County springs was not available at the time.

Jackson and Wharton Counties springs are not numerous or large due to the relatively flat topography of the Counties. Spring waters in the county are generally of the sodium bicarbonate type, hard, and alkaline (Brune 1981).

Table 5. Distribution and Estimated Size (in 1980) of Springs and Seeps in the Study Area (Brune 1981)

County	Large	Moderately large	Medium	Small	Very small	Seep	Former
Jackson	0	0	0	1	0	0	5
Lavaca	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wharton	0	0	0	0	0	1	3

The numbers above are a reflection of either a spring or a group of springs.
Codes:
Large = 280 to 2,800 cfs
Moderately large = 28 to 280 cfs
Medium = 2.8 to 28 cfs
Former = no flow or inundated
Small = 0.28 to 2.8 cfs
Very Small = 0.028 to 0.28 cfs
Seep = less than 0.028 cfs

Gulf Coast Aquifer

The Gulf Coast Aquifer forms an irregular shaped belt along the Gulf of Mexico from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties and extends from the Rio Grande northeastward to the Louisiana-Texas border. Total pumpage was approximately 1.1 million acre-feet in 1994. Municipal pumpage accounted for 51 percent of the total, irrigation accounted for 36 percent, and industrial accounted for 12 percent. The Greater Houston Metropolitan Area is the largest user (Texas Water Development Board 1997).

Water quality is generally good in the shallower portion of the aquifer. Groundwater containing less than 500 mg/l dissolved solids is usually encountered to a maximum depth of 3,200 feet in the aquifer from San Antonio River Basin northeastward to Louisiana. From the San Antonio River Basin southward to Mexico, quality deterioration is evident in the form of increased chloride concentration and salt-water encroachment along the coast (Texas Water Development Board 1997).

Freshwater Mussels

Freshwater mussels (Family Unionidae) are sensitive biological indicators of environmental quality and are often the first organisms to decline when environmental quality of aquatic ecosystems begins to degrade (Howells et al. 1996). Consequently, freshwater mussels have become important elements of environmental impact considerations. Surveys of mussels in Texas show many of the 52 species recognized in the state have declined greatly in recent years. These population declines probably reflect poor land and water management practices and subsequent loss of mussel habitat (Howells et al. 1997). Over-grazing, the clearing of native vegetation, the design and construction of highways and bridges, and general land clearing and development have contributed to the increase of runoff and scouring floods. Scouring in upstream reaches often results in excessive deposits of soft silt or deep shifting sand on downstream substrates, eliminating mussel habitat. Mussels with reported occurrence in the study area are shown in Table 6.

Table 6. Freshwater Mussels (Howells et al. 1996)

Scientific Name	Common Name
Amblema plicata	Threeridge
Anodonta grandis	Giant floater
Anodonta imbecillis	Paper pondshell
Arcidens confragosus	Rock-pocket book
Cyrtonais tampicoensis	Tampico pearlymussel
Glebula rotundata	Round pearlshell
Lampsilis bracteata	Texas fatmucket
Lampsilis teres	Yellow sandshell
Leptodea fragilis	Fragile papershell
Ligumaia subrostrata	Pond mussel
Potamilus ohiensis	Pink papershell
Potamilus purpuratus	Bleufer
Quadrula apiculata	Southern Mapleleaf
Quadrula houstonensis	Smooth pimpleback
Toxolasma texasensis	Texas lilliput
Truncilla macrodon	Texas fawnsfoot
Uniomerus declivis	Tapered pondhorn
Uniomerus tetralasmus	Pondhorn

Fish

Most Texas estuaries that receive freshwater inflow from rivers provide habitats for over 200 species of fish and shellfish. Many of these are important to the commercial and recreational fishing industries. Species such as brown, white and pink shrimp, oysters, blue crab, redfish, sea trout, and flounder are very important to the economy of the Texas coast. The estuarine habitats of Jackson County contribute to this economy.

One of the species of fish reported in the area (Table 7) is included on the Special Species List (Table 8) produced by the Texas Parks and Wildlife Department (1998a). This species is Guadalupe bass, it is the official state fish of Texas (Hubbs et. al 1991). The Guadalupe bass is endemic to the streams of the northern and eastern Edwards Plateau including portions of the Brazos, Colorado, Guadalupe, and San Antonio basins.

Table 7. Fish Species Reported in the Study Area
(Lee et al. 1980; Hubbs et al. 1991)

Species	Common Name
Ameiurus melas	Black bullhead
Ameiurus natalis	Yellow bullhead
Anguilla rostrata	American eel
Aplodinotus grunniens	Freshwater drum
Astyanax mexicanus	Mexican tetra
Campostoma anomalum	Central stoneroller
Carassius auratus	Goldfish
Carpiodes carpio	River carpsucker
Cycleptus elongatus	Blue sucker
Cyprinella lutrensis	Red shiner
Cyprinella venusta	Blacktail shiner
Cyprinodon variegatus	Sheepshead minnow
Cyprinus carpio	Common carp
Dorosoma cepedianum	Gizzard shad
Dorosoma petenense	Threadfin shad
Etheostoma gracile	Slough darter
Fundulus chrysotus	Golden topminnow
Fundulus grandis	Gulf killifish
Fundulus notatus	Blackstripe topminnow
Fundulus pulvereus	Bayou killifish
Gambusia affinis	Western mosquitofish
Ictalurus furcatus	Blue catfish
Ictalurus punctatus	Channel catfish
Ictiobus bubalus	Smallmouth buffalo
Lepisosteus oculatus	Spotted gar

Table 7 cont'd.

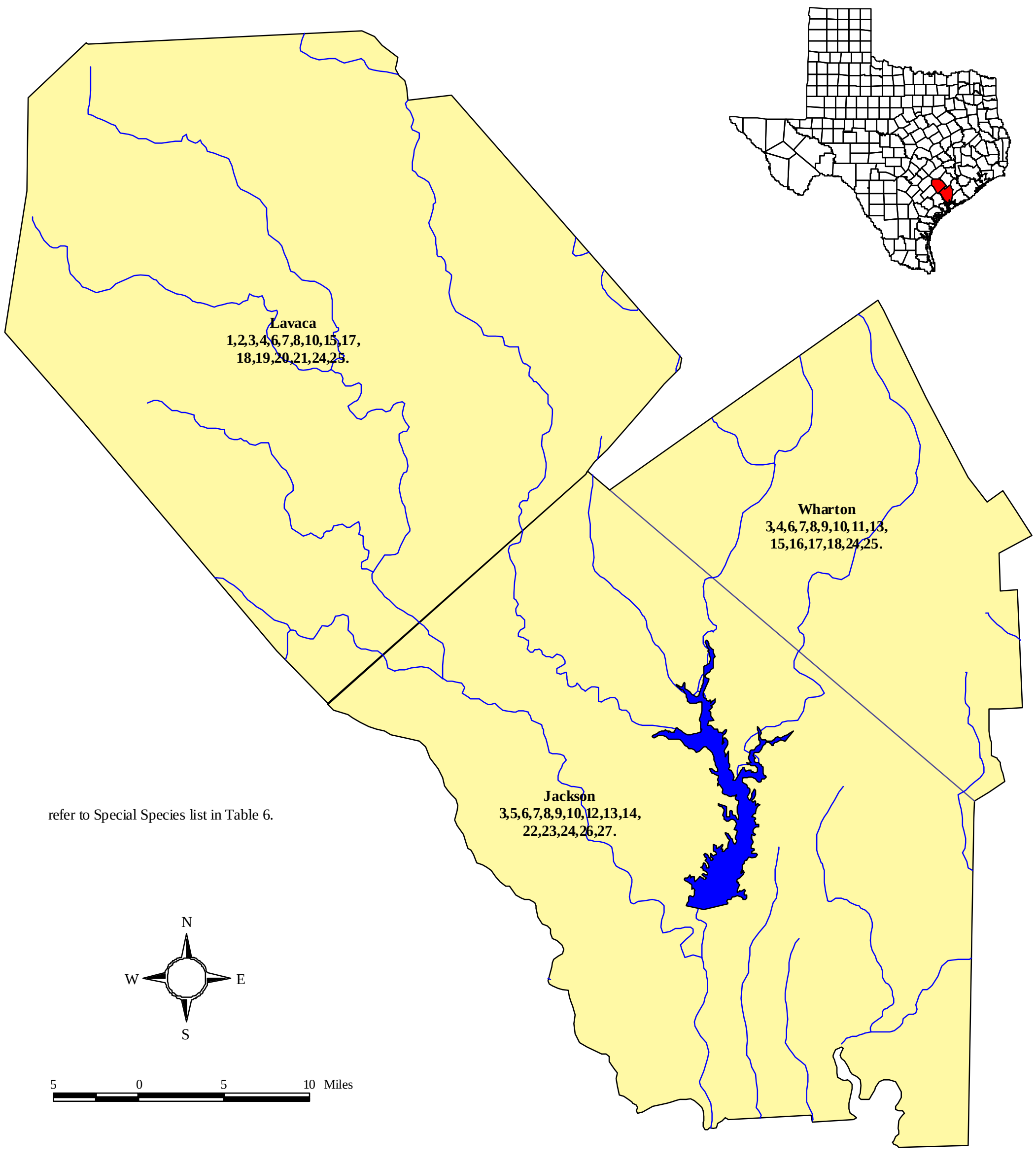
Lepisosteus osseus	Longnose gar
Lepisosteus spatula	Alligator gar
Lepomis auritus	Redbreast sunfish
Lepomis cyanellus	Green sunfish
Lepomis gulosus	Warmouth
Lepomis humilis	Orangespotted sunfish
Lepomis macrochirus	Bluegill
Lepomis megalotis	Longear sunfish
Lepomis microlophus	Redear sunfish
Lepomis punctatus	Spotted sunfish
Lythrurus fumeus	Ribbon shiner
Macrhybopsis aestivalis	Speckled chub
Menidia beryllina	Inland silverside
Micropterus treculi	Guadalupe bass
Micropterus salmoides	Largemouth bass
Morone chrysops	White bass
Mugil cephalus	Stiped mullet
Notemigonus crysoleucas	Golden shiner
Notropis amnis	Pallid shiner
Notropis buchanani	Ghost shiner
Notropis shumardi	Silverband shiner
Notropis texanus	Weed shiner
Notropis volucellus	Mimic shiner
Noturus gyrinus	Tadpole madtom
Opsopoeodus emiliae	Pugnose minnow
Percina macrolepida	Bigscale logperch
Pimephales promelas	Fathead minnow
Pimephales vigilax	Bullhead minnow
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Pylodictis olivaris	Flathead catfish
Syngnathus scovelli	Gulf pipefish

Table 8. Species of Special Concern in the Study Area (Texas Parks and Wildlife Department 1998a)

Map code*	Scientific name	Common name	Fed. Status	State Status
	AMPHIBIANS			
1	*Bufo houstonensis*	Houston toad	LE	E
	BIRDS			
2	*Ammodramus henslowii*	Henslow's sparrow		
3	*Buteo albicaudatus*	White-tailed hawk		T
4	*Charadrius montanus*	Mountain plover	PT	
5	*Egretta rufescens*	Reddish egret		T
6	*Falco peregrinus anatum*	American peregrine falcon	LE	E
7	*Falco peregrinus tundrius*	Arctic peregrine falcon	E/SA	T
8	*Grus americana*	Whooping crane	LE	E
9	*Haliaeetus leucocephalus*	Bald eagle	LT	T
10	*Mycteria americana*	Wood stork		T
11	*Numenius borealis*	Eskimo curlew	LE	E
12	*Pelecanus occidentalis*	Brown pelican	LE	E
13	*Plegadis chihi*	White-faced ibis		T
14	*Sterna antillarum athalassos*	Interior least tern	LE	E
15	*Tympanuchus cupido attwateri*	Attwater's greater prairie-chicken	LE	E
	FISHES			
16	*Micropterus treculi*	Guadalupe bass		
	MAMMALS			
17	*Spilogale putorius interrupta*	Plains spotted skunk		
	REPTILES			
18	*Crotalus horridus*	Timber/Canebrake rattlesnake		T
19	*Gopherus berlandieri*	Texas tortoise		T
20	*Graptemys caglei*	Cagle's map turtle	C1	
21	*Liochlorophis vernalis*	Smooth green snake		T
22	*Malaclemys terrapin littoralis*	Texas diamondback terrapin		
23	*Nerodia clarkii*	Gulf saltmarsh snake		
24	*Phrynosoma cornutum*	Texas horned lizard		T
25	*Thamnophis sirtalis annectens*	Texas garter snake		
	VASCULAR PLANTS			
26	*Psilactis heterocarpa*	Welder machaeranthera		
27	*Thurovia triflora*	Threeflower broomweed		

* Lookup code for map of Figure 6.
Status Code: LE, LT – Federally Listed Endangered/Threatened; E/SA – Federally Endangered by Similarity of Appearance; E, T – State Endangered/Threatened; PT – Federally Proposed Threatened;
C1 – Federal Candidate, Category 1, information supports proposing to list as endangered/threatened.

Figure 5. Special Species by County



Produced by the TPWD Water Resources Team, June 1999. No claims are made to the accuracy of the data or the suitability of the data for a particular use.

Sources:
TPWD Gis lab archives data 1998.
Projections:
Texas Statewide Projection

Birds and Waterfowl

Many species of neotropical songbirds, wintering shorebirds, and a large number of waterfowl stop-over in the study area to feed and rest along the river banks and creek bottoms. The Special Species List (Texas Parks and Wildlife Department 1998a) for the study area includes 14 birds (Table 8), some of which are riparian and/or wetland dependent. Several of the birds occur in the study area only as migrants (i.g. peregrine falcon, whooping crane). Migrating peregrine falcons utilize wetlands as they prey mostly on ducks and shorebirds. Migrating whooping cranes use wetlands for feeding and roosting. An extensive list of birds observed in Lake Texana State Park can be obtained at the park headquarters (also see http:www.tpwd.state.tx.us/park/laketexa/laketexa.htm).

Mammals, Amphibians, and Reptiles

There are 1,100 vertebrate species in Texas, 60 of which are endemic to the state (Texas Audubon Society 1997). There are at least 87 species of mammals (Table 9), amphibians (Table 10), and reptiles (Table 11), listed in the Texas Parks and Wildlife Biological Conservation Database (BCD), present in the study area.

The plains spotted skunk is the only mammal in Table 9 that is listed in the Special Species List. Table 10 includes one amphibian that is listed in the Special Species List, the Houston toad. Table 11 includes eight reptiles that are listed in the Special Species List (Table 8), the timber rattlesnake, Texas horned lizard, Texas garter snake, Texas tortoise, Cagle's map turtle, smooth green snake, Texas diamondback terrapin, and the Gulf saltmarsh snake. Figure 6 shows the county distribution of those species listed on the Special Species List.

The Houston Toad, a federally and state listed endangered species is found only in a small pocket of southeastern Texas, including Austin, Bastrop, Burleson, Colorado, Lavaca, Leon, Milam, and Robertson Counties. It is found in pine forests and prairies with sandy ridges (Texas Parks and Wildlife 1999).

The Houston Toad is endangered because many small natural breeding ponds have been drained. Clearing natural vegetation and planting pasture grasses such as bermudagrass also eliminates habitat. Also, fire ants may kill young toads as they leave the pond (Texas Parks and Wildlife 1999).

The Texas garter snake is found in wet or moist microhabitats, but not necessarily restricted to them. It hibernates underground or under surface cover. The Timber/Canebrake rattlesnake occurs in swamps, floodplains, upland pine, deciduous woodlands, riparian zones, and abandoned farms.

The Cagle's map turtle is endemic to the Guadalupe River System. It occurs in short stretches of shallow water with swift to moderate flow and gravel or cobble bottom, connected to deeper pools with a slower flow rate and a silt or mud bottom. It nests on gently sloping sand banks within 30 feet of the water.

Table 9. Mammals of the Study Area (Davis and Schmidly 1994; Texas Parks and Wildlife Department 1998a)

Scientific Name	Common Name
Baiomys taylori	Northern pygmy mouse
Canis rufus	Red wolf (extirpated)
Chaetodipus hispidus	Hispid pocket mouse
Didelphis virginiana	Virginia opossum
Geomys attwateri	Attwater's pocket gopher
Lasiurus borealis	Eastern red bat
Lepus californicus	Black-tailed jack rabbit
Mephitis mephitis	Striped skunk
Neotoma floridana	Eastern woodrat
Oryzomys palustris	Marsh rice rat
Peromyscus leucopus	White-footed mouse
Peromyscus maniculatus	Deer mouse
Reithrodontomys fulvescens	Fulvous harvest mouse
Sciurus niger	Eastern fox squirrel
Sigmodon hispidus	Hispid cotton rat
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel
Spilogale putorius interrupta	Plains spotted skunk
Sylvilagus floridanus	Eastern cottontail
Urocyon cinereoargenteus	Gray fox

Table 10. Amphibians of the Study Area (Texas Parks and Wildlife Department 1998a)

Scientific Name	Common Name
Acris crepitans	Northern cricket frog
Ambystoma texanum	Smallmouth salamander
Bufo houstonensis	Houston toad
Bufo speciosus	Texas toad
Bufo valliceps	Gulf coast toad
Bufo woodhousii	Woodhouse's toad
Gastrophryne carolinensis	Eastern narrowmouth toad
Gastrophryne olivacea	Great plains narrowmouth toad
Hyla chrysoscelis	Cope's gray treefrog
Hyla cinerea	Green treefrog
Hyla versicolor	Northern gray treefrog
Notophthalmus viridescens	Eastern newt
Pseudacris clarkii	Spotted chorus frog
Pseudacris streckeri	Strecker's chorus frog
Pseudacris triseriata	Striped chorus frog
Rana catesbeiana	Bullfrog
Rana sphenocephala	Southern leopard frog
Scaphiopus holbrookii	Eastern spadefoot
Siren intermedia	Lesser siren

Table 11. Reptiles of the Study Area (Texas Parks and Wildlife Department 1998a)

Scientific Name	**Common Name**
Agkistrodon contortrix	Copperhead
Agkistrodon piscivorus	Cottonmouth
Alligator mississippiensis	American alligator
Anolis carolinensis	Green anole
Chelydra serpentina	Snapping turtle
Cnemidophorus gularis	Texas spotted whiptail
Cnemidophorus sexlineatus	Six-lined racerunner
Coluber constrictor	Racer
Crotalus atrox	Western diamondback rattlesnake
Crotalus horridus	Timber (canebrake) rattlesnake
Deirochelys reticularia	Chicken turtle
Elaphe obsoleta	Black rat snake
Eumeces fasciatus	Five-lined skink
Eumeces laticeps	Broadhead skink
Eumeces septentrionalis	Prairie skink
Farancia abacura	Mud snake
Gopherus berlandieri	Texas tortoise
Graptemys caglei	Cagle's map turtle
Hemidactylus turcicus	Mediterranean gecko
Heterodon platirhinos	Eastern hognose snake
Kinosternon flavescens	Yellow mud turtle
Kinosternon subrubrum	Eastern mud turtle
Lampropeltis calligaster	Prairie kingsnake
Lampropeltis getula	Common kingsnake
Liochlorophis aestivus	Rough green snake
Malaclemys terrapin littoralis	Texas diamondback terrapin
Masticophis flagellum	Coachwhip
Micrurus fulvius	Eastern coral snake
Nerodia cyclopion	Green water snake
Nerodia erythrogaster	Plainbelly water snake
Nerodia fasciata	Southern water snake
Nerodia rhombifer	Diamondback water snake
Ophisaurus attenuatus	Slender glass lizard
Phrynosoma cornutum	Texas horned lizard
Pseudemys texana	Texas river cooter
Regina grahamii	Graham's crayfish snake
Sceloporus undulatus	Eastern fence lizard
Scincella lateralis	Ground skink
Sistrurus miliarius	Pigmy rattlesnake
Storeria dekayi	Brown snake
Tantilla gracilis	Flathead snake
Terrapene carolina	Eastern box turtle

Table 11 cont'd.

Terrapene ornata	Western box turtle
Thamnophis marcianus	Checkered garter snake
Thamnophis proximus	Western ribbon snake
Trionyx muticus	Smooth softshell
Trionyx spiniferus	Spiny softshell
Virginia striatula	Rough earth snake

Conclusions

Region P has a variety of valuable aquatic, wetland, riparian, and estuarine habitats. The estuary of the Lavaca and Navidad Rivers provides habitats for economically important and ecologically characteristic marine and estuarine animals as well as for freshwater and terrestrial animals. This is true also for the smaller estuarine reach of Garcitas Creek from Lavaca Bay upstream to the Arenosa Creek confluence. The estuarine habitats are in southern Jackson County.

Extensive pecan-elm type bottomland hardwood forests occur along several rivers and streams in Jackson and Wharton Counties. The Lavaca River, Garcitas Creek, Arenosa Creek, West Carancahua Creek, and West Mustang Creek all satisfy at least one of the criteria for ecologically unique river and stream segments. These include: the Lavaca River from the Navidad river confluence upstream about 20 miles; the Navidad River west of Lake Texana; Sandy Creek and its tributaries north of Lake Texana in Jackson County and Wharton Counties; and West and East Carancahua Creeks in southeastern Jackson County. Arenosa Creek on the Western border of Jackson County and West Mustang Creek in Jackson and Wharton Counties have also been identified as ecologically significant stream segments (see Appendix C & D).

Lake Texana, in Jackson County, also supports fringing wetland and bottomland habitats as well as several recreational areas, including Lake Texana State Park, that are economic assets to the region.

The above habitats include 9 sites on the Texana loop of the Great Texana Coastal Birding Trail, all in Jackson County. These are also of high economic value to the region.

