2016 Lavaca Regional Water Plan

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

Prepared for:
Texas Water Development Board

November 2015

Adopted

2016 Lavaca Regional Water Plan

Prepared by:
Lavaca Regional Water Planning Group

with funding assistance from the Texas Water Development Board

With assistance from:
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STATE OF TEXAS
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Abbreviations Used in the Report

Ac-ft/yr	Acre-feet per year
CBGCD	Coastal Bend Groundwater Conservation District
DOR	Drought of Record
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
LNRA	Lavaca-Navidad River Authority
LRWPA	Lavaca Regional Water Planning Area
LRWPG	Lavaca Regional Water Planning Group
MGD	Million gallons per day
ROR	Run of River
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
WAM	Water Availability Model
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 2016 Regional Water Planning process continues the planning process set forth by the 2011 Regional Water Plans (RWPs) for the State of Texas. Beginning in 2011, the 2016 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 May 1, 2015. Following a comment period from state agencies and the general public, these plans were finalized and adopted by December 1, 2015, to be combined into the 2017 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 DB17.

Data provided by the TWDB in DB17 Reports are included in **Appendix ES.A** through **ES.F**.

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 **Figure 1-1** 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 & 2B – Non-Population Related Water Demand Projections and Population and Population-Related Water Demand Projections

Task 2 was 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 95 percent of the demands shown are related to irrigation supplies. This supply is obtained from both groundwater and surface water sources. 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	63,430	63,447	63,419	63,413	63,452	63,502
Lavaca	16,704	15,967	15,487	15,041	14,552	14,364
Wharton (Region P)	153,462	153,557	153,625	153,713	153,816	153,912
LRWPA Total	233,596	232,971	232,531	232,167	231,820	231,778

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. 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 virtually all of the WUG demands within the LRWPA. Irrigation, the single largest demand for the region, would be served entirely by groundwater during a repeat of the DOR. 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	23,615	23,615	23,615	23,615	23,615	23,615
	Lavaca	41,927	41,927	41,927	41,927	41,927	41,927
	Lavaca-Guadalupe	10,844	10,844	10,844	10,844	10,844	10,844
	County Total	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***
Lavaca	Guadalupe	41	41	41	41	41	41
	Lavaca	19,944	19,944	19,944	19,937	19,932	19,932
	Lavaca-Guadalupe	400	400	400	400	400	400
	County Total	***20,385***	***20,385***	***20,385***	***20,378***	***20,373***	***20,373***
Wharton	Colorado	441	441	441	441	441	441
	Colorado-Lavaca	11,549	11,549	11,549	11,549	11,549	11,549
	Lavaca	87,763	87,763	87,763	87,763	87,763	87,763
	County Total	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***

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 shortages for the LRWPA.

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

County	WUG	Basin	2020	2030	2040	2050	2060	2070
WHARTON	IRRIGATION	COLORADO-LAVACA	-12,779	-12,779	-12,779	-12,779	-12,779	-12,779
WHARTON	IRRIGATION	LAVACA	-37,506	-37,506	-37,506	-37,506	-37,506	-37,506

The sum of projected shortages for the planning horizon is 50,285 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 steam-electric and manufacturing demands in the Region in the near future. Currently, LNRA does not have sufficient water supplies to meet the potential demand and would show water needs if those demands had been identified earlier in the planning process.

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 because irrigators are sensitive to the increase in water prices and all shortages in the LRWPA were assumed to impact these users.

A majority of the strategies considered for evaluation were for meeting Irrigation water needs. The remaining strategies were 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.

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. 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. A socioeconomic impact analysis of not meeting water needs in the region was prepared by TWDB, and is included in **Appendix 6B**.

Overall, the recommended strategies keep the groundwater levels within their desired future condition 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. 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 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** addresses the following:

- The number of political subdivisions and/or non-