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APPENDIX A

Scientific Names of Plants Mentioned
(from McMahan et al. 1984)

APPENDIX A

Scientific Names of Plants Mentioned

American beautyberry	*Callicarpa americana*
Ash, green	*Fraxinus pennsylvanica*
Baccharis	*Baccharis spp.*
Bermudagrass	*Cynodon dactylon*
Bluestem, bushy	*Andropogon glomeratus*
_______, little	*Schizachyrium scoparium var. frequens*
_______, silver	*Bothriochloa saccharoides*
_______, slender	*Schizachyrium tenerum*
Buffalograss	*Buchloe dactyloides*
Bulrush, California	*Scirpus californicus*
______, Olney's	*S. americanus*
______, saltmarsh	*S. maritimus*
Coral-berry	*Symphoricarpos orbiculatus*
Cordgrass, Gulf	*Spartina spartinae*
________, marshhay	*S. patens*
Cottonwood	*Populus deltoides*
Cypress, bald	*Taxodium distichum*
Dewberry	*Rubus spp.*
Elm, American	*Ulmus americana*
___, cedar	*U. crassifolia*
Frostweed	*Verbesina virginica*
Grape, mustang	*Vitis mustangensis*
Greenbriar	*Smilax spp.*
Hackberry	*Celtis spp.*
Hawthorn	*Crataegus spp.*
Hickory, black	*Carya texana*
Huisache	*Acacia farnesiana*
Johnsongrass	*Sorghum halepense*
Lovegrass, sand	*Eragrostis trichodes*
Mesquite	*Prosopis glandulosa*

Oak, blackjack	*Quercus marilandica*
___, live	*Q. virginiana*
___, post	*Q. stellata*
___, sandjack	*Q. incana*
___, water	*Q. nigra*
Panicum, beaked	*Panicum anceps*
Paspalum , brownseed	*Paspalum plicatulum*
________, seashore	*P. vaginatum*
________, single-spike	*P. monostachyum*
Pecan	*Carya illinoinensis*
Poison oak	*Rhus toxicodendron*
Ragweed, western	*Ambrosia psilostachya*
Reed, common	*Phragmites australis*
Redcedar, eastern	*Juniperus virginiana*
Rescuegrass	*Bromus unioloides*
Rose, Macartney	*Rosa bracteata*
Smutgrass	*Sporobolus indicus*
Sprangle-grass	*Chasmanthium sessiliflorum*
Supplejack	*Berchemia scandens*
Sycamore	*Platanus occidentalis*
Three-awn	*Aristida spp.*
Tickclover	*Desmondium spp.*
Trumpet creeper	*Campsis radicans*
Virgin’s bower	*Clematis virginiana*
Widgeon grass	*Ruppia maritima*
Wildrye, Canada	*Elymus canadensis*
______, Virginia	*E. virginicus*
Willow, black	*Salix nigra*
Windmillgrass	*Chloris spp.*
Yaupon	*Ilex vomitoria*

APPENDIX B

Estimated Economic Importance of Selected TPWD Facilities
(from Crompton et al. 1998)

LAKE TEXANA STATE RECREATION AREA

JACKSON COUNTY

AVERAGE PARTY SIZE:
Day Visitors = 3.62
Overnight Visitors = 3.41

AVERAGE DISTANCE TRAVELED TO SITE:
Day Visitors = 72.6 Miles
Overnight Visitors = 100.6 Miles

ACTUAL 1997 VISITATION (Fiscal Year):
Day Visitors = 556,092
Overnight Visitors = 58,659

PERCENT OF OUT-OF-COUNTY VISITORS:
Day Visitors = 80.95
Overnight Visitors = 94.43

PER PERSON PER DAY EXPENDITURES

Sector	Day Visitors*			Overnight Visitors			Visitor
	Adjacent	Enroute	Total	Adjacent	Enroute	Total	Average
Transportation	$1.68	$1.88	$3.56	$1.68	$0.45	$2.12	**$2.84**
Food	2.69	1.47	4.17	4.21	0.65	4.86	**4.51**
Lodging	0.31	0.15	0.46	0.04	0.00	0.04	**0.25**
Other	1.01	0.15	1.16	1.07	0.00	1.07	**1.12**
Total	**5.70**	**3.65**	**9.35**	**6.99**	**1.10**	**8.09**	**8.72**

ESTIMATED ANNUAL ECONOMIC IMPACT ON SALES

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$755,125	$755,125	$1,049,171	$92,918	$92,918	$129,100	**$1,178,271**
Food	1,211,854	1,211,854	2,164,249	233,044	233,044	416,194	**2,580,443**
Lodging	140,063	140,063	237,170	2,248	2,248	3,807	**240,976**
Other	456,729	456,729	882,400	59,198	59,198	114,370	**996,770**
Total	**2,563,771**	**2,563,771**	**4,332,989**	**387,408**	**387,408**	**663,471**	**4,996,460**

ESTIMATED ANNUAL ECONOMIC IMPACT ON PERSONAL INCOME

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$755,125	$330,292	$401,047	$92,918	$40,642	$49,349	**$450,396**
Food	1,211,854	354,588	572,601	233,044	68,189	110,113	**682,714**
Lodging	140,063	38,952	62,090	2,248	625	997	**63,087**
Other	456,729	152,410	253,621	59,198	19,754	32,873	**286,494**
Total	**2,563,771**	**876,242**	**1,289,359**	**387,408**	**129,211**	**193,331**	**1,482,691**

ESTIMATED ANNUAL ECONOMIC IMPACT ON EMPLOYMENT

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$755,125	10.62	15.43	$92,918	1.31	1.90	**17.33**
Food	1,211,854	39.56	55.22	233,044	7.61	10.62	**65.84**
Lodging	140,063	3.27	4.88	2,248	0.05	0.08	**4.96**
Other	456,729	20.11	27.36	59,198	2.61	3.55	**30.90**
Total	**2,563,771**	**73.56**	**102.88**	**387,408**	**11.57**	**16.14**	**119.03**

* Average PPPD expenditure data for Texas State Recreation Areas were used.

LAKE TEXANA STATE RECREATION AREA

JACKSON COUNTY

AVERAGE PARTY SIZE:
Day Visitors = 3.62
Overnight Visitors = 3.41

AVERAGE DISTANCE TRAVELED TO SITE:
Day Visitors = 72.6 miles
Overnight Visitors = 100.6 miles

ACTUAL 1997 VISITATION (Fiscal Year):
Day Visitors = 556,092
Overnight Visitors = 58,659

PERCENT OF OUT-OF-COUNTY VISITORS:
Day Visitors = 80.95
Overnight Visitors = 94.43

PER PERSON PER DAY EXPENDITURES

Sector	Day Visitors*			Overnight Visitors			Visitor
	Adjacent	Enroute	Total	Adjacent	Enroute	Total	Average
Transportation	$1.68	$1.88	$3.56	$1.68	$0.45	$2.12	**$2.84**
Food	2.69	1.47	4.17	4.21	0.65	4.86	**4.51**
Lodging	0.31	0.15	0.46	0.04	0.00	0.04	**0.25**
Other	1.01	0.15	1.16	1.07	0.00	1.07	**1.12**
Total	**5.70**	**3.65**	**9.35**	**6.99**	**1.10**	**8.09**	**8.72**

ESTIMATED ANNUAL ECONOMIC SURGE ON SALES (Including Local Visitors)

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$932,829	$932,829	$1,296,072	$98,399	$98,399	$136,715	**$1,432,788**
Food	1,497,040	1,497,040	2,673,563	246,791	246,791	440,743	**3,114,307**
Lodging	173,025	173,025	292,983	2,381	2,381	4,031	**297,014**
Other	564,211	564,211	1,090,056	62,690	62,690	121,116	**1,211,172**
Total	**3,167,104**	**3,167,104**	**5,352,674**	**410,260**	**410,260**	**702,606**	**6,055,280**

ESTIMATED ANNUAL ECONOMIC SURGE ON PERSONAL INCOME (Including Local Visitors)

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$932,829	$408,019	$495,425	$98,399	$43,040	$52,260	**$547,685**
Food	1,497,040	438,034	707,351	246,791	72,211	116,609	**823,960**
Lodging	173,025	48,118	76,702	2,381	662	1,055	**77,757**
Other	564,211	188,277	313,306	62,690	20,920	34,812	**348,118**
Total	**3,167,104**	**1,082,448**	**1,592,785**	**410,260**	**136,832**	**204,735**	**1,797,520**

ESTIMATED ANNUAL ECONOMIC SURGE ON EMPLOYMENT (Including Local Visitors)

Sector	Day Visitors*			Overnight Visitors			Visitor
	Expenditures	Direct Impact	Total Impact	Expenditures	Direct Impact	Total Impact	Total
Transportation	$932,829	13.12	19.06	$98,399	1.38	2.01	**21.07**
Food	1,497,040	48.87	68.22	246,791	8.06	11.25	**79.46**
Lodging	173,025	4.04	6.03	2,381	0.06	0.08	**6.11**
Other	564,211	24.84	33.80	62,690	2.76	3.76	**37.55**
Total	**3,167,104**	**90.87**	**127.10**	**410,260**	**12.26**	**17.09**	**144.19**

* Average PPPD expenditure data for Texas State Recreation Areas were used.

APPENDIX C

TPWD Information Supporting River and Stream Segment Designations

Texas Parks and Wildlife Department Draft List of Texas streams and rivers satisfying at least one of the criteria defined in Senate Bill 1 for ecologically unique river and stream segments.

REGION P (LAVACA)

Arenosa Creek - From the confluence with Garcitas Creek in Jackson/Victoria County upstream to its headwaters along the northern boundary of Victoria County

Aq. Life: Ecoregion Stream[1]; Benthic macroinvertebrates[1,2]

Garcitas Creek - From the confluence with Lavaca Bay in Jackson/Victoria/Calhoun County upstream to the Arenosa Creek confluence in Jackson/Victoria County

Aq. Life: Ecoregion Stream, Dissolved oxygen[1]; Benthic macroinvertebrates[1,2]

End/Threat: One of only a few locales in Texas where Texas palmetto occurs naturally[32]; Diamondback terrapin[32]

Biol. Function: Extensive estuarine wetland habitat

Lavaca River - From the confluence with Lavaca Bay in Calhoun/Jackson County to a point 5.3 miles downstream of US 59 in Jackson County (TNRCC stream segment 1601)

Biol. Function: Extensive freshwater and estuarine wetland habitat[14]

End/Threat: Diamondback terrapin[32]

Hydrologic Function: Forested riparian habitats perform all hydrologic functions

West Carancahua Creek - From the confluence with Carancahua Creek in Jackson County upstream to the FM 111 crossing east of Edna in Jackson County

Aq. Life: Ecoregion Stream, Dissolved oxygen[1]; Benthic macroinvertebrates[1,2]

Hydrologic Function: Forested riparian habitats perform all hydrologic functions

West Mustang Creek - From the point where East Mustang Creek and West Mustang Creek join to form Mustang Creek in Jackson County upstream to FM 1160 in Wharton County

Aq. Life: Ecoregion Stream[1]; Benthic macroinvertebrates[1,2]

REFERENCES

[1] Bayer, C.W., J.R. Davis, S.R. Twidwell, R. Kleinsasser, G. Linam, K. Mayes, and E. Hornig. 1992. Texas aquatic ecoregion project: an assessment of least disturbed streams (draft). Texas Water Commission, Austin, Texas.

[2] Davis, J.R. 1998. Personal communication. Texas Natural Resource Conservation Commission, Austin, Texas.

[14] Bauer J., R. Frye, and B. Spain. 1991. A Natural Resource Survey for Proposed Reservoir Sites and Selected Stream Segments in Texas. Texas Parks and Wildlife Dept., PWD-BK-0300-06 7/91, Austin, Texas

[32] Ortego, B. 1999. Personal communication. Texas Parks and Wildlife Department, Victoria, Texas.

Appendix D

§357.8 Ecologically Unique River and Stream Segments

Title 31. NATURAL RESOURCES AND CONSERVATION

Part X. TEXAS WATER DEVELOPMENT BOARD

Chapter 357. REGIONAL WATER PLANNING GUIDELINES

§ 357.8 Ecologically Unique River and Stream Segments

(a) Regional water planning groups may include in adopted regional water plans recommendations for all or parts of river and stream segments of unique ecological value located within the regional water planning area by preparing a recommendation package consisting of a physical description giving the location of the stream segment, maps, and photographs of the stream segment and a site characterization of the stream segment documented by supporting literature and data. The recommendation package shall address each of the criteria for designation of river and stream segments of ecological value found in subsection (b) of this section. The regional water planning group shall forward the recommendation package to the Texas Parks and Wildlife Department and allow the Texas Parks and Wildlife Department 30 days for its written evaluation of the recommendation. The adopted regional water plan shall include, if available, Texas Parks and Wildlife Department's written evaluation of each river and stream segment recommended as a river or stream segment of unique ecological value.

(b) A regional water planning group may recommend a river or stream segment as being of unique ecological value based upon the following criteria:

(1) biological function--stream segments which display significant overall habitat value including both quantity and quality considering the degree of biodiversity, age, and uniqueness observed and including terrestrial, wetland, aquatic, or estuarine habitats;

(2) hydrologic function--stream segments which are fringed by habitats that perform valuable hydrologic functions relating to water quality, flood attenuation, flow stabilization, or groundwater recharge and discharge;

(3) riparian conservation areas--stream segments which are fringed by significant areas in public ownership including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan;

(4) high water quality/exceptional aquatic life/high aesthetic value--stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality; or

(5) threatened or endangered species/unique communities--sites along streams where water development projects would have significant detrimental effects on state or federally listed

threatened and endangered species, and sites along streams significant due to the presence of unique, exemplary, or unusually extensive natural communities.

Source: The provisions of this § 357.8 adopted to be effective March 11, 1998, 23 TexReg 2338.

Contents

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Chapter 9 – Water Infrastructure Financing Recommendations

9.1 Introduction

In SB 2 of the 77th Texas Legislature, the preparation of an infrastructure financing report (IFR) was added to the regional planning process and this step is carried into the 2021 Planning Round. The purpose of the report is to identify the funding needed to implement the water management strategies recommended in RWPs. The primary objectives of this chapter/report are:

- Determine the number of political subdivisions with identified needs that will be unable to finance their water infrastructure needs
- Determine the amount of infrastructure costs in the RWPs that cannot be financed by the local political subdivisions
- Determine funding options, such as state funding, that are proposed by the political subdivisions to finance water infrastructure costs that cannot be financed locally
- Determine additional roles the RWPG propose for the state in financing the recommended water supply projects

[REMAINDER OF INTRODUCTION TO BE PROVIDED AS PART OF FINAL PLAN]

9.2 Summary of Survey Responses

[RESULTS OF IFR SURVEY TO BE INCLUDED AS PART OF FINAL PLAN]

9.3 Policy Recommendations

The LRWPG is directed by the TWDB to propose roles for the State to take in financing the recommended water supply projects. In previous Regional Water Plans, recommendations were made regarding policies and programs that directly or indirectly funded water projects and water infrastructure. While there are no new recommendations for the 2021 RWP, those still relevant recommendations are discussed below.

9.3.1 Summary

The LRWPG reviewed the existing state and federal programs for funding water supply and infrastructure for their applicability to the Lavaca RWP. Generally, recommendations were classified into two categories: those addressing direct assistance programs (loans and grants) and those addressing indirect actions that impact water infrastructure financing. The LRWPG recommendations are summarized below and detailed discussions of each program or policy are provided in the following sections.

The LRWPG recommends the State develop programs to provide matching funds to farmers for implementing water conservation measures. This would include costs for precision leveling and the conversion of irrigation canals to pipelines. These funds would provide a mechanism to leverage federal grant programs by providing the local matching share.

The LRWPG recommends increased funding of the Agricultural Water Conservation Loan Program and adding a one-time grant or subsidy program to stimulate early adoption of conservation practices by individual irrigators.

The LRWPG recommends increased funding of the State Revolving Fund (SRF) Programs in future decades. This program will remain important to assist some systems in upgrading their infrastructure to meet future demands and minimum water quality standards. As infrastructure ages and water quality standards increase, the demand for this assistance will grow. The State Loan Program for political subdivisions and water supply corporations offers loans at a cost advantage over many commercial and many public funding options.

The LRWPG supports the continued and increased funding of the USDA's Rural Utilities Service program at the federal level as well as the state Rural Water Assistance Fund at the state level. These programs offer water and waste disposal loans and grants to rural areas and towns of up to 10,000 people. Certain communities within Texas are specifically targeted for these grants.

The LRWPG supports the placement of a five-cent state tax on the sale of all bottled water to be used for the funding of water-related projects by TWDB. These would include municipal and agricultural conservation programs.

The LRWPG supports financial assistance from the State, in the form of grants and low-interest loans (including SWIFT), for infrastructure improvements including Advanced Metering Infrastructure (AMI) and leak detection technologies. Small municipalities in Texas tend to have older infrastructure and lack the budget needed for improvements.

The LRWPG supports the Legislature reviewing private activity bonds to expand the authority beyond the current $50 million cap. Private activity bonds provide areas with the opportunities to encourage economic growth.

The LRWPG has and continues to support desalination as a supply alternative to neighboring regions that will develop shortages in the near future. However, desalination is not yet cost-competitive with more traditional water supply projects. It is recommended that the State continue to fund programs to promote desalination research and implementation.

The LRWPG supports provision of increased research grants to study and better develop efficient irrigation practices and to develop varieties of crops that require less water to grow and provide increased first-crop yields. Irrigators cannot generally afford the increased cost of water when new supplies are developed. By reducing demand in a cost-efficient manner, small irrigators may be able to continue farming.

9.3.2 Recommendations Relating to Direct Financial Assistance Programs

Program/Policy Item: Agricultural Water Conservation Programs

Discussion: The Agricultural Water Conservation Loan Program provides loans to soil and water conservation districts, underground water conservation districts, and districts authorized to supply water for irrigation. These districts may further lend the funds to private individuals for equipment and materials, labor, preparation, and installation costs to improve water-use efficiency related to irrigation of their private lands. There is also a grant program for equipment purchases by eligible districts for the measurement and evaluation of irrigation systems and agricultural water conservation practices and for efficient irrigation and conservation demonstration projects, among others. However, these grants are not available directly to individual irrigators. The program also includes a linked deposit loan program allowing individuals to access TWDB funding through participant farm credit institutions and local state depository banks.

EQIP, available through USDA, provides some limited funding to natural resources issues, including water quantity and availability. In 2008, Texas was allocated over $105 million in EQIP funds for projects including irrigation supply, brush control, water and air quality from livestock operations, wildlife, and invasive species. These funds are typically provided at a 50 percent cost-share rate. Jackson, Lavaca, and Wharton Counties were designated within the primary area of concern for irrigation water quantity issues. The implementation of a similar program at the state level would allow additional opportunities for irrigators to receive assistance in implementing conservation practices.

Eligible districts will need to act as conservation brokers, identifying those irrigators with the potential to reduce water demand through equipment improvements, and matching them with available loans. To assist with the immediate adoption of these improved conservation practices, a one-time grant or subsidy program for water-efficient equipment purchases may help by reducing the loan amount required by each irrigator. If the requirements of an existing federal loan or grant program could be met, the state could provide all or part of the local matching share. Since the methods used by irrigators vary across the state, such a program would need to be flexible, with local oversight provided by those districts currently eligible for the Agricultural Water Conservation Loan Program. Consistency with the applicable RWP may be included as a prerequisite for this program, as it is for other state grants and loans.

Policy Recommendation: Provide a mechanism to leverage federal grant programs by providing the local matching share. Increase funding of this loan program and consider adding a one-time grant or subsidy component to stimulate early adoption of conservation practices by individual irrigators.

Program/Policy Item: Drinking Water State Revolving Fund Program

Discussion: This program provides loans at subsidized interest rates for the construction of water treatment and distribution systems and for source water protection. As the loans are paid off, the TWDB uses the funds to make new loans (thus the name revolving fund). State funds for the program receive a federal match through the U.S. Environmental Protection Agency. These loans are intended for projects to bring existing systems into compliance with rules and regulations and are available to political subdivisions, water supply corporations, and privately-owned water systems. Applications are collected at the beginning of each year, given a priority ranking, and funded to the extent possible. Projects not funded in a given year may be carried forward into the next year’s ranking.

These programs are important in that they assist sub-standard water systems in attaining the minimum water quality mandated by federal and state regulations, but they are not intended to fund system expansions due to projected growth. However, the SRF Fund may provide assistance to water providers with aging infrastructure.

Policy Recommendation: Increase the funding of this program in future decades.

Program/Policy Item: State Loan Program

Discussion: The State Loan Program provides loans to political subdivisions and water supply corporations for water, wastewater, flood control, and municipal solid waste projects. The interest rates for this program are not subsidized as they are in the Drinking Water SRF Program. The loan can be used for a number of water system improvements including the improvement or construction of wells, treatment facilities, and transmission and distribution systems. Loans are made on a first come, first served basis. This program will be helpful to regions that are seeking funding alternatives for adding groundwater supply infrastructure.

Policy Recommendation: Increase funding of this program to meet near-term infrastructure cost projections.

Program/Policy Item: Water and Waste Disposal Loans and Grants from the USDA's Rural Utilities Service

Discussion: This federal program provides loans and grants in rural areas and communities of up to 10,000 people for water, wastewater, storm water, and municipal solid waste projects. The program is intended for communities that cannot obtain commercial loans at reasonable rates. Loans are made at or below market rates, depending upon the eligibility of the recipient. Grants can cover up to 75 percent of project costs when required to reduce user costs to a reasonable level. A separate program of Emergency Community Water Assistance Grants (up to $500,000 per project) is also available to communities experiencing rapid declines in water quality or quantity.

This program is similar to the state loan and revolving fund programs. It offers another option to small communities and rural areas unable to finance required infrastructure without assistance. However, this is a nationwide program, and the competition for available funds is correspondingly greater. Colonias and border areas are specifically identified as target areas for the grant portion of this program, and it is therefore in the state's interest to support its continued funding.

At the state level, the Rural Water Assistance Fund provides low-interest loans to municipalities, water districts, and non-profit water supply corporations. LRWPG also promotes the funding of this program in an effort to assist small rural utilities in providing safe, reliable water supplies.

Policy Recommendation: Support continued and increased funding of this program at the federal level and fund the state Rural Water Assistance Fund.

9.3.3 Policy Recommendations Which Indirectly Impact Financing for Water Infrastructure

Program/Policy Item: TWDB Funding Through Taxation of Bottled Water Sales

Discussion: In order to finance programs relating to water-related issues, the state should develop a dedicated means of acquiring funds for these projects. A tax on bottled water would generate revenue that could then be applied to conservation of water for municipal, agricultural, and industrial uses.

Policy Recommendation: Use funds generated from sales tax on the sale of bottle water to fund water-related projects, namely municipal and agricultural infrastructure projects.

Program/Policy Item: Desalination Research and Demonstration Projects

Discussion: House Bill 1370 of the 78th Texas Legislature directed TWDB to "undertake or participate in research, feasibility and facility planning studies, investigations and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state." Funding was appropriated under the 79th Texas Legislature to continue and expand the State's efforts in desalination research. Subsequently, TWDB has participated in two seawater desalination pilot projects and several brackish water desalination demonstration projects

The Lavaca Region anticipates meeting future shortages through other methods; LRWPG recognizes the growing demands of surrounding regions. By supporting programs to promote the research and implementation of desalination, LRWPG wishes to promote desalinated water as a strategy to allow regions to meet their future needs without increasing the pressure to transfer supplies from rural areas in other regions.

Policy Recommendation: Provide research grants for the study of current and upcoming desalination technologies available to wholesale and retail water suppliers. Continue to fund appropriate demonstration facilities and subsidize the use of these facilities to develop a customer base.

Program/Policy Item: Water Research Program – Agriculture

Discussion: The TWDB offers research grants to individuals or political subdivisions for water research on topics published in the TWDB's Request for Proposals. Eligible topics include product and process development.

One recommendation to the Legislature is to establish funding for agricultural research in the areas of efficient irrigation practices and the development of new crop varieties that provide more yield with less water. Generally, irrigators cannot afford the increased cost of water when new supplies are developed in today's market. By reducing demand in a cost-efficient manner, small irrigators may be able to continue farming. This is another potential topic for the Water Research Program.

Policy Recommendation: Provide increased research grants to study and better develop efficient irrigation practices.

Contents

List of Appendices

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Chapter 10 – Public Participation

10.1 Introduction

The Lavaca Regional Water Planning Group's (LRWPG) approach to public involvement has been to secure early participation of interested parties so that concerns could be addressed as the Plan is being developed. From its initial deliberations, the LRWPG has made a commitment to an open planning process and has actively solicited public input and involvement in developing the elements of the Regional Water Plan. This has been accomplished by pursuing several avenues to gain public involvement.

The first line of public involvement occurs through the membership of the LRWPG. As a result of the small geographic area and the relatively small population, the LRWPG members are highly visible and well-known representatives of the interests of water users in the Lavaca Regional Water Planning Area. The individual group members provide a liaison with identified associations, such as the soil and water conservation districts, the farm service agencies in the counties, the Texas Farm Bureau, and similar organizations. In addition, individual group members, staff members of the Lavaca-Navidad River Authority (LNRA), and members of the consultant team have made themselves available to other regional planning groups and to civic organizations such as the Lion's Clubs, Kiwanis Clubs, Rotary Clubs, and Chambers of Commerce throughout the regional planning area and in neighboring regional planning areas where LNRA customers were located. All planning group meetings are open to members of the public in order to welcome public participation in the planning process. The 2021 Lavaca Regional Water Plan was developed in accordance with the public participation requirements of the Texas Open Meetings Act.

Members of the LRWPG and personnel from LNRA attended various other regional planning meetings and meetings of community and civic organizations to present findings and decisions made by the group.

10.2 Public Meetings

LRWPG held the first meeting for the 2021 Planning Cycle in March of 2016. All of these meetings welcomed public participation as elements of RWP were addressed. The following is a summary of the minutes of those meetings. The complete minutes can be found in *Appendix 10A*.

10.2.1 March 21, 2016, Meeting

Jim Coleman of Jackson Electric Cooperative, Inc., elected as new voting member to fill position of Roy Griffin. Tom Chandler elected as voting member to fill water utilities position. Motion passed to re-elect Harrison Stafford II, chairman, L. G. Raun, Vice-Chairman, and Patrick Brzozowski, Secretary of the LRWPG and Ed Weinheimer to the Executive Committee. Motion passed to ratify Executive Committee's authorization for Lavaca-Navidad River Authority to provide public notice and hold a public meeting to take public input on issues that should be addressed or provisions that should be included in the regional or state water plan for the fifth cycle of regional water planning. Texas Water Development Board Project Manager, Ron Ellis, updated the Group on the 2021 Regional Planning Cycle. No public comments received.

10.2.2 May 24, 2016, Meeting

The Group approved a Notice of Solicitation for Nominations for Persons to Serve on the LRWPG for two open positions on the LRWPG. The Group ratified previous group action taken in January and March 2015 to execute an agreement with the Texas Water Development Board for funding related to the Fifth Cycle of the Regional Water Planning and include subsequent amendments to the agreement. The Group reviewed qualifications received for professional services related to regional water management planning for the Lavaca Regional Water Planning Area – 2021 Regional Water Plan. Qualifications were received from Freese and Nichols and AECOM. The Group approved AECOM to provide professional services related to regional water management planning for the Lavaca Regional Water Planning Area – 2021 Regional Water Plan. Contracting entity, Lavaca-Navidad River Authority, approved to execute a contract with approved consultant group (AECOM), for professional services related to regional water management planning for the Lavaca Regional Water Area – 2021 Regional Water Plan. Ron Ellis, TWDB Project Manager, informed the Group of TWDB's new Executive Administrator, Jeff Walker, who was appointed on May 19, 2016. Ron Ellis presented an overview of the 2017 State Water Plan to the Group. Kevin Kluge presented information on Population and Water Demand Projections – 2021 Regional Water Plans. No public comments received.

10.2.3 December 12, 2016, Meeting

At the time of this meeting, the Group had four open positions: Agriculture, Small Business, and Industries in Lavaca County and Agriculture in Jackson County. Marie Day, a Lavaca County resident an Analyst for Shell Exploration and Production Company, was approved to join LRWPG for Lavaca County, Industries. Patrick Brzozowski recommended that the Group circulate and publish a Notice of Solicitation for Nominations for Persons to Serve on the LRWPG for the remaining three open positions. The Group passed the motion to authorize the Region P political subdivision, Lavaca-Navidad River Authority, to provide public notice and submit a grant application to the TWDB on behalf of Region P for funding to complete the fifth round of regional water planning, and to negotiate and execute the amendment to the TWDB contract. Ron Ellis and Scott Galloway presented SWIFT information and 2016 Planning Rule Revisions. No public comments received.

10.2.4 February 23, 2017, Meeting

No response received for Notice of Solicitation for Nominations for Persons to Serve on the LRWPG for the three positions had been published in the area newspapers. Gary Skalicky nominated to fill the Jackson County, Agriculture position. AECOM Consultant briefed the Group on the following topics: Notice to Apply for Grant Funds posted on February 1, 2017; Grant application for funding was submitted to TWDB on February 6, 2017; Scope and Schedule for 5th Planning Cycle; Draft Population and Municipal Demand Projections; and Draft Mining Demand Projections. Scott Galloway and Ron Ellis briefed the group on the SWIFT funding applications, modeled available groundwater (MAG) peak factor produced by TWDB; and the Water Planning process. Stephen Cortes from Kip Averitt and Associates presented the Group with information regarding the Goldwater Project. Averitt and Associates have been contracted by the TWDB to quantify and measure water conservation strategies being implemented in all 16 regions under the 2017 State Water Plan. One of the goals of the Goldwater Project is to ensure methodology for measuring conservation in all regions that also accounts for unique situations among utilities. Ultimately, planners will have a reliable numerical value for the conservation work being done. No public comments received.

10.2.5 October 2, 2017, Meeting

Consultant briefed the Group about draft population, municipal and non-municipal demand projections. The Group was presented copies of the draft projections for their review. Multiple revisions were requested, and the Group passed motions to make revisions. Consultant stated a letter with supporting documentation will be prepared to communicate to TWDB the comments and revision requests from the LRWPG discussed and voted on today. Ron Ellis briefed group on upcoming rule revisions to the regional planning rules (31 Texas Administrative Code Chapter 357), SWIFT Projects Update, and Simplified Planning. No public comments received.

10.2.6 April 16, 2018, Meeting

The Group accepted resignation of Chairman Harrison Stafford II's and Vice Chairman L. G. Raun. New voting members nominated to serve include: Steve Cooper, Wharton County, nominated to serve representing Agricultural, Wharton County; Dennis Simons, Jackson County Judge, nominated to serve representing Agricultural, Jackson County; Bart McBeth, Lavaca County, nominated to serve representing Agricultural, Lavaca County. Neil Hudgins nominated to serve as Vice Chairman of LRWPG. Phillip Spenrath nominated to serve as Chairman. Executive committee elected as follows: Phillip Spenrath, Neil Hudgins, Patrick Brzozowski, Jim Coleman, Marie Day, Jack Maloney, and Ed Weinheimer. Group briefed on TWDB Update on revised 31 Texas Administrative Code Rules, Chapters 355 and 357. Consultant briefed group on the project status to date, the final population and water demand projections, water availability and supplies, wholesale water providers and major water providers, work effort and timeline. Consultant also briefed the Group on the process of identifying potentially feasible water management strategies. The Group approved this process. Group was briefed on the proposed regional water planning contract amendment with TWDB for additional funding (an amount of $83,547). Lavaca-Navidad River Authority (LNRA) approved as contract entity to execute contract amendment with TWDB for additional funding and to negotiate with TWDB for additional funding if available. No public comments received.

10.2.7 June 18, 2018, Meeting

New voting member sought for Lavaca County, Small Business position. TWDB project manager Elizabeth McCoy briefed the Group on the revised 31 TAC Rules, which are on the TWDB website; Flood Assessment report to be posted for public comments in the summer; Identification of Major Water Providers (MWP). Consultant briefed the Group on project status and timeline, existing water supplies, initial identification of water needs in the region, and potentially feasible water management strategies. The Group was presented with information supporting LRWPG request to use a modified TCEQ Water Availability Model (WAM) Run 3 for surface water availability modeling in the 2021 Lavaca Regional Water Plan development (Hydrologic Variance Request). The Group was presented a draft letter to TWDB requesting hydrologic variance. LNRA identified as the single Major Water Provider in the region. No public comments received.

10.2.8 August 6, 2018, Meeting

Group updated on TWDB approval of LRWPG's request to modify surface water availability hydrologic assumptions for development of the 2021 Region P Regional Water Plan, the State Flood Assessment, and the Water for Texas 2019 Conference. Consultant updated the Group about work effort to date and timeline, existing water supplies and identified water needs, potentially feasible water management strategies. Resignation announced for Robert Martin, Jackson County, Agriculture. New voting member sought for the same position. Consultant briefed the Group on the Technical Memorandum which is a compilation of the task work performed to date as part of the regional water planning process to develop the 2021 Lavaca Regional Water Plan for Region P, prepared for TWDB. Consultant authorized to address the Region P changes to the draft Technical Memorandum and approve submittal of the Technical Memorandum to TWDB prior to September 10, 2018, including public comments received through August 20, 2018. The Group was briefed on potential water management strategy evaluation scope of work (Task 5A). Task 5A Scope of Work was approved as presented and consultant was authorized to make minor adjustments as needed. LNRA was authorized to submit a request to the TWDB for a Notice-to-Proceed with the Scope of Work for Task 5A and execute subsequent contract amendments. No public comments received.

10.2.9 January 28, 2019 Meeting

Nominations needed for Lavaca County, Small Business and Jackson County, Agriculture. Officers and executive committee members re-elected to current positions. The Group was briefed on the Regional and State Water Planning Rules and Texas Statute Reference Pamphlet, Task 5A notice to

Proceed Request (approved on 10/24/18), Technical Memorandum (administratively complete letter issued 10/2/18), Water Management Strategies (WMS) evaluation tools available on TWDB website, socioeconomic impact analysis required by 31 TAC 357.33(c) and 357.40(a), Uniform Standards Stakeholder Committee Meeting, Texas Water Service Boundary Viewer, and State Flood Assessment 2019 SWIFT abridged applications. Consultant briefed the Group on the effort to date, 2021 Lavaca Regional Water Plan draft chapters 1-4, conservation and drought managements water management strategies and consideration of potential methodologies for developing evaluations, and upcoming work effort and timeline. The Group approved request to TWDB to conduct a socioeconomic analysis of not meeting identified water needs for Region P for inclusion in the 2021 Lavaca Regional Water Plan. No public comments received.

10.2.10 May 20, 2019, Meeting

Nominations needed for Lavaca County, Small Business; Jackson County, Agriculture; and Jackson County, Counties. Briefing and update from TWDB covered 2019 Texas Legislative Bills, anticipated recommendations from the Drought Preparedness Council and template for Chapter 7, and educational information available on TWDB website. The Group authorized Lavaca-Navidad River Authority to amend and execute their regional water planning contract with TWDB for additional funding (an amount of $41,775) as presented. Consultant briefed group on project status to date and timeline. Drafts for Chapters 1-4 were presented, and comments were solicited. Updates for strategy evaluations presented for Municipal Drought Management, Manufacturing Drought Management, Municipal Conservation, Conservation for Manufacturing, and El Campo Reuse. Group moved to not moved forward with a MAG Peak Factor request. No public comments received.

10.2.11 August 19, 2019, Meeting

The Group was briefed on LNRA Water Conservation and Drought Contingency Plans. Briefing and update from TWDB included Socio-Economic Impact Analysis Reports (available December 2019), newly launched interactive RWP data dashboard from TWDB, Legislative update. The legislature passed three bills directly relevant to regional water planning and significant bills related to flood planning and project funding, including House Bill (HB) 807, HB 721, HB 723, SB 7 and SB 8. HB 807 directs the TWDB to appoint an Interregional Planning Council consisting of one member from each RWPG. Patrick Brzozowski nominated by group as a member of the TWDB Interregional Planning Council and naming the Region P Chair as an alternate. Consultant briefed the Group on project status and timeline. Draft water management strategy evaluations presented. Comments for draft evaluations were solicited. Consultant presented on unique stream segments and reservoirs, indicating that no ecologically unique stream segments are identified in Region P. No public comments received.

10.2.12 December 16, 2019, Meeting

Nominations needed for new members for Small Business and Municipalities in Lavaca County and Counties and Agriculture (2) in Jackson County. Jill Sklar, Jackson Judge was approved to fill the position of Counties, Jackson County. The Group was introduced to their new TWDB project manager, Jean Devlin. The Group was briefed on TWDB rulemaking efforts, 2020 SWIFT applications, agriculture water conservation grants, the Socioeconomic Impact Analysis Dashboard, and the IPP / Final Plan process. Consultant briefed the Group on project status and timeline. Updated draft water management strategy evaluations were presented, and the Group determine which strategies should be recommended, alternative, or just considered. Additional information on unique stream segments and reservoirs was presented. No public comments received.

APPENDIX 10A

Meeting Minutes

Minutes of Lavaca Regional Water Planning Group
March 21, 2016
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, March 21, 2016 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Gerald Clark, Robert Martin, Phillip Spenrath, Richard Ottis, Edward Pustka, L.G. Raun, Harrison Stafford II and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Neil Hudgins, Lester Little, Jack Maloney, Robert Shoemate, Michael Skalicky, and David Wagner.

Also present was: Ron Ellis and Carmen Cernosek of Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Jami H. McCool of the Texas Department of Agriculture, Tom Chandler, citizen, Jim Coleman of Jackson Electric Cooperative, Inc., Kevin Conlon, SAM, LLC, and Mike Rivet of Formosa Plastics Corporation. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President and Sandy Johs, LNRA Board member, Karen Gregory, LNRA Deputy General Manager, Administration and Doug Anders, LNRA Deputy General Manager, Operations.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the November 17, 2015 were reviewed.

Pustka moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski introduced Jim Coleman, Jackson Electric Cooperative, Inc. as a potential new voting member to fill the position of Roy Griffin who retired. He also introduced Tom Chandler to fill the position in Water Utilities.

Raun moved to elect Coleman and Chandler as voting members to the Lavaca Regional Water Planning Group. Brzozowski seconded the motion. Motion passed.

Election of Officers

Clark moved to re-elect Stafford, Chairman, Raun, Vice-Chairman, and Brzozowski, Secretary of the Lavaca Regional Water Planning Group and Ed Weinheimer to the Executive Committee. Pustka seconded the motion. Motion passed.

Ratify Executive Committee's Action

Spenrath moved to ratify the Executive Committee's authorization for Lavaca-Navidad River Authority to provide public notice and hold a public meeting to take public input on issues that should be addressed or provisions that should be included in the regional or state water plan for the fifth cycle of regional water planning. Clark seconded the motion. Motion passed.

Public Input

There were no public comments.

Update from Texas Water Development Board Project Manager

Ellis briefed the Group on the new regional planning cycle and the State Water Plan draft plan schedule for comments. He briefly discussed utility-based planning and indicated that Kevin Kluge would be at the next group meeting to present more information.

A TWDB Potential Projection Distribution to Regional Water Planning Groups for the 2021 Regional Water Plans and a Fifth Planning Cycle Schedule is attached to these minutes.

The Group's next tentative scheduled meeting is May 24, 2016 at 1:30 p.m.

Public Comments

There were no public comments.

The meeting adjourned at 2:28 p.m.

Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
May 24, 2016
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Tuesday, May 24, 2016 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, John Butschek, Tom Chandler, Gerald Clark, Neil Hudgins, Jack Maloney, Robert Martin, Phillip Spenrath, L.G. Raun, Robert Shoemate, Michael Skalicky, and Chairman Harrison Stafford II.

Absent Voting Group Members were: Jim Coleman, Lester Little, Richard Ottis, Edward Pustka, David Wagner, and Ed Weinheimer.

Also present was: Ron Ellis and Kevin Kluge of Texas Water Development Board, Jaime Burke of AECOM, Jami H. McCool of the Texas Department of Agriculture, and Mike Rivet of Formosa Plastics Corporation. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President and Sandy Johs, LNRA Board member, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the March 21, 2016 were reviewed.

Brzozowski moved to approve the minutes as presented. Spenrath seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that there were two voting member positions open on the LRWPG. One open position is in Small Business and one is in Industries, both in Lavaca County. He recommended that the Group circulate and publish a Notice of Solicitation for Nominations for Persons to Serve on the Lavaca Regional Water Planning Group. A copy of the draft notice was presented to the Group for their review.

Maloney moved to approve the Notice of Solicitation as presented. Hudgins seconded the motion. Motion passed.

Authorizing LNRA to Execute Contract for Fifth Cycle

Spenrath moved to ratify previous Group action taken in January and March 2015 to execute an agreement with the Texas Water Development Board for funding related to the Fifth Cycle of Regional Water Planning and include subsequent amendments to the agreement. Butschek seconded the motion. Motion passed.

Request for Qualifications

The Group reviewed and discussed the qualifications received for professional services related to regional water management planning for the Lavaca Regional Water Planning Area – 2021 Regional Water Plan. Qualifications were received from Freese and Nichols and AECOM.

Spenrath moved to approve AECOM to provide professional services related to regional water management planning for the Lavaca Regional Water Planning Area – 2021 Regional Water Plan. Skalicky seconded the motion. Motion passed.

Authorize LNRA to Contract with Consultant Group for Professional Services

Maloney moved to authorize the contracting entity, Lavaca-Navidad River Authority, to execute a contract with approved consultant group (AECOM), for professional services related to regional water management planning for the Lavaca Regional Water Area -2021 Regional Water Plan. Clark seconded the motion. Motion passed.

Texas Water Development Board Updates

Ellis, TWDB Project Manager, informed the Group of TWDB's new Executive Administrator, Jeff Walker, who was appointed on May 19, 2016.

Ellis also presented an overview of the 2017 State Water Plan as adopted by the Board on May 19, 2016. Information was presented via Power Point, a copy of which is attached and made a part of the minutes.

Kluge presented the Group information on Population and Water Demand Projections – 2021 Regional Water Plans. Information was presented via Power Point, a copy of which is attached and made part of the minutes.

Future Meeting Dates

The Group agreed to schedule a Committee meeting to discuss water use methodology for agriculture and power projections prior to the next regular LRWPG meeting. The Committee will include Brzozowski, Raun, Hudgins, Skalicky, and Spenrath or other members interested. Information will be available prior to the Committee meeting.

The Group's next regular meeting will tentatively be scheduled in August.

Public Comments

There were no public comments.

The meeting adjourned at 2:48 p.m.

Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
December 12, 2016
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, December 12, 2016 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Neil Hudgins, Jack Maloney, L.G. Raun, Phillip Spenrath, Michael Skalicky, Chairman Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Lester Little, Robet Martin, Richard Ottis, Edward Pustka, Robert Shoemate, and David Wagner.

Also present was: Ron Ellis and Scott Galaway of Texas Water Development Board, Jaime Burke of AECOM, and Marie Day, Lavaca County citizen.Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, Sandy Johs, LNRA Board member, Doug Anders, LNRA Deputy General Manager, Operations, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the May 24, 2016 meeting were reviewed.

Skalicky moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that Gerald Clark, Lavaca Regional Water Planning Group member, Jackson County, Agriculture, has passed away. He also informed the Group that Lester Little, Lavaca County, Agriculture, had submitted his resignation from the LRWPG. The Group now has four open positions, Agriculture, Small Business, and Industries in Lavaca County and Agriculture in Jackson Coutny.

Brzozowski introduced Marie Day, a Lavaca County resident and RtP Analyst for Shell Exploration and Production Company. Brzozowski moved for Marie Day to fill the position as LRWPG member, Lavaca County, Industries. Weinheimer seconded the motion. Motion passed.

Brzozowski recommended that the Group circulate and publish a Notice of Solicitation for Nominations for Persons to Serve on the Lavaca Regional Water Planning Group for the remaining three open positions.

Authorizing LNRA to Provide Public Notice and Submit a Grant Application

Ellis briefed the Group on the need to authorize the Region P political subdivision, Lavaca-Navidad River Authority, to provide public notice and submit a grant application to the Texas Water Development Board (TWDB) on behalf of Region P for funding to complete the fifth round of regional water planning, and to negotiate and execute the amendment to the TWDB contract. This grant application is to provide additional funding for the fifth cycle of regional water planning.

Raun moved to authorize the Region P political subdivision, Lavaca-Navidad River Authority, to provide public notice and submit a grant application to the Texas Water Development Board (TWDB) on behalf of Region P for funding to complete the fifth round of regional water planning, and to negotiate and execute the amendment to the TWDB contract. Weinheimer seconded the motion. Motion passed.

Briefing from Region P Committee

The Group reviewed and discussed the draft comments prepared by the Committee regarding proposed draft water demand projection methodologies. The Group was presented a copy of the draft comments for their review.

Weinheimer moved to approve and submit to Texas Water Development Board the draft comments as presented by the Committee. Brzozowski seconded the motion. Motion passed.

Update from TWDB

Ellis and Galloway presented the following:

- SWIFT Information
- 2016 Planning Rule Revisions

Future Meeting Dates

The Group's next regular meeting is scheduled for Thursday, February 23, 2017 at noon.

Public Comments

There were no public comments.

The meeting adjourned at 1:55 p.m.

Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
February 23, 2017
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Thursday, February 23, 2017 at noon.

Voting Group Members present were: Patrick Brzozowski, John Butschek, Tom Chandler, Jim Coleman, Marie Day, Neil Hudgins, Jack Maloney, Robert Martin, Richard Ottis, L.G. Raun, Robert Shoemate, Phillip Spenrath, Michael Skalicky, Chairman Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: Robert Martin, Edward Pustka, and David Wagner.

Also present was: Ron Ellis and Scott Galaway of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, and Gary Skalicky, Jackson County citizen. Also present was Stephen Cortes of Kip Averitt and Associates, Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, Sandy Johs, LNRA Board member, Doug Anders, LNRA Deputy General Manager, Operations, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the December 12, 2016 meeting were reviewed.

Skalicky moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that a Notice of Solicitation for Nominations for Persons to Serve on the LRWPG for the three open positions had been published in the area newspapers, with no response.

Michael Skalicky moved to nominate Gary Skalicky to fill the Jackson County, Agriculture position. Brzozowski seconded the motion. Motion passed.

Day informed the Group that she was actively seeking potential members for the Lavaca County open positions.

Election of Officers

Maloney moved to re-elect Stafford, Chairman, Raun, Vice-Chairman, and Brzozowski, Secretary of the Lavaca Regional Water Planning Group and Jim Coleman, Jack Maloney, Phillip Spenrath, and Ed Weinheimer to the Executive Committee. Shoemate seconded the motion. Motion passed.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Notice to Apply for Grant Funds was posted on February 1, 2017.
- Grant application for funding was submitted to TWDB on February 6, 2017.
- Scope and Schedule for 5th Planning Cycle.
- Draft Population and Municipal Demand Projections.
- Draft Mining Demand Projections

Briefing and Update from Texas Water Development Board

Galaway updated the Group on the SWIFT funding. Applications were due February 3rd and 22 applications were received totaling approximately 1.9 billion from across the state of Texas.

Ellis briefed the Group on the modeled available groundwater (MAG) peak factor. The Group was presented information regarding the MAG peak factor produced by the Texas Water Development Board.

Ellis also presented the Group via powerpoint a Water Planning introduction, indicating information on the water planning process.

Briefing on Goldwater Project

Stephen Cortes from Kip Averitt and Associates presented the Group with information regarding the Goldwater Project.

Averitt and Associates have been contracted by the Texas Water Development Board (TWDB) to quantify and measure water conservation strategies being implemented in all 16 regions under the 2017 State Water Plan. The TWDB wants to know how much progress is being made toward reaching the conservation goals laid out in the state water plan.

One of the goals of the Goldwater Project is to ensure a uniform methodology for measuring conservation in all regions that also accounts for unique situations among utilities. Ultimately, planners will have a reliable numerical value for the conservation work being done. Cortes stated that reports should be available for the Group by August 2017.

Future Meeting Dates

The Group's next regular meeting will be scheduled for mid July.

Public Comments

There were no public comments.

The meeting adjourned at 2:45 p.m.

Harrison Stafford III
Chairman

Minutes of Lavaca Regional Water Planning Group
October 2, 2017
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, October 2, 2017 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Neil Hudgins, Jack Maloney, Richard Ottis, Edward Pustka, L.G. Raun, Robert Shoemate, Gary Skalicky, Michael Skalicky, Phillip Spenrath, Chairman Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Marie Day, Robert Martin, and David Wagner.

Also present was: Ron Ellis of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Steve Ramos, City of Corpus Christi. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, Sandy Johs, LNRA Board member, Doug Anders, LNRA Deputy General Manager, Operations, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the February 23, 2017 meeting were reviewed. Coleman moved to approve the minutes as presented. Brzozowski seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that Voting Member Marie Day was actively seeking potential members for the Lavaca County open positions.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Update on draft population and municipal demand projections.
- Presentation of draft non-municipal demand projections.
    - Draft irrigation demand projections

- Draft manufacturing demand projections
- Draft steam-electric demand projections
- Draft mining demand projections
- Draft livestock demand projections

The Group was presented copies of the draft projections for their review.

Spenrath moved to request revising the Base GPCD numbers for the municipal WUGs be modified to reflect the 2011 historical utility-boundary GPCD, and that the municipal demands reflect this change. M. Skalicky seconded the motion. Motion passed.

Spenrath moved to request revising the irrigation demand projections in all counties to equal an average of the water use in the years 2011- 2013, rather than 2010-2014. Raun seconded the motion. Motion passed.

Brzozowski moved to request changing the manufacturing demand projections in Wharton County to include the potentially unaccounted-for additional manufacturing use data provided by TWDB, and in Jackson County to include a recently increased LNRA customer demand. Ottis seconded the motion. Motion passed.

TWDB inadvertently listed a Region K steam-electric facility as part of the Region P demand. Brzozowski moved to request TWDB move the demand to Region K. Spenrath seconded the motion. Motion passed.

Spenrath moved to request revising the livestock demand projections in all counties to reflect a water use rate of 30 GPCD for fed/other cattle, rather than 15 GPCD. M. Skalicky seconded the motion. Motion passed.

Burke will prepare a letter with supporting documentation to TWDB to communicate the comments and revision requests from the LRWPG discussed and voted on today.

Briefing and Update from Texas Water Development Board

Ellis briefed the Group on legislative updates including:

- Upcoming rule revisions to the regional planning rules (31 Texas Administrative Code Chapter 357)
- SWIFT Projects Update
- Simplified Planning

Future Meeting Dates

The Group's next regular meeting was tentatively scheduled for January 18, 2018 at 1:30 p.m.

Public Comments

There were no public comments.

The meeting adjourned at 3:40 p.m.

Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
April 16, 2018
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, April 16, 2018 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Marie Day, Neil Hudgins, Jack Maloney, Richard Ottis, Edward Pustka, L.G. Raun, Gary Skalicky, Michael Skalicky, Phillip Spenrath, Chairman Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Jim Coleman, Robert Martin, Robert Shoemate and David Wagner.

Also present was: Ron Ellis and Elizabeth McCoy of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Mike Rivet of Formosa Plastics Corporation, Rusty Ray of Texas State Soil and Water Conservation Board, Dennis Simons, Steve Cooper, and Bart McBeth, public. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, Doug Anders, LNRA Deputy General Manager, Operations, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the October 2, 2017 meeting were reviewed. M Skalicky moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Accept Resignation

Brzozowski informed the Board that Chairman Stafford had submitted his resignation letter to the Lavaca Regional Water Planning Group.

Brzozowski moved to accept the resignation, with regrets, from Harrison Stafford II as Chairman and voting member of the Lavaca Regional Water Planning Group. Ottis seconded the motion. Motion passed.

Vice Chairman Raun announced his resignation from the Lavaca Regional Water Planning Group.

Brzozowski moved to accept the resignation, with regrets, from L.G. Raun as Vice Chairman and voting member of the Lavaca Regional Water Planning Group. Ottis seconded the motion. Motion passed.

Resolution Presentation to Harrison Stafford II

Brzozowski presented Stafford with a Resolution recognizing his diligence in carrying out the duties and responsibilities while serving twenty years on the Lavaca Regional Water Planning Group.

M Skalicky moved to approve the Resolution as presented. Maloney seconded the motion. Motion passed.

Nominations for New Voting Members

Raun introduced Steve Cooper, Wharton County, and nominated Cooper to serve on the Lavaca Regional Water Planning Group representing Agricultural, Wharton County. Weinheimer seconded the motion. Motion passed.

Brzozowski introduced Dennis Simons, Jackson County Judge, and nominated Simons to serve on the Lavaca Regional Water Planning Group representing Counties, Jackson County. Ottis seconded the motion. Motion passed.

Maloney introduced Bart McBeth, Lavaca County, and nominated McBeth to serve on the Lavaca Regional Water Planning Group representing Agricultural, Lavaca County. Putska seconded the motion. Motion passed.

Conduct Election of Officers

Weinheimer moved to re-elect Brzozowski as Secretary of the Lavaca Regional Water Planning Group. G Skalicky seconded the motion. Motion passed.

Brzozowski moved to nominate Hudgins to serve as Vice Chairman of the Lavaca Regional Water Planning Group. Weinheimer seconded the motion. Motion passed.

Weinheimer moved to nominate Spenrath to serve as Chairman of the Lavaca Regional Water Planning Group. M Skalicky seconded the motion. Motion passed.

Putska moved to nominate the Executive Committee as follows: Spenrath, Hudgins, Brzozowski, Coleman, Day, Maloney, and Weinheimer. Weinheimer seconded the motion. Motion passed.

Briefing and Update from Texas Water Development Board

Ellis briefed the Group via Power Point presentation on the Texas Water Development Board Update on revised 31 Texas Administrative Code Rules, Chapters 355 and 357. A copy of the presentation is attached to these minutes.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Update on process and progress, including project status to date.
- Presentation of final population and water demand projections.
- Discussion of water availability and supplies.
- Discussion of wholesale water providers and major water providers.
- Upcoming work effort and timeline.

The Group was presented a copy of the information including final population and water demand projections, and wholesale water providers and major water providers.

Identifying Potentially Feasible Water Management Strategies

Burke briefed the Group on the process on identifying potentially feasible water management strategies according to the Texas Water Development Board guidelines for Water Management Strategies. Burke presented the Lavaca Region Identifiction Process for Potentially Feasible Water Management Strategies.

There were no public comments.

Brzozowski moved to approve the process on identifying potentially feasible water management strategies as presented to the Group. Weinheimer seconded the motion. Motion passed.

Regional Water Planning Contract Amendment

Ellis briefed the Group on the proposed regional water planning contract amendment with TWDB for additional funding. The additional committed funds of $83,547 will bring the total committed funds amount to $122,544.

Brzozowski moved to approve Lavaca-Navidad River Authority (LNRA) as the contracting entity, to execute the contract amendment with TWDB for additional funding as presented and to negotiate with the TWDB for additional funding if available. M Skalicky seconded the motion. Motion passed.

Future Meeting Dates

Meetings are to be scheduled in June and September. A poll via email will be taken of the members to determine a date in which the majority can attend.

Public Comments

There were no public comments.

The meeting adjourned at 2:20 p.m.

Neil Hudgins

For Phillip Spenrath
Chairman

Vice-Chairman

Minutes of Lavaca Regional Water Planning Group
June 18, 2018
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, June 18, 2018 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Marie Day, Neil Hudgins, Jack Maloney, Bart McBeth, Richard Ottis, Robert Shoemate, Dennis Simons, Gary Skalicky, and Michael Skalicky.

Absent Voting Group Members were: John Butschek, Steve Cooper, Robert Martin, Edward Pustka, Phillip Spenrath, David Wagner, and Ed Weinheimer.

Also present was: Elizabeth McCoy of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Tony Franklin of Texas State Soil and Water Conservation Board, Esteban Ramos of City of Corpus Christi, and Jami McCool, Texas Department of Agriculture. Also present was Ronald Kubecka, LNRA Board President, Doug Anders, LNRA Deputy General Manager, Operations, and Karen Gregory, LNRA Deputy General Manager, Administration.

Vice Chairman Hudgins called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the April 16, 2018 meeting were reviewed. M Skalicky moved to approve the minutes as presented. Ottis seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski reported that the Group should continue the solicitation of a new voting member for Lavaca County, Small Business.

Briefing and Update from Texas Water Development Board

McCoy briefed the Group on the following:

- Revised 31 Texas Administrative Code Rules are on the TWDB website, Regional Water Planning, 5th Planning Cycle.
- Flood Assessment report will be posted for public comments this summer.

- Reminder that the Technical Memo is due September 10, 2018.
- Identification of Major Water Providers.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Update on process and progress, project status to date and timeline.
- Discussed existing water supplies, including the survey responses.
- Initial identification of water needs in the region.
- Discussed potentially feasible water management strategies, including the survey responses.

Submittal of Hydrologic Variance Request to TWDB

Burke briefed the Group on the surface water modeling assumptions and the associated hydrologic variance request. The Group was presented via power point information which supported LRWPG request to utilize a modified Texas Commission on Environmental Quality (TCEQ) Water Availabiltiy Model (WAM) Run 3 for surface water availability modeling in the 2021 Lavaca Regional Water Plan development (Hydrologic Variance Request). The Group was also presented a draft letter to TWDB requesting the hydrologic variance.

M Skalicky moved to approve the surface water availability modeling assumption for supplies and strategies and submittal of the associated hydrologic varance request to TWDB as presented. Brzozowski seconded the motion. Motion passed.

Potential Major Water Providers

Burke briefed the Group on the potential Major Water Providers (MWP). A MWP should be of particular significance to the region's water supply as determined by the RWPG, responsible for developing and/or delivering significant quantities of water in the region, and more data is reported for this category in the Plan.

Day moved to identify Lavaca-Navidad River Authority (LNRA) as the single Major Water Provider in the region. Ottis seconded the motion. Motion passed.

Future Meeting Dates

A Region P meeting is tentatively scheduled for Monday, August 6, 2018.

Public Comments

There were no public comments.

The meeting adjourned at 1:20 p.m.

Phillip Spenrath
Chairman

Minutes of Lavaca Regional Water Planning Group
August 6, 2018
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, August 6, 2018 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Steve Cooper, Neil Hudgins, Jack Maloney, Robert Shoemate, Dennis Simons, Gary Skalicky, Michael Skalicky, Phillip Spenrath and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Jim Coleman, Marie Day, Robert Martin, Bart McBeth, Richard Ottis, Edward Pustka, and David Wagner.

Also present was: Elizabeth McCoy of Texas Water Development Board, Jaime Burke of AECOM, Caren Collins of Texas Parks and Wildlife Department, and Tony Franklin of Texas State Soil and Water Conservation Board. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, and Karen Gregory, LNRA Deputy General Manager, Administration.

Chairman Spenrath called the meeting to order.

It was determined that a quorum of the LRWPG was not present. Additional members were expected to arrive before any action items would need to be taken.

Public Comments

There were no public comments.

Briefing and Update from Texas Water Development Board

McCoy briefed the Group on the following:

- TWDB approval of LRWPG's request to modify surface water availability hydrologic assumptions for development of the 2021 Region P Regional Water Plan.
- State Flood Assessment is expected to be available online (texasfloodassessment.com) and open for public comments in August 2018. Final report is expected to be delivered in December 2018.
- Water for Texas 2019 Conference (January 23-25) registration is now available.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Update on effort to date and timeline.
- Update on existing water supplies and identified water needs.
- Update on potentially feasible waer management strategies.

Nominations for New Voting Members

Brzozowski informed the Group that Robert Martin, Jackson County, Agriculture, had submitted his resignation from the LRWPG. The Group will continue to solicit new voting members for Lavaca County, Small Business and Jackson County, Agriculture.

Presentation of Technical Memorandum

Burke briefed the Group on the Technical Memorandum which is a compilaton of the task work performed to date as part of the regional water planning process to develop the 2021 Lavaca Regional Water Plan for Region P. It is prepared for the Texas Water Development Board (TWDB) as a deliverable associated with Task 4C.

The Technical Memorandum includes the TWDB DB22 Database Reports that provide data on the following areas:

- Population Projections
- Water Demand Projections for all water use categories
- Summary of demands, supplies, and needs by water use category
- Water sources and their availability volumes
- Exising water supplies for all Water User Groups
- Analysis of water needs and surpluses
- Water Source Balance (Availability-Water User Group Supply)
- Comparison of Water User Group and Water Source data between the 2016 RWP and 2021 RWP

There were no public comments.

G Skalicky and Shoemate entered the Group's meeting at 1:28 p.m. and Chairman Spenrath declared that a quorum of the Region P Group was formed.

Weinheimer moved to authorize the Technical Consultant (AECOM) to address the Region P changes to the draft Technical Memorandum and approve submittal of the Technical Memorandum to TWDB prior to September 10, 2018, including public comments received through August 20, 2018. Cooper seconded the motion. Motion passed.

Minutes

The minutes of the June 18, 2018 meeting were reviewed. Weinheimer moved to approve the minutes as presented. Brzozowski seconded the motion. Motion passed.

Potential Water Management Strategy Evaluation Scope of Work (Task 05A)

Burke briefed the Group on Task 5A Scope of Work, Water Management Strategy Evaluation Task. TWDB has allocated budget to Task 5A ($45,001). The Group is required to prepare a scope of work for each strategy evaluation to be performed. The scope of work must be preented for public input and Group approval before submitting to TWDB for their approval. The Group was presented a copy of Scoping Template for Currently Contracted Task 5A Funding for Region-Specific Subtasks for their review. Burke recommended for $2,500 of the budget to be unallocated for additional strategies.

There were no public comments.

Spenrath moved to approve the Task 5A Scope of Work as presented and authorize the technical consultant to make minor adjustments as needed, authorize LNRA to submit a request to the TWDB for a Notice-to-Proceed with the Scope of Work for Task 5A, and execute the subsequent contract amendments. Weinheimer seconded the motion. Motion passed.

Future Meeting Dates

A Region P meeting is tentatively scheduled for Monday, January 28, 2019 at noon.

Public Comments

There were no public comments.

The meeting adjourned at 1:41 p.m.

Phillip Spenrath
Chairman

Minutes of Lavaca Regional Water Planning Group
January 28, 2019
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, January 28, 2019 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Steve Cooper, Marie Day, Neil Hudgins, Jack Maloney, Bart McBeth, Richard Ottis, Robert Shoemate, Gary Skalicky, Michael Skalicky, Phillip Spenrath and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Edward Pustka, Dennis Simons, and David Wagner.

Also present was: Elizabeth McCoy of Texas Water Development Board, Jaime Burke and Alicia Smiley of AECOM, Mike Rivet of Formosa Plastics Corporation, Josh Harper of Texas Parks and Wildlife Department, Tony Franklin of Texas State Soil and Water Conservation Board, and Jami McCool, Texas Department of Agriculture. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice President, Karen Gregory, LNRA Deputy General Manager, Administration, and Scott Hartl, LNRA Assistant Manager, Operations.

Chairman Spenrath called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the August 6, 2018 meeting were reviewed. M Skalicky moved to approve the minutes as presented. Cooper seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that nominations were needed for new members for Lavaca County, Small Business and Jackson County, Agriculture.

Election of Officers

Ottis moved to re-elect the current slate of officers of the Lavaca Regional Water Planning Group as follows: Spenrath, Chairman, Hudgins, Vice-Chairman, Brzozowski, Secretary and the Executive Committee as follows: Spenrath, Hudgins, Brzozowski, Coleman, Day, Maloney, and Weinheimer. Coleman seconded the motion. Motion passed.

Briefing and Update from Texas Water Development Board

McCoy briefed the Group on the following:

- Regional and State Water Planning Rules and Texas Statute Reference Pamphlet is now available. Copies were presented to the Group.

- Task 5A Notice to Proceed Request – Approved by the TWDB Deputy Executive Administrator – 10/24/18

- Technical Memorandum
    - Administratively complete letter issued 10/2/18
    - TWDB reviewed source data and methodologies presented in the Technical Memorandum and has no comments on the Region P source data and methodology.

- Water Management Strategy (WMS) evaluation tools available on TWDB website.
    - Uniform Costing Tool
    - Conservation Planning Tool

- Socioeconomic analysis "as of date" and planning group action. Socioeconomic impact assessments of not meeting identified water needs are required by rule (31 TAC 357.33(c) and 357.40(a)).
  RWPGs may request that the TWDB perform the socioeconomic impact analysis on the planning group's behalf. If they choose to do so, the RWPG must take action on the request and submit the request to the PM. Request must be submitted to TWDB by July 2019. Analysis will be based on water needs in the planning database as of May 31, 2019.

- Uniform Standards Stakeholder Committee Meeting
    - Committee met in November 2018 to review the uniform standards for prioritizing projects in the RWPs and agreed by consensus to adopt changes.
    - A TWDB Guidance Document will be made available for optional use.
    - Consider approving the revised Uniform Standards at a February Board meeting.

- Texas Water Service Boundary Viewer
  TWDB mapping application was developed to facilitate the collection of digital maps for retail water service areas of all community public water system (PWS) in the state of Texas. This tool also allows authorized PWS contact to update and verify their service area.

- State Flood Assessment
  Final version presented to the Board in December. Available online.

- 2019 SWIFT abridged applications.
    - Abridged Applications are due February 1, 2019.
    - SWIFT program information, applications, program requirements

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Update on effort to date.

- Discussion of 2021 Lavaca Regional Water Plan draft chapters 1-4. Handouts for RWPG members to begin review process.
- Discussion of conservation and drought management water management strategies and consideration of potential methodologies for developing evaluations.
- Upcoming work effort and timeline.

Socioeconomic Analysis

Brzozowski moved to approve to request TWDB to conduct a socioeconomic analysis of not meeting identified water needs for Region P for inclusion in the 2021 Lavaca Regional Water Plan. Day seconded the motion. Motion passed.

Future Meeting Dates

The Region P Group will meet on April 22, 2019 or May 20, 2019 after determining when a quorum of members are available.

Public Comments

There were no public comments.

The meeting adjourned at 2:00 p.m.

Phillip Spenrath
Chairman

Minutes of Lavaca Regional Water Planning Group
May 20, 2019
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, May 20, 2019 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Steve Cooper, Marie Day, Neil Hudgins, Jack Maloney, Bart McBeth, , and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Richard Ottis, Edward Pustka, Robert Shoemate, Gary Skalicky, Michael Skalicky, Phillip Spenrath, and David Wagner.

Also present was: Elizabeth McCoy of Texas Water Development Board, Jaime Burke and Alicia Smiley of AECOM, Mike Rivet of Formosa Plastics Corporation, Josh Harper of Texas Parks and Wildlife Department. Also present was Ronald Kubecka, LNRA Board President, Doug Anders, LNRA Deputy General Manager, Operations, Karen Gregory, LNRA Deputy General Manager, Administration, and Scott Hartl, LNRA Assistant Manager.

Vice-Chairman Hudgins called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the January 28, 2019 meeting were reviewed. Maloney moved to approve the minutes as presented. Cooper seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that nominations were needed for new members for Lavaca County, Small Business, Jackson County, Agriculture, and Jackson County, Counties.

Briefing and Update from Texas Water Development Board

McCoy briefed the Group on 2019 Texas Legislative Bills:

- Related to the State and Regional Water Planning Process

- Related to Flood Planning and Infrastructure
  Addressing the needs of stormwater management and flooding in the state. This is largely due to the damage that Hurricane Harvey affected on Texas in 2018.

McCoy informed the Group of anticipated recommendations from the Drought Preparednesd Council and a template for Chapter 7 that is posted on the TWDB website.

McCoy also briefed the Group on regional water planning educational information available on TWDB's website. The Group was presented copies of the following:

- Regional Water Planning Groups in Texas: What They Do and Don't Do
- Designating Unique Stream Segments and Unique Reservoir Sites
- State Water Implementation Fund for Texas (SWIFT) Project Prioritization

Amendment to Regional Water Planning Contract with TWDB

McCoy briefed the Group on the upcoming Fall 2019 amendment to the regional water planning contract between LNRA and TWDB for additional funding in the amount of $41,775. This will increase the committed funds to the full study cost amount.

Maloney moved to authorize Lavaca-Navidad River Authority to amend and execute their regional water planning contract with TWDB for additional funding as presented. Brzozowski seconded the motion. Motion passed.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Project Status to Date
- Timeline

Copies of the power point with details were available for the Group's review.

Regional Water Planning Group Comments on Draft Chapter 1-4

Burke requested for the Group to review the draft chapters. The chapters are available electronically or paper copies were made available. Comments may be sent to Burke electronically or discussed at a future meeting. Comments will be presented to the Group once received.

Update RWPG on Various Strategy Evaluations

Burke updated the Group on strategy evaluations for:

- Municipal Drought Management
- Manufacturing Drought Management
- Municipal Conservation
- Conservation for Manufacturing
- El Campo Reuse

Discuss Expand Use of Groundwater Strategy and Potential MAG Peak Factor

After discussion by the Group, Weinheimer moved to not move forward with a MAG Peak Factor request. Day seconded the motion. Motion passed.

Future Meeting Dates

The Region P Group will meet in August or September after determining when a quorum of members are available.

Public Comments

There were no public comments.

The meeting adjourned at 2:07 p.m.

Phillip Spenrath
Chairman

Minutes of Lavaca Regional Water Planning Group
August 19, 2019
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, August 19, 2019 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Marie Day, Neil Hudgins, Richard Ottis, Robert Shoemate, Phillip Spenrath, Michael Skalicky, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Jim Coleman, Steve Cooper, Jack Maloney, Bart McBeth, Edward Pustka, Gary Skalicky, and David Wagner.

Also present was: Elizabeth McCoy of Texas Water Development Board, Jaime Burke and Alicia Smiley of AECOM, Mike Rivet of Formosa Plastics Corporation, and Josh Harper of Texas Parks and Wildlife Department, and Jami McCool of Texas Department of Agriculture. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice-President, Doug Anders, LNRA Deputy General Manager, Operations, Karen Gregory, LNRA Deputy General Manager, Administration, and Scott Hartl, LNRA Assistant Manager.

Chairman Spenrath called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the May 20, 2019 meeting were reviewed. Skalicky moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that nominations were needed for new members for Lavaca County, Small Business, Jackson County, Agriculture, and Jackson County, Counties.

Briefing on LNRA Water Conservation and Drought Contingency Plans

In compliance with Texas Commission on Environmental Quality (TCEQ), the LRWPG members were presented a copy of the LNRA Water Conservation Plan and Drought Contingency Plan (DCP) for their review. Brzozowski briefed the Group on the Drought Response Measures and the Response Stages as stated in the DCP.

Briefing and Update from Texas Water Development Board

McCoy briefed the Group on the following:

- Soci-Economic Impact Analysis Reports – Available December 2019

- TWDB recently launched a new interactive data dashboard that visualizes historical and project RWP data.

- Legislative Update

The Legislature passed three bills directly relevant to regional water planning and significant bills related to flood planning and project funding. Information regarding HB 807, HB 721, HB 723, SB 7 and 8 (flood related) was presented to the Group. McCoy informed the Group that stakeholder meeting have been held around the state to gather preliminary input on SB7 and SB8 implementation.

TWDB Interregional Planning Council

McCoy informed the Group of House Bill (HB) 807 which directs the Texas Water Development Board (TWDB) to appoint an Interregional Planning Council. The Council as appointed by the TWDB Board will consist of one member from each RWPG. Each Group is asked to nominate one or more members to serve on the Council.

Spenrath moved to nominate Patrick Brzozowski as a member of the TWDB Interegional Planning Council and naming the Region P Chair as an alternate. Skalicky seconded the motion. Motion passed.

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Project Status to Date
- Timeline

Copies of the power point with details were available for the Group's review.

Presentation and Discusson of Draft Water Management Strategy Evaluations

Burke presented the Group with the draft Water Management Strategy Evaluations which included Municipal Drought Management, Manufacturing Drought Management, Irrigation Drought Management, ElCampo Reuse, Conservation for Manufacturing, Municipal Conservaton, Irrigation Conservation, Expand Use of Groundwater, Lavaca Off-Channel Reservoir, LNRA Desalination, LNRA Aquifer Storage and Recovery, and Lake Texana Dredging for their review. The Group discussed each one and were asked to submit additional comments before the next RWPG meeting.

Unique Stream Segments and Reservoirs

Burke outlined the terminology for a unique stream segment and reservoir. Information was available for the Group's review. Burke indicated that currently there are no ecologically unique stream segments in Region P. The proposed Palmetto Bend Stage II Reservoir has been designated as a unique reservoir site. The Group will need to review/update policy recommendations from last cycle for the 2021 Plan. The Group was presented a copy of the 2016 LRWP Policy Recommendations.

No action was taken.

Future Meeting Dates

The Region P Group will meet in October or November determining when a quorum of members are available.

Public Comments

There were no public comments.

The meeting adjourned at 3:16 p.m.

Phillip Spenrath
Chairman

Minutes of Lavaca Regional Water Planning Group
December 16, 2019
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM 3131, located approximately seven (7) miles east of Edna, Jackson County, Texas off FM 3131 on Monday, December 16, 2019 at noon.

Voting Group Members present were: Patrick Brzozowski, Tom Chandler, Jim Coleman, Neil Hudgins, Jack Maloney, Edward Pustka , Robert Shoemate, and Phillip Spenrath.

Absent Voting Group Members were: John Butschek, Steve Cooper, Marie Day, Bart McBeth, Richard Ottis, Michael Skalicky, David Wagner and Ed Weinheimer.

Also present was: Elizabeth McCoy and Jean Devlin of Texas Water Development Board, Jaime Burke and Alicia Smiley of AECOM, Leslie Hartman of Texas Parks and Wildlife Department, Rusty Ray of TSSWCB, Jill Sklar, Jackson County Judge, and Jami McCool of Texas Department of Agriculture. Also present was Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board Vice-President, Karen Gregory, LNRA Deputy General Manager, Administration, and Scott Hartl, LNRA Assistant Manager.

Chairman Spenrath called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the August 19, 2019 meeting were reviewed. Brzozowski moved to approve the minutes as presented. Shoemate seconded the motion. Motion passed.

Nominations for New Voting Members

Brzozowski informed the Group that nominations were needed for new members for Small Business and Municipalities in Lavaca County and Counties and Agriculture (2) in Jackson County.

Brzozowski nominated and moved to approve Jill Sklar, Jackson Judge to fill the position of Counties, Jackson County. Pustka seconded the motion. Motion passed.

Briefing and Update from Texas Water Development Board

McCoy introduced Jean Devlin as the new TWDB Project Manager.

The Group was briefed on the following:

- Agency Rulemaking Efforts
    - House Bill 807
    - Flood Financial Assistance

    - Flood Planning Rules and Regions

- 2020 State Water Implementation Fund (SWIFT) Abridge Application
- Agriculture Water Conservation Grants
- Socioeconomic Impact Analysis Dashboard and Presentation
- Initially Prepared Plan/ Final Plan Process
    - Handout Schematic and Notice Summary

Briefing from AECOM Consultant

Burke briefed the Group on the following:

- Project Status to Date
- Timeline
    - Draft 2021 Plan due March 2020
    - Spring/Summer 2020
      Public hearing on Draft Plan, respond to comments, Water Infrastructure Financin survey, adopt Final 2021 Plan
    - Final 2021 Plan due October 2020

Presentation and Discusson of Draft Water Management Strategy Evaluations

Burke presented the Group with the draft Water Management Strategy Evaluations which included:

- Drought Management
    - Municipal, Manufacturing and Irrigation
- El Campo Reuse
- Conservation for Manufacturing
- Multiple Advanced Water Conservation Strategies
    - Municipal and Irrigation
- Expand Use of Groundwater
- Lavaca Off-Channel Reservoir
- LNRA Desalination
- LNRA Aquifer Storage and Recovery
- Lake Texana Dredging

The Group was presented copies for their review and discussed each strategy.

Unique Stream Segments and Reservoirs

Burke outlined the terminology for a unique stream segment and reservoir. Information was available for the Group's review. Burke indicated that currently there are no ecologically unique stream segments in Region P. The proposed Palmetto Bend Stage II Reservoir had been designated as a unique reservoir site, but that designation expired in 2015. The Group will need to review/update policy recommendations from last cycle for the 2021 Plan. The Group was presented a copy of the 2016 LRWP Policy Recommendations.

Future Meeting Dates

The Region P Group decided tentatively to meet on January 20, 2020 and February 10, 2020.

Public Comments

There were no public comments.

The meeting adjourned at 2:12 p.m.

Phillip Spenrath
Chairman

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Chapter 11 – Implementation and Comparison to the Previous Regional Water Plan

This chapter presents a discussion and survey of water management strategy projects that were recommended in the 2016 Regional Water Plan and have since been implemented or the sponsors have begun some phase of implementation, as well as providing a summary comparison of the 2021 Regional Water Plan to the 2016 Regional Water Plan with respect to population, demands, water availability and supplies, and water management strategies.

11.1 Implementation

In the 2016 Lavaca Regional Water Plan, the only identified water needs were for Irrigation in Wharton County. Water management strategies involving irrigation conservation were recommended to meet the needs. In addition, strategies for municipal water user groups such as drought management and conservation, and several strategies for LNRA were recommended, even though there were no needs shown in the plan.

During this planning cycle, the TWDB developed an implementation survey spreadsheet that the RWPGs were required to fill out as best able based on responses from water management strategy project sponsors as part of the planning process. Individual surveys were created and sent to the project sponsors. Based on the responses received, the TWDB implementation survey template was filled out and is included as *Appendix 11A*.

11.2 Comparison to the Previous Regional Water Plan

This section discusses how the 2021 Regional Water Plan compares to the 2016 Regional Water Plan, with respect to population, water demands, water supplies, and water management strategies.

11.2.1 Population Projections

Across all counties in Region P, and across all planning decades in each plan, there is no difference in population projection between the 2016 and 2021 Regional Water Plans. Additionally, there is no change in population growth rate by planning decade between the 2016 RWP and 2021 RWP. Tabular data and bar graphs comparing the two plans can be found in *Appendix 11B*.

These changes by county are summarized in *Table 11-1*.

Table 11-1 Population Change by County in Year 2070, from 2016 RWP to 2021 RWP

County	Population in Year 2070 (2016 RWP to 2021 RWP)	Population Growth Rate (2016 RWP to 2021 RWP)
Jackson	No Change	No Change
Lavaca	No Change	No Change
Wharton (partial)	No Change	No Change
Total (Region P)	**No Change**	**No Change**

11.2.2 Water Demand Projections

Overall for Region P, there is a decrease in water demand of approximately 22,634 acre-feet/year for Year 2070 between the 2016 RWP and the 2021 RWP. Additionally, the water demand rate of growth by planning decade is approximately 0.1% less than estimated in the 2016 RWP. Tabular data and bar graphs comparing the two plans can be found in *Appendix 11B*.

Water demands for each usage category have changed between the 2016 RWP and the 2021 RWP, as compared to the 2016 RWP. The following water usage categories have a higher water demand predicted by Year 2070 in the 2021 RWP: Municipal, Livestock, Manufacturing, and Steam-Electric Power Generation. Irrigation is predicted to have a lower water demand, while Mining is predicted to have no change in water demand, by Year 2070 in the 2021 RWP, as compared to the 2016 RWP.

Water demand growth rates for each usage category have also changed between the 2016 RWP and the 2021 RWP. The following water usage categories had a slower water demand growth rate in the 2021 RWP: Municipal and Manufacturing. The remaining water usage categories had no change in demand growth rate between plans: Livestock, Irrigation, Mining, and Steam-Electric Power Generation.

These changes are summarized in *Table 11-2*.

Table 11-2 Water Demand Change by Water Usage Category in Year 2070, from 2016 RWP to 2021 RWP

Water Usage Category	Demand in Year 2070 (2016 RWP to 2021 RWP)	Demand Growth Rate (2016 RWP to 2021 RWP)
Municipal	Increase	Decrease
Livestock	Increase	No Change
Irrigation	Decrease	No Change
Manufacturing	Increase	Decrease
Mining	No Change	No Change
Steam-Electric Power Generation	Increase	No Change
Total Water Demand	**Decrease**	**Decrease**

Table 11-3 identifies counties that have a higher water demand by Year 2070 than was shown in the 2016 RWP. In addition, the usage categories that have the greatest growth are shown in *Table 11-3*.

Table 11-3 Counties with Year 2070 Water Demand Increase, from 2016 RWP to 2021 RWP

County	Total Water Demand Increase in Year 2070 (acre-feet/year)	Greatest Water Usage Increase
Jackson	29,699	Irrigation, Manufacturing
Lavaca	2,027	Livestock, Irrigation

Table 11-4 identifies Counties that have a lower water demand by Year 2070 than was shown in the 2016 RWP. In addition, the usage category that has the greatest decrease is shown in *Table 11-4*.

Table 11-4 Counties with Year 2070 Water Demand Decrease, from 2016 RWP to 2021 RWP

County	Total Water Demand Decrease in Year 2060 (acre-feet/year)	Greatest Water Usage Decrease
Wharton	(59,171)	Irrigation

11.2.3 Drought of Record and Hydrologic Assumptions

There are no changes to the Drought of Record for the Lavaca Region since the 2016 RWP. There have been changes to the hydrologic assumptions for the surface water availability analysis since the 2016 RWP.

For the 2016 RWP, the unmodified TCEQ Lavaca WAM Run 3 Model was used for the surface water availability analysis. For the 2021 RWP, the model used to determine surface water availability volumes, including the firm yield of the Lake Texana Reservoir, is a modified version of the TCEQ Lavaca WAM Run 3 Model (version date 9/2/2014) known as the proposed Freese & Nichols Inc. Lavaca WAM Run 3 Model. The modified model was approved for use in evaluating existing water supply availabilities by the TWDB Executive Administrator on July 20, 2018. Projected sedimentation has been incorporated into the model runs for 2020-2070.

The modifications to the TCEQ Lavaca WAM Run 3 include the following:

1. Several changes to the existing code used to model SB3 pulse flow requirements in the Lavaca WAM.
2. Addition of missing SB3 pulse flow code for the Navidad River at Strane Park near Edna.
3. Revisions to Lake Texana SV SA records
    - These records are also updated for 2020-2070 sedimentation for regional water planning analysis, as required by TWDB guidelines.
4. Addition of a synthetic primary control point to correct a naturalized flow calculation.
5. Revisions to modeling of Lake Texana interruptible diversions
    - 3 authorizations split out rather than lumped under one diversion
    - Include annual diversion limit (simplifies the coding)
    - Pattern change to allow more water to be diverted in the last three months of the year (if available)
6. Revisions to Stage 2 of the Palmetto Bend Project location and SV SA records to model it as described in COA 16-2095.

11.2.4 Groundwater and Surface Water Availability and Water Supplies

Overall for Region P, the total water source availability, including surface and groundwater, is 263,191 acre-feet/year in the 2021 RWP. This represents a decrease in water source availability of approximately 7,800 acre-feet/year (approximately 3 percent) for all planning decades when comparing the 2016 RWP and the 2021 RWP. This loss occurs from the Gulf Coast aquifer availability in Lavaca and Wharton Counties of 1 and 22 percent, respectively. Jackson County has an 18 percent increase in Gulf Coast aquifer availability as compared to the 2016 RWP. There is no change in the surface water source availability in Lavaca County between the 2016 RWP and the 2021 RWP. *Table 11-5* shows a comparison of the source availability in Region P between the 2016 RWP and the 2021 RWP.

Table 11-5 Region P Source Availability Comparison from 2016 RWP to 2021 RWP

REGION P SOURCE AVAILABILITY						
Water Source		County	Basin	2016 RWP Plan 2070 Source Availability (AFY)	2021 RWP Plan 2070 Source Availability (AFY)	Change from 2016 RWP to 2021 Plan (AFY)
Groundwater	Gulf Coast Aquifer	Jackson	Colorado-Lavaca	23,615	28,025	4,410
			Lavaca	41,927	49,582	7,655
			Lavaca-Guadalupe	10,844	12,875	2,031
			County Total	**76,386**	**90,482**	**14,096**
	Gulf Coast Aquifer	Lavaca	Guadalupe	41	41	-
			Lavaca	19,932	19,811	(121)
			Lavaca-Guadalupe	400	401	1
			County Total	**20,373**	**20,253**	**(120)**
	Gulf Coast Aquifer	Wharton	Colorado	441	873	432
			Colorado-Lavaca	11,549	14,091	2,542
			Lavaca	87,763	62,992	(24,771)
			County Total	**99,753**	**77,956**	**(21,797)**
Surface Water	Lake Texana/ Reservoir	Jackson	Lavaca	74,500	74,500	-
Region P Total Source Availability				**271,012**	**263,191**	**(7,821)**

The current water supplies available to Region P total 196,766 acre-feet/year in the 2021 RWP. This represents an increase in existing water supply of approximately 12,435 acre-feet/year (approximately 7 percent) for all planning decades between the 2016 RWP and the 2021 RWP.

Distributed between water usage categories, all categories increased in water supply since the 2016 RWP except mining, which remained the same, and municipal, which decreased very slightly.

Table 11-6 Region P Supply Comparison from 2016 RWP to 2021 RWP

REGION P 2070 SUPPLIES BY WUG CATEGORY			
	2016 RWP (AFY)	2021 RWP (AFY)	Change from 2016 RWP to 2021 RWP (AFY)
Irrigation	167,561	167,569	8
Livestock	3,866	6,479	2,613
Manufacturing	1,843	11,664	9,821
Mining	2,636	2,636	-
Municipal	8,425	8,418	(7)
Total Region P Supplies	184,331	196,766	12,435

11.2.5 Water Needs

Water needs in the 2021 RWP and 2016 RWP are limited to Irrigation WUGs in Wharton County. The 2070 water needs in Wharton County, and thus Region P, have decreased from 50,235 acre-feet/year in the 2016 RWP to 8,067 acre-feet/year in the 2021 RWP.

There were no needs for any other water use category or the region's wholesale water provider in both the 2016 RWP and the 2021 RWP.

11.2.6 Recommended Water Management Strategies

A variety of strategies were recommended in the 2016 RWP to meet Irrigation water needs in Wharton County. Additional strategies were recommended by the LRWPG in order to aid municipalities and wholesale water providers in having the projects included in the Regional Water Plan, and thus eligible for certain types of State funding, including SWIFT funding. A number of these strategies continue to be recommended in the 2021 RWP, with minor updates. These include:

- Drought Management (Municipal Water Users only)
- Irrigation Conservation – On-farm Conservation
- Irrigation Conservation – Tail water Recovery
- Municipal Conservation
- Reuse of Municipal Effluent (El Campo)
- Lavaca River Off-Channel Reservoir
- LNRA Desalination

The following strategy was recommended in the 2016 RWP, but has since been removed from the 2021 RWP due to implementation:

- Local Wharton County Off-Channel Reservoir(s) – Lane City Reservoir.

The following strategy was newly recommended by the LRWPG in the 2021 RWP:

- Conservation for Manufacturing

11.2.7 Alternative Water Management Strategies

One strategy was included in the 2016 RWP as an alternative strategy. It is not able to be included in the RWP as a recommended strategy because the water volume exceeds the Modeled Available Groundwater (MAG) volume shown as available for regional water planning. This strategy continues to be included in the 2021 RWP as an alternative strategy:

- Expand Use of the Gulf Coast Aquifer – Wharton County

The following strategies were newly included as alternative strategies by the LRWPG in the 2021 RWP:

- LNRA Aquifer Storage and Recovery
- Lake Texana Dredging

11.2.8 Assessment of Progress Towards “Regionalization”

HB 807 requires that the regional water plan shall “assess the progress of the RWPA in encouraging cooperation between water user groups for the purpose of achieving economies of scale and otherwise incentivizing strategies that benefit the entire region.”

Due to the dependence of the Lavaca Region on groundwater supplies, regional-level supply infrastructure has not developed in the region, nor is it anticipated to develop or be needed in the foreseeable future. WUGs and individual agricultural irrigators predominantly are supplied by their own wells. Municipal WUGs are unlikely to display interest in regional water infrastructure development as they have access to adequate supplies and for a majority of municipal WUGs, limited or no growth is projected. At the same time, irrigated agriculture cannot financially support development of large-scale water infrastructure.

APPENDIX 11A

Implementation Survey Template for 2016 RWP Projects

Planning Region	WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Implementation Survey Record Type	Database ID	Has Sponsor taken affirmative vote or actions?* (TWC 16.053(h)(10))	If yes, in what year did this occur?	If yes, by what date is the action on schedule for implementation?	At what level of implementation is the project currently?*	If not implemented, why?* (When "If other, please describe" is selected, please add the descriptive text to that field)	What impediments presented to implementation?* (When "If other, please describe" is selected, please add the descriptive text to that field)	Current water supply project yield (ac-ft/yr)	Funds expended to date ($)	Project Cost ($)	Year the project is online?*	Is this a phased project?*
P	AQUIFER STORAGE AND RECOVERY	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1667			N/A	Feasibility study ongoing	If other, please describe. No WTP with available capacity; Need further investigation to evaluate opportunity to store treated water	If other, please describe: Lack of infrastructure	unknown				
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EDNA	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2993											
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EL CAMPO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2997											
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EL CAMPO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	10951											
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: GANADO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2999											
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: HALLETTSVILLE	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3001	Yes	2019	2019	All phases fully implemented	-	-	-	-	-		
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: MOULTON	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3003											
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: SHINER	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3005	Yes	2013	DCP Completed		-	-	-	-	-		
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: YOAKUM	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3007	Yes	Ordinance #2066 5/21/14	-	Sponsor has taken official action to initiate project	-	Not applicable	-	-	-	2015	No
P	IRRIGATION CONSERVATION - ON FARM	2020	PROJECT SPONSOR(S): IRRIGATION (WHARTON)	RECOMMENDED WMS PROJECT	1273											
P	IRRIGATION CONSERVATION - TAILWATER RECOVERY	2020	PROJECT SPONSOR(S): IRRIGATION (WHARTON)	RECOMMENDED WMS PROJECT	1274											
P	LAVACA OFF-CHANNEL RESERVOIR	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1162	Yes	2020	6-Feb-20	Permit application submitted/pending		If other, please describe: Permit approval, land acquistion for diversion location, funding	30,000 AFY	$ 1,000,000.00			Yes
P	LNRA DESALINATION	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1276			N/A	Feasibility study ongoing	If other, please describe: Other less expensive sources available for development	Permitting process	28,000 AFY				
P	MUNICIPAL CONSERVATION - EL CAMPO	2020	PROJECT SPONSOR(S): EL CAMPO	RECOMMENDED WMS PROJECT	1161											
P	MUNICIPAL CONSERVATION - HALLETTSVILLE	2020	PROJECT SPONSOR(S): HALLETTSVILLE	RECOMMENDED WMS PROJECT	1264											
P	MUNICIPAL CONSERVATION - MOULTON	2020	PROJECT SPONSOR(S): MOULTON	RECOMMENDED WMS PROJECT	1267											
P	MUNICIPAL CONSERVATION - SHINER	2020	PROJECT SPONSOR(S): SHINER	RECOMMENDED WMS PROJECT	1269		-	-		-	-	-	-	-		
P	MUNICIPAL CONSERVATION - YOAKUM	2020	PROJECT SPONSOR(S): YOAKUM	RECOMMENDED WMS PROJECT	1270	Yes	5/21/2014	-	Sponsor has taken official action to initiate project	-	Not applicable	-	-	-	2014	No
P	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: YOAKUM	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	14797											
P	REUSE	2020	PROJECT SPONSOR(S): EL CAMPO	RECOMMENDED WMS PROJECT	1277											

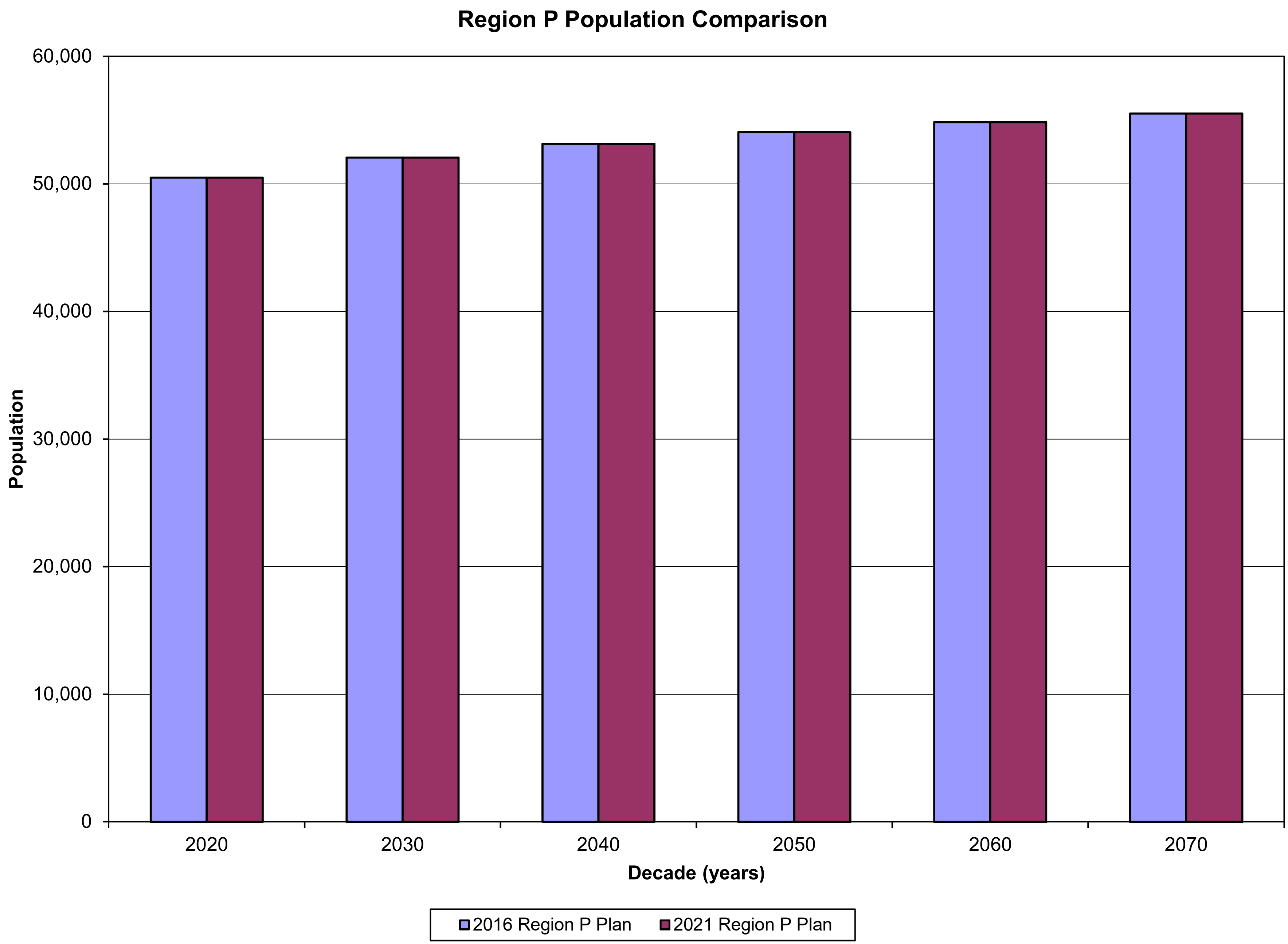
Planning Region	WMS or WMS Project Name	Database Online Decade	Related Sponsor Entity and/or Benefitting WUGs	Implementation Survey Record Type	Database ID	(Phased) Ultimate volume (ac-ft/yr)	(Phased) Ultimate project cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Funding Mechanism if Other?	Included in 2021 plan?*	Does the project or WMS involve reallocation of flood control?*	Does the project or WMS provide any measurable flood risk reduction?*	Optional Comments
P	AQUIFER STORAGE AND RECOVERY	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1667	unknown				unknown	Yes	No	No	
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EDNA	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2993						Yes			
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EL CAMPO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2997						Yes			
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: EL CAMPO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	10951						Yes			
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: GANADO	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	2999						Yes			
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: HALLETTSVILLE	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3001	-	-			-	Yes	No	No	
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: MOULTON	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3003						Yes			
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: SHINER	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3005	-	-			-	Yes	No	No	Have not had to implement any water restrictions to date.
P	DROUGHT MANAGEMENT	2020	WUG REDUCING DEMAND: YOAKUM	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	3007	-	-	2070	Other	Current Budget	Yes	No	No	-
P	IRRIGATION CONSERVATION - ON FARM	2020	PROJECT SPONSOR(S): IRRIGATION (WHARTON)	RECOMMENDED WMS PROJECT	1273						Yes			
P	IRRIGATION CONSERVATION - TAILWATER RECOVERY	2020	PROJECT SPONSOR(S): IRRIGATION (WHARTON)	RECOMMENDED WMS PROJECT	1274						Yes			
P	LAVACA OFF-CHANNEL RESERVOIR	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1162	30,000 AFY	290,000,000				Yes	No	No	
P	LNRA DESALINATION	2020	PROJECT SPONSOR(S): LAVACA NAVIDAD RIVER AUTHORITY	RECOMMENDED WMS PROJECT	1276					unknown	Yes	No	No	
P	MUNICIPAL CONSERVATION - EL CAMPO	2020	PROJECT SPONSOR(S): EL CAMPO	RECOMMENDED WMS PROJECT	1161						Yes			
P	MUNICIPAL CONSERVATION - HALLETTSVILLE	2020	PROJECT SPONSOR(S): HALLETTSVILLE	RECOMMENDED WMS PROJECT	1264						Yes			
P	MUNICIPAL CONSERVATION - MOULTON	2020	PROJECT SPONSOR(S): MOULTON	RECOMMENDED WMS PROJECT	1267						Yes			
P	MUNICIPAL CONSERVATION - SHINER	2020	PROJECT SPONSOR(S): SHINER	RECOMMENDED WMS PROJECT	1269	-	-			-	Yes	No	No	Going to begin problematic water line replacement in 2020.
P	MUNICIPAL CONSERVATION - YOAKUM	2020	PROJECT SPONSOR(S): YOAKUM	RECOMMENDED WMS PROJECT	1270	-	-	2070	Other	Current Budget	Yes	No	No	-
P	MUNICIPAL WATER CONSERVATION (RURAL)	2020	WUG REDUCING DEMAND: YOAKUM	RECOMMENDED DEMAND REDUCTION STRATEGY WITHOUT WMS PROJECT	14797						No			
P	REUSE	2020	PROJECT SPONSOR(S): EL CAMPO	RECOMMENDED WMS PROJECT	1277						Yes			

APPENDIX 11B

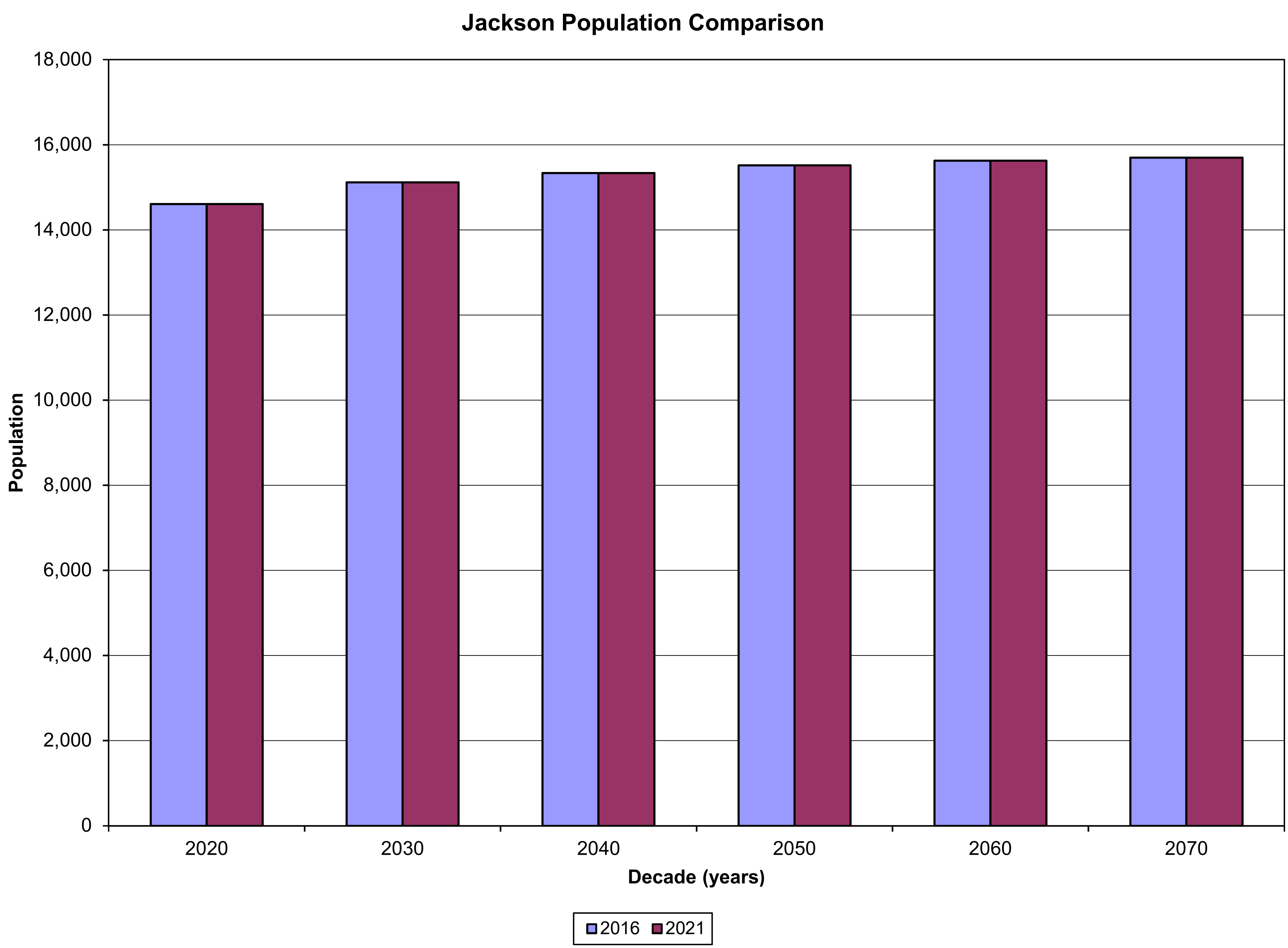
Comparison Tables and Graphs for Population and Demand Projections

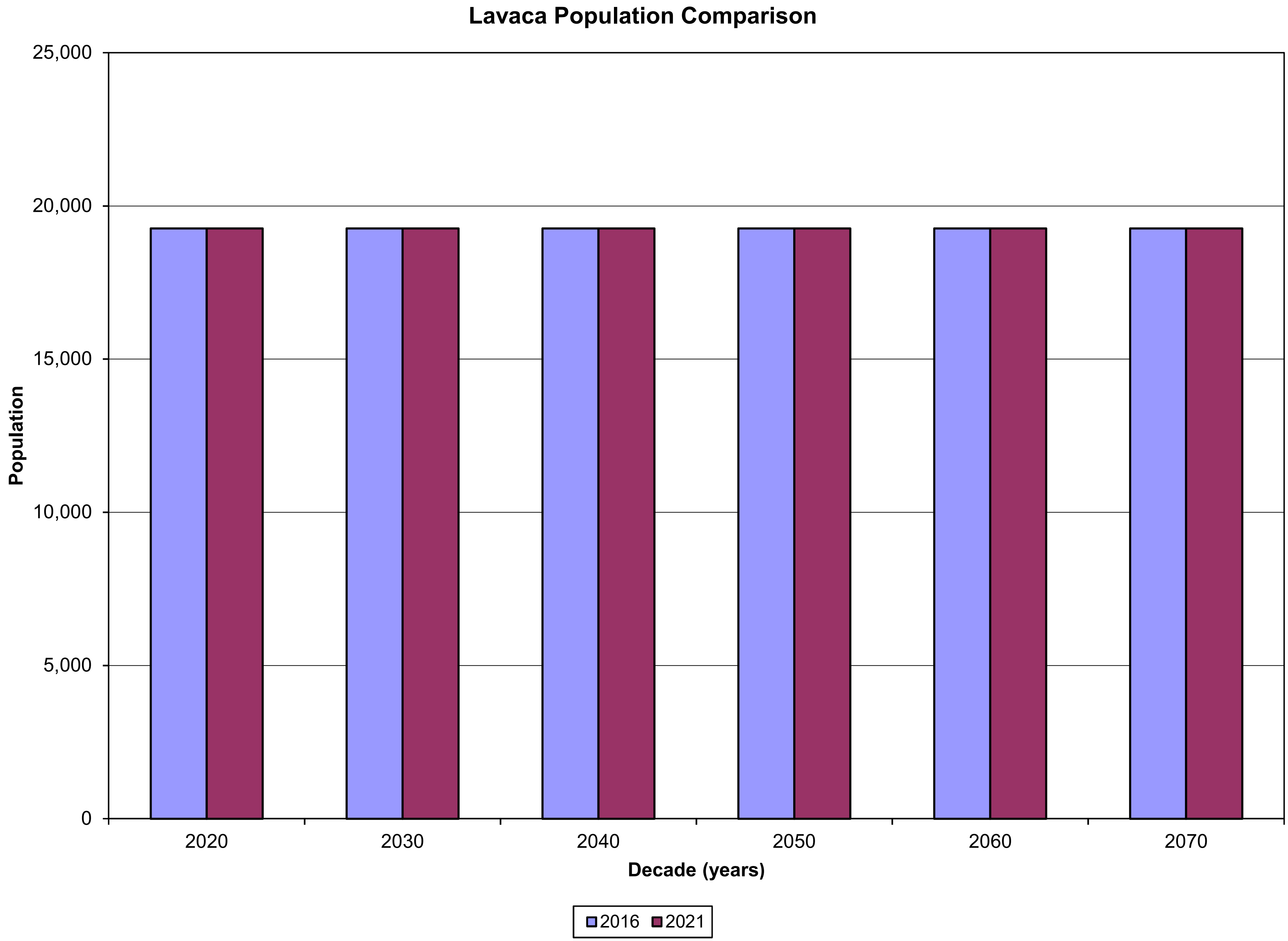
Region P Population

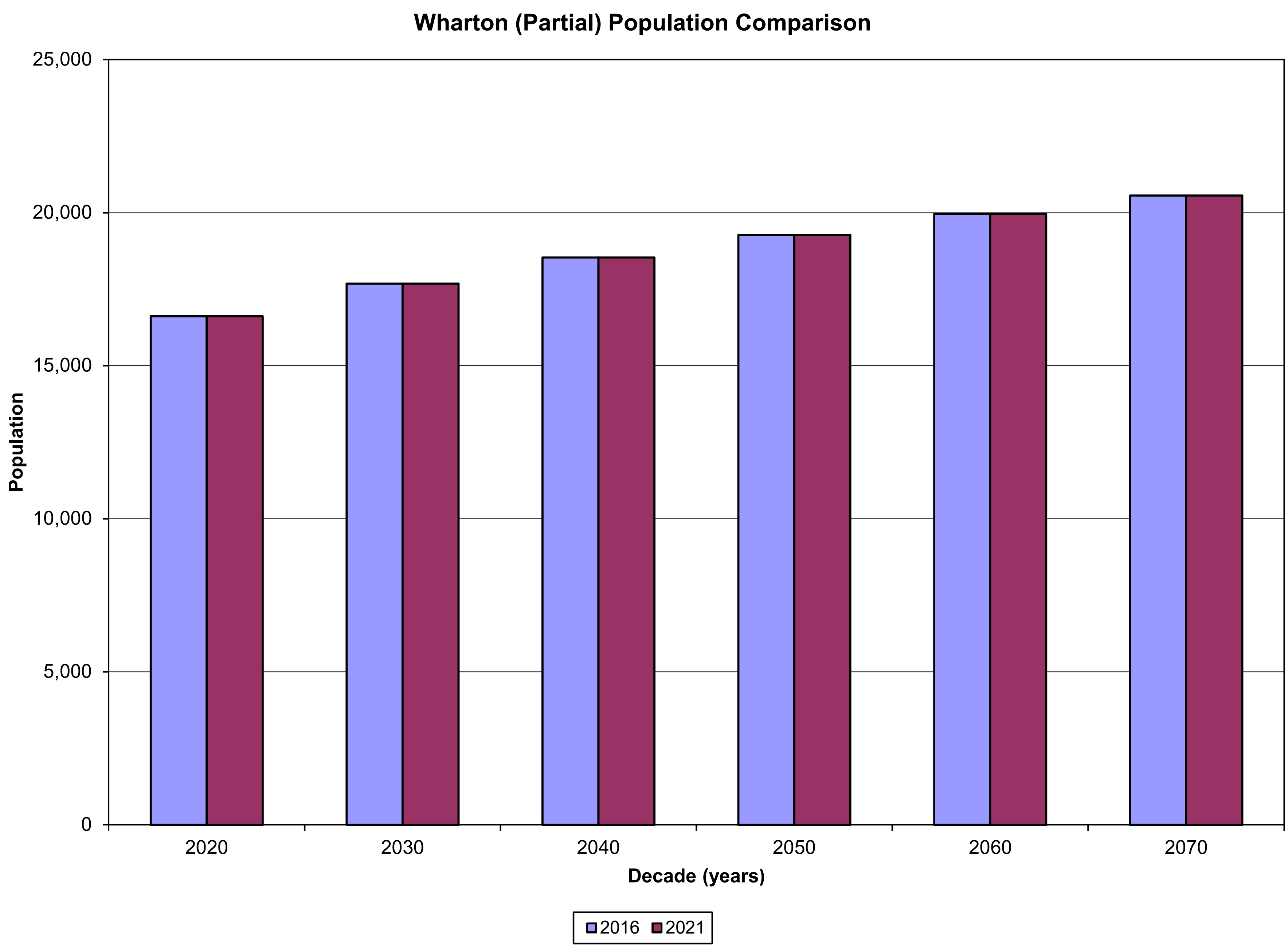
RWP	2020	2030	2040	2050	2060	2070
Region P						
2021	50,489	52,068	53,137	54,053	54,846	55,522
2016	50,489	52,068	53,137	54,053	54,846	55,522
Difference	0	0	0	0	0	0
% Change	0.0	0.0	0.0	0.0	0.0	0.0
Jackson						
2021	14,606	15,119	15,336	15,515	15,627	15,699
2016	14,606	15,119	15,336	15,515	15,627	15,699
Difference	0	0	0	0	0	0
% Change	0.0	0.0	0.0	0.0	0.0	0.0
Lavaca						
2021	19,263	19,263	19,263	19,263	19,263	19,263
2016	19,263	19,263	19,263	19,263	19,263	19,263
Difference	0	0	0	0	0	0
% Change	0.0	0.0	0.0	0.0	0.0	0.0
Wharton						
2021	16,620	17,686	18,538	19,275	19,956	20,560
2016	16,620	17,686	18,538	19,275	19,956	20,560
Difference	0	0	0	0	0	0
% Change	0.0	0.0	0.0	0.0	0.0	0.0



Region P Population Comparison
60,000
50,000
40,000
30,000
20,000
10,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2016 Region P Plan
2021 Region P Plan


Jackson Population Comparison
Population
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021


Lavaca Population Comparison
25,000
20,000
15,000
10,000
5,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021



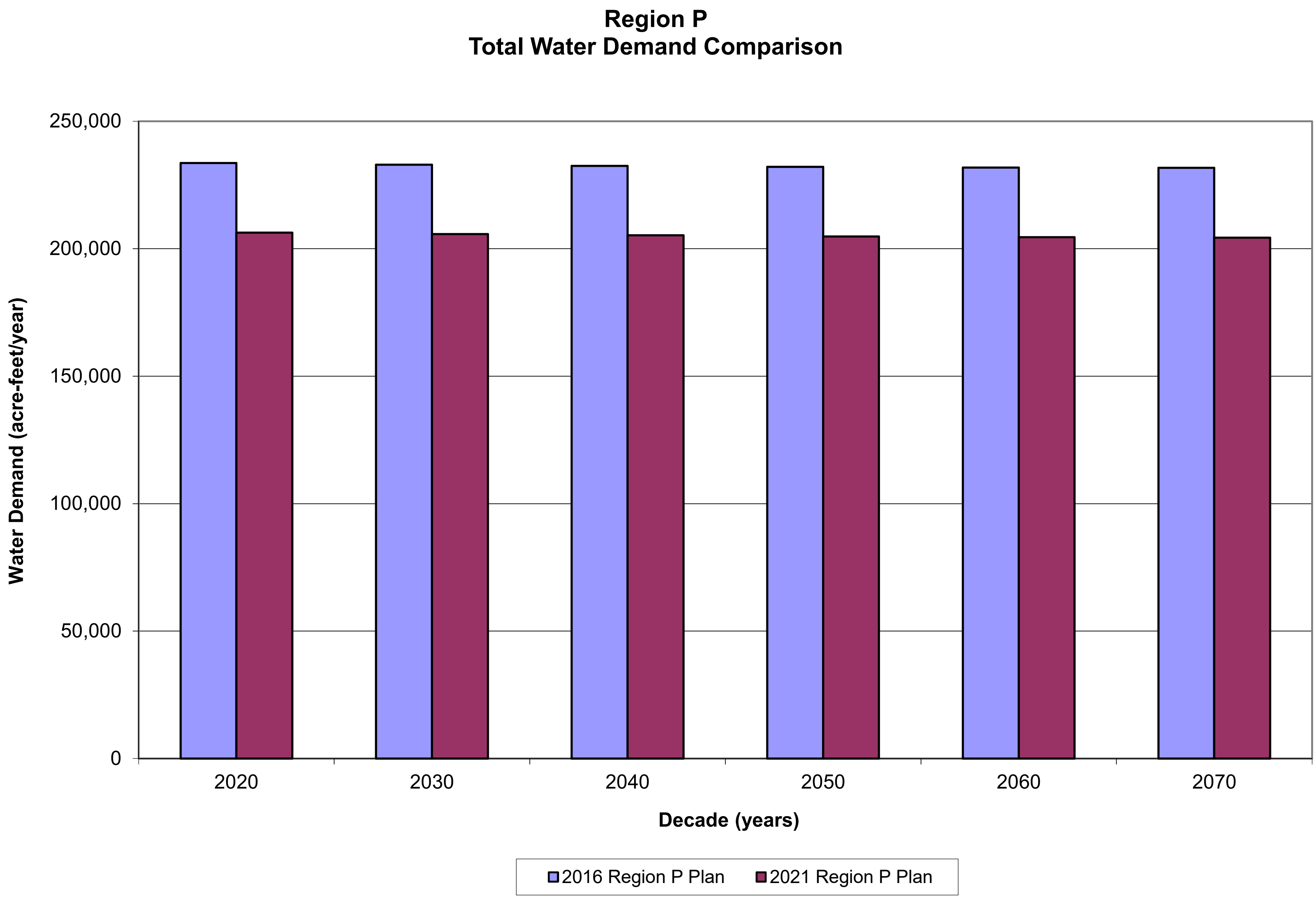
Wharton (Partial) Population Comparison
25,000
20,000
15,000
10,000
5,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

Water Demands* (in acre-feet per year) by WUG Category
Region P

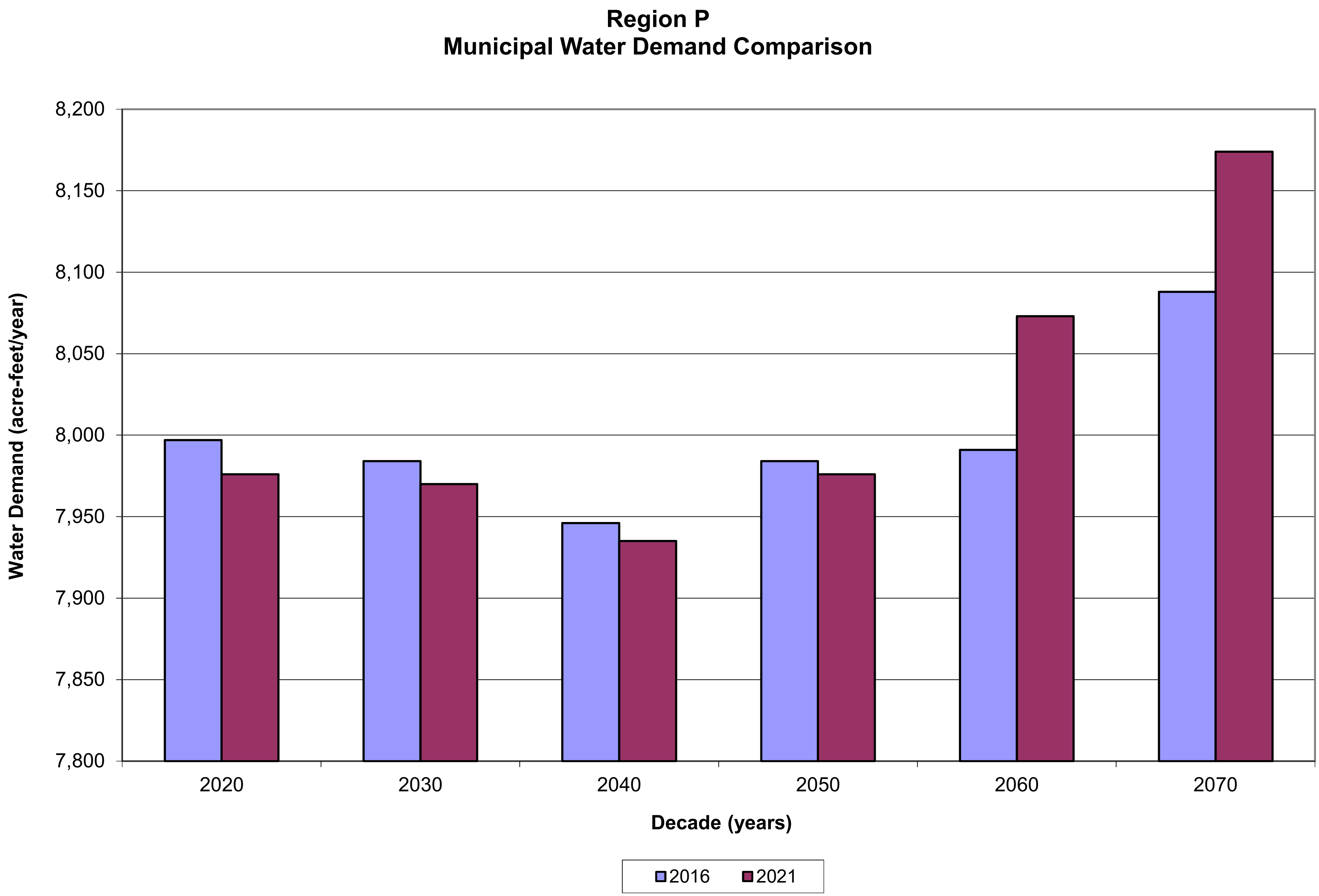
RWP	2020	2030	2040	2050	2060	2070
Municipal						
2021	7,976	7,970	7,935	7,976	8,073	8,174
2016	7,997	7,984	7,946	7,984	7,991	8,088
Difference	-21	-14	-11	-8	82	86
% Change	-0.3	-0.2	-0.1	-0.1	1.0	1.1
Livestock						
2021	6,479	6,479	6,479	6,479	6,479	6,479
2016	3,866	3,866	3,866	3,866	3,866	3,866
Difference	2,613	2,613	2,613	2,613	2,613	2,613
% Change	67.6	67.6	67.6	67.6	67.6	67.6
Irrigation						
2021	175,636	175,636	175,636	175,636	175,636	175,636
2016	217,846	217,846	217,846	217,846	217,846	217,846
Difference	-42,210	-42,210	-42,210	-42,210	-42,210	-42,210
% Change	-19.4	-19.4	-19.4	-19.4	-19.4	-19.4
Manufacturing						
2021	11,521	11,664	11,664	11,664	11,664	11,664
2016	1,255	1,323	1,388	1,444	1,547	1,658
Difference	10,266	10,341	10,276	10,220	10,117	10,006
% Change	818.0	781.6	740.3	707.8	654.0	603.5
Mining						
2021	2,632	1,952	1,485	1,027	570	320
2016	2,632	1,952	1,485	1,027	570	320
Difference	0	0	0	0	0	0
% Change	0.0	0.0	0.0	0.0	0.0	0.0
Steam-Electric Power Generation						
2021	2,060	2,060	2,060	2,060	2,060	2,060
2016	0	0	0	0	0	0
Difference	2,060	2,060	2,060	2,060	2,060	2,060
% Change	NA	NA	NA	NA	NA	NA

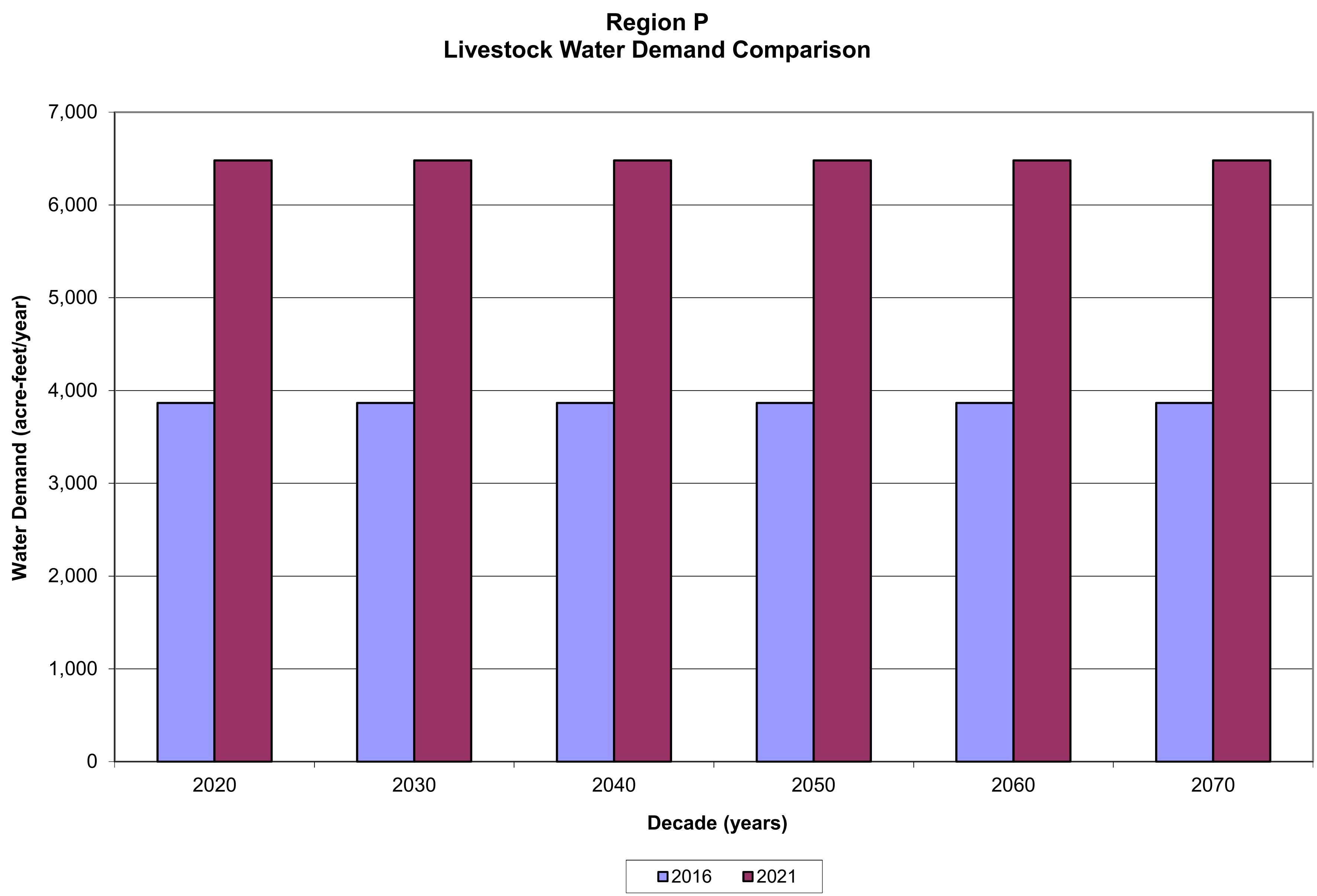
*All values are presented in acre-feet per year

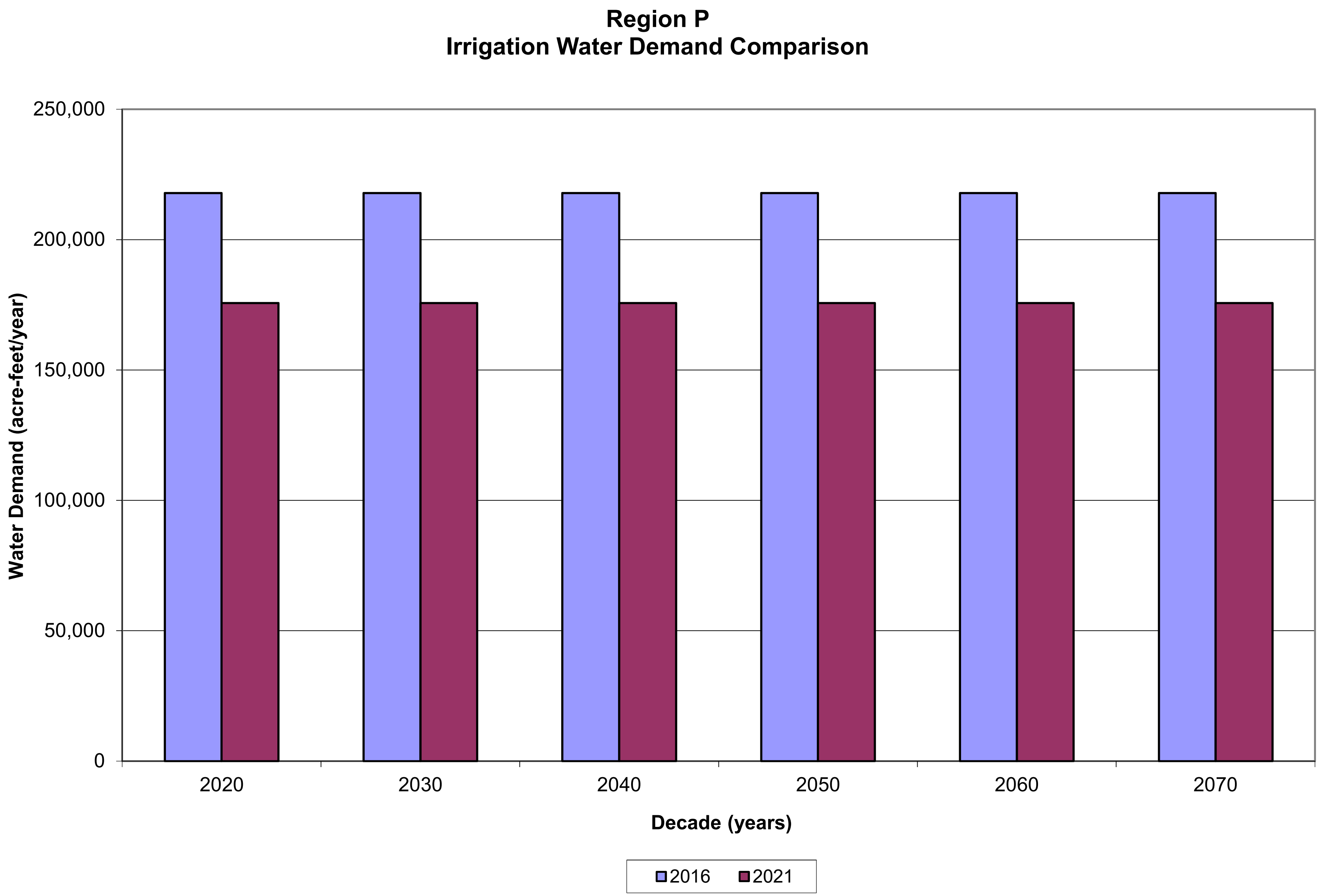
Total Water Demand						
2021	206,304	205,761	205,259	204,842	204,482	204,333
2016	233,596	232,971	232,531	232,167	231,820	231,778
Difference	-27,292	-27,210	-27,272	-27,325	-27,338	-27,445
% Change	-11.7	-11.7	-11.7	-11.8	-11.8	-11.8

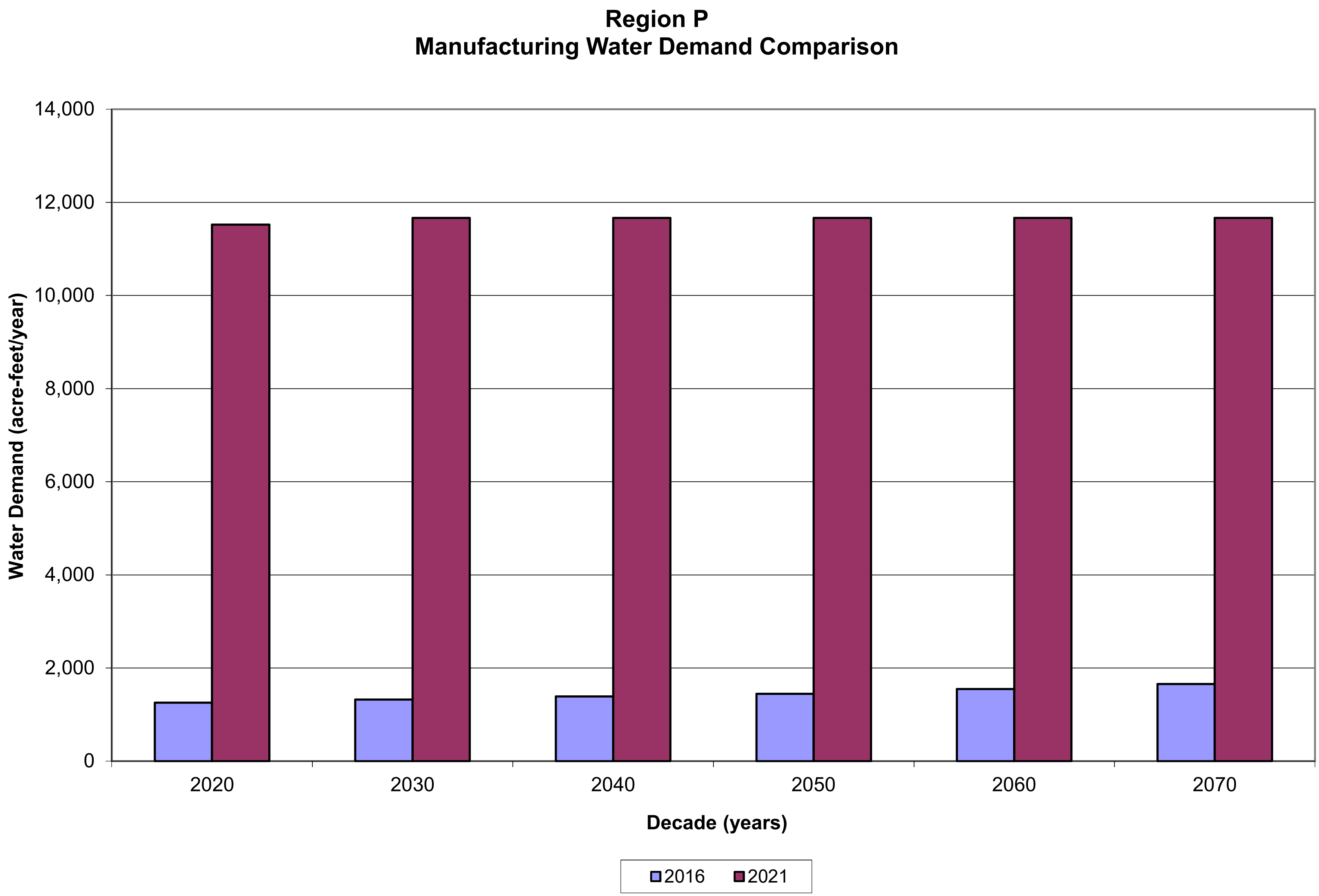


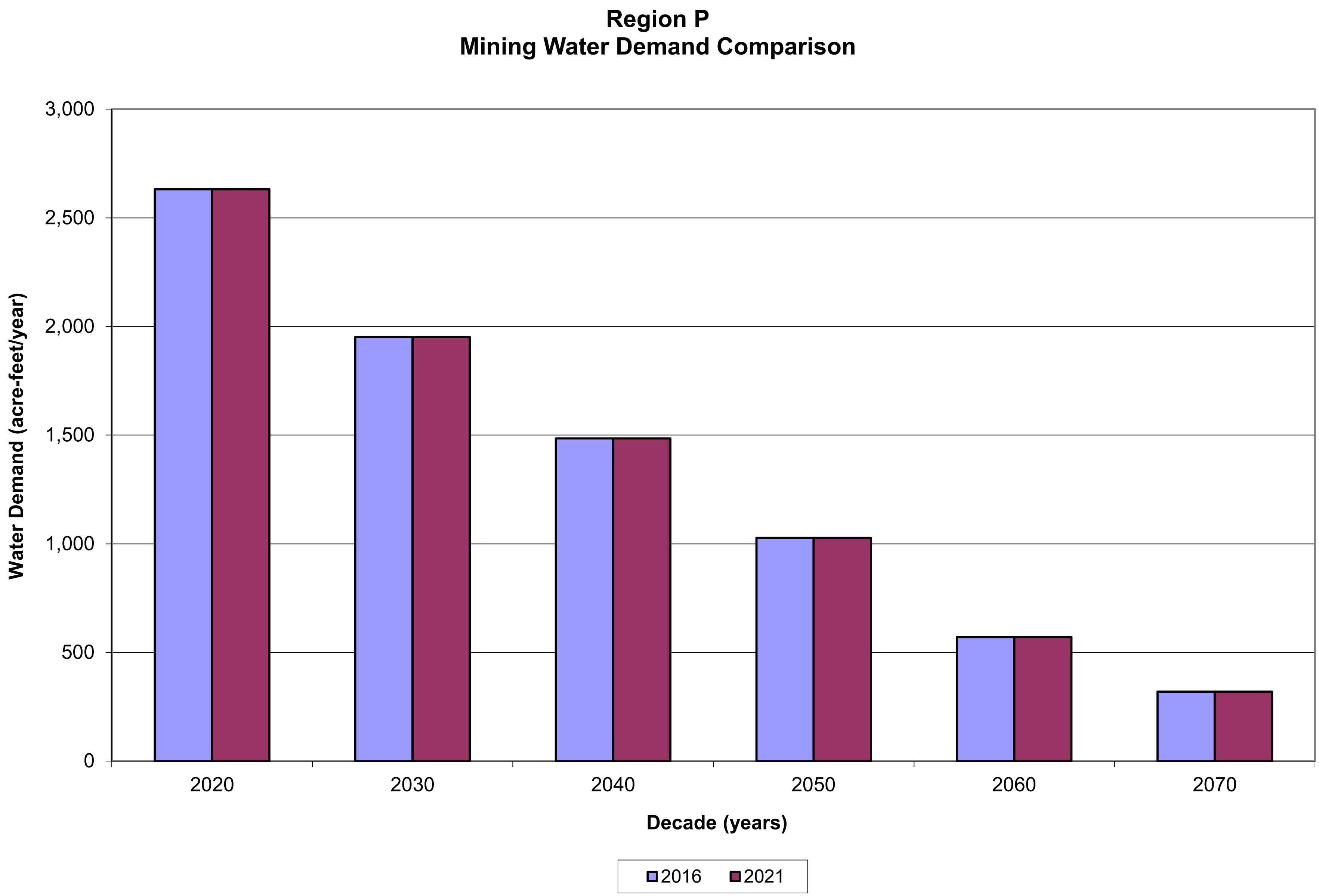
Region P
Total Water Demand Comparison
250,000
200,000
150,000
100,000
50,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016 Region P Plan
2021 Region P Plan


Region P
Municipal Water Demand Comparison
Water Demand (acre-feet/year)
8,200
8,150
8,100
8,050
8,000
7,950
7,900
7,850
7,800
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

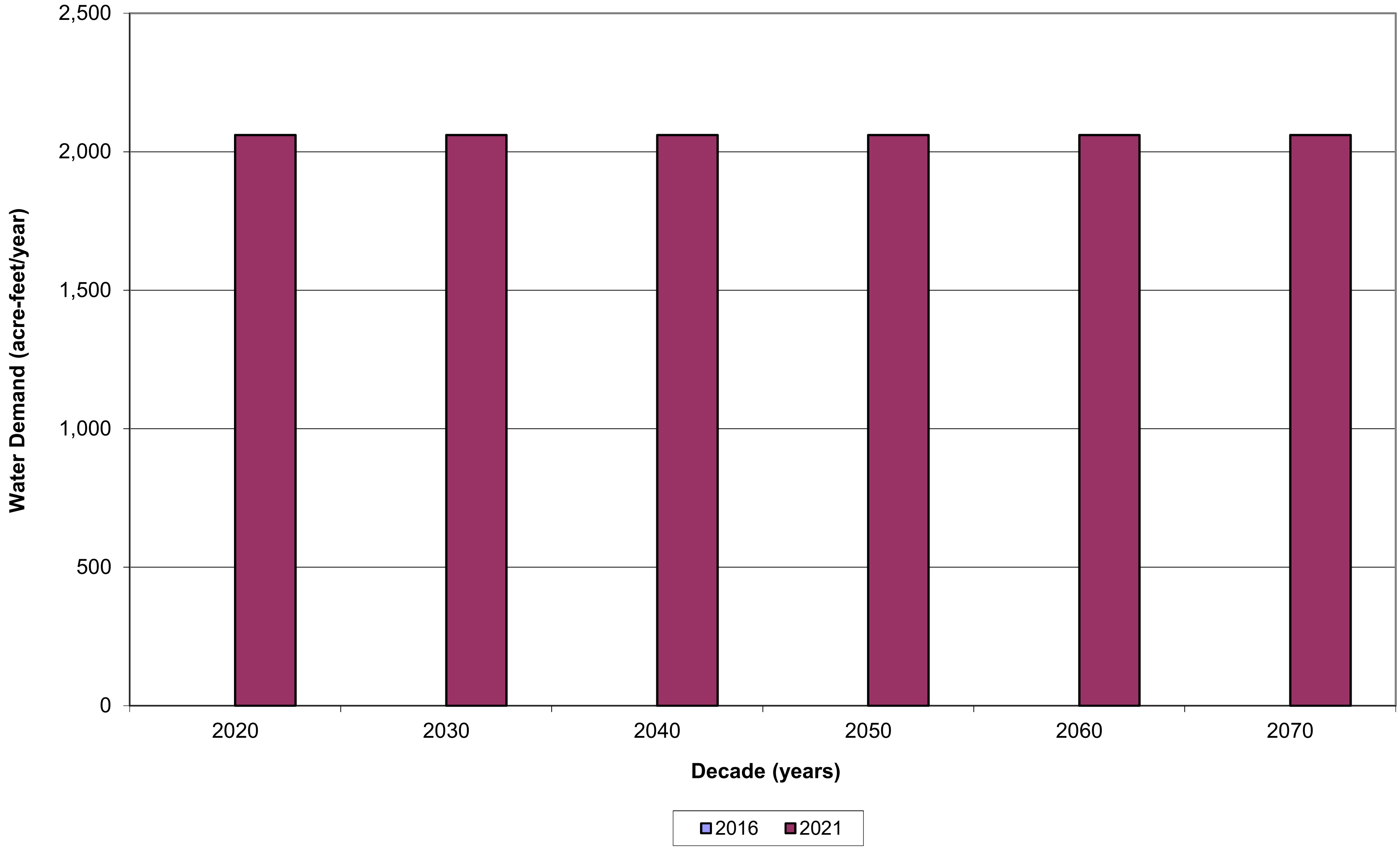

Region P
Livestock Water Demand Comparison
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

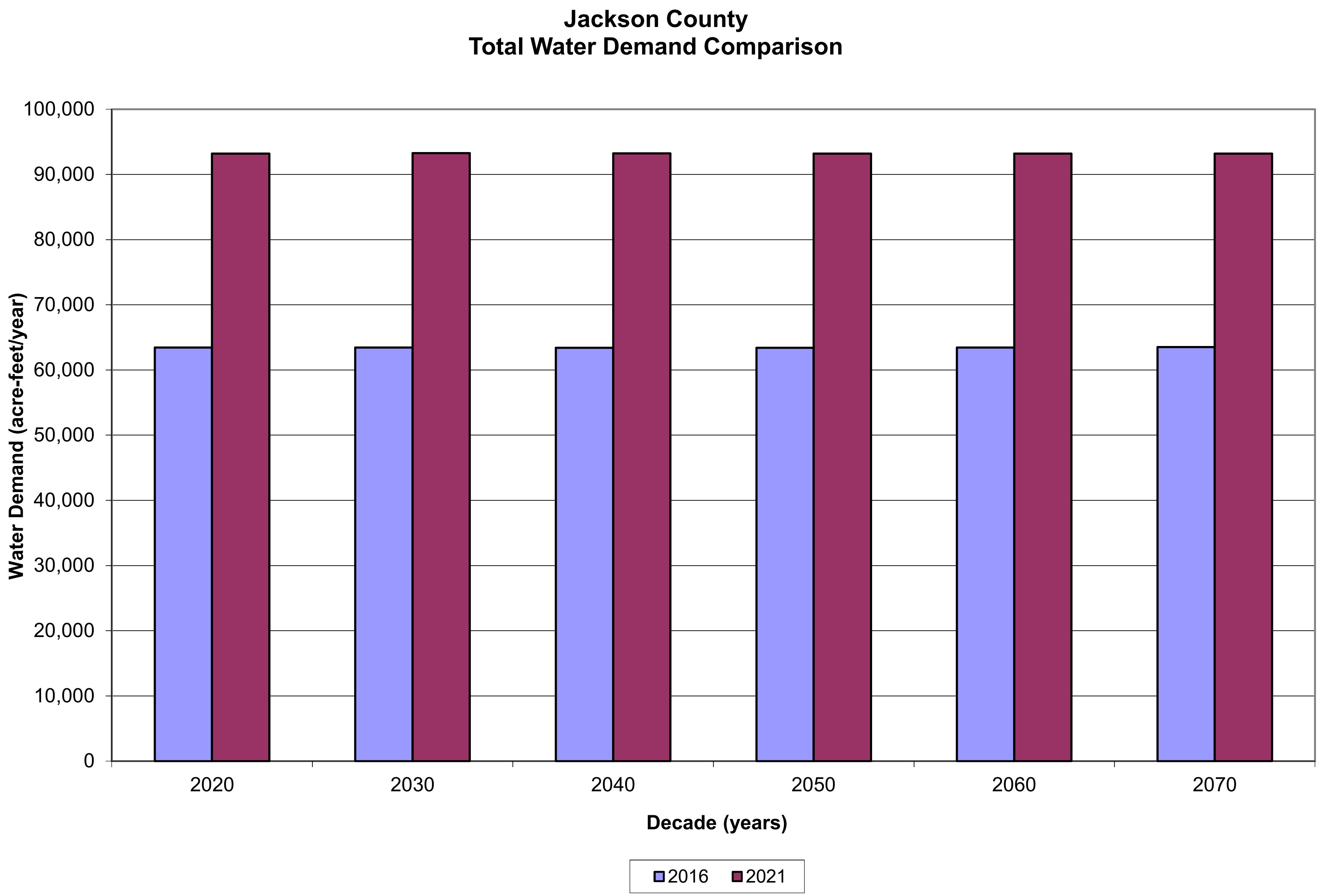

Region P
Irrigation Water Demand Comparison
250,000
200,000
150,000
100,000
50,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

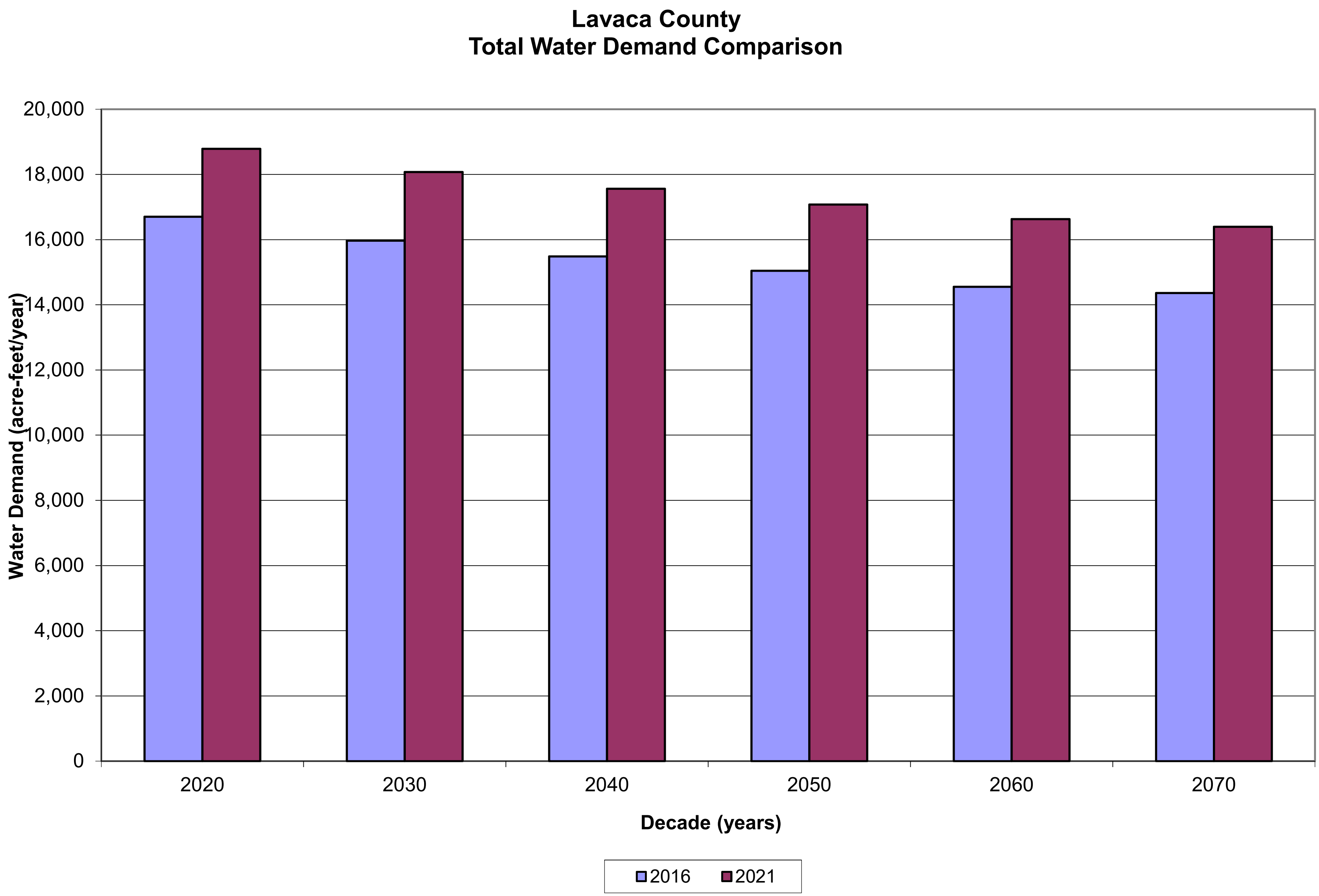

Region P
Manufacturing Water Demand Comparison
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

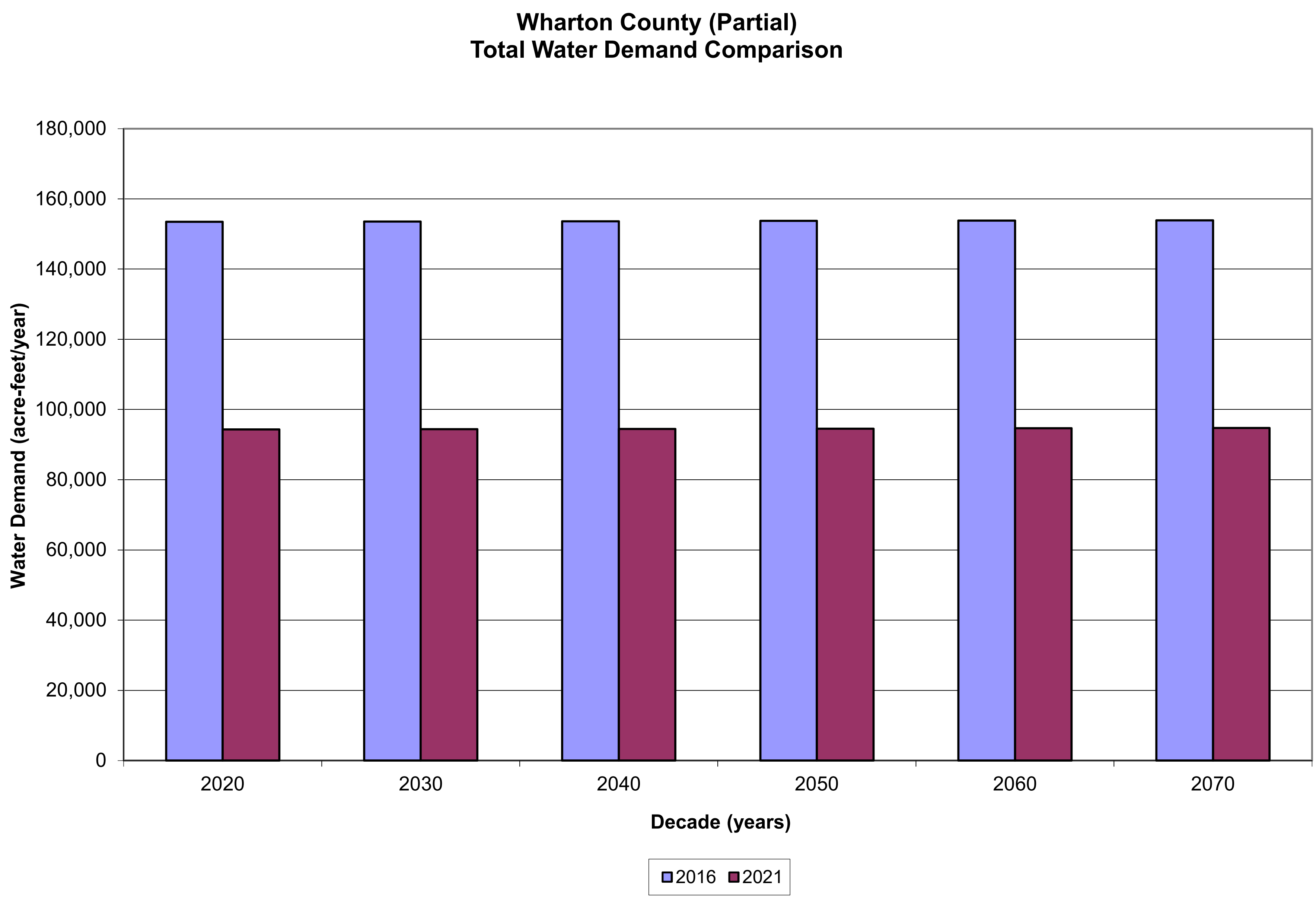

Region P
Mining Water Demand Comparison
Water Demand (acre-feet/year)
3,000
2,500
2,000
1,500
1,000
500
0
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021

Region P
Steam-Electric Water Demand Comparison




Jackson County
Total Water Demand Comparison
Water Demand (acre-feet/year)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021


Lavaca County
Total Water Demand Comparison
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021



Wharton County (Partial)
Total Water Demand Comparison
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2016
2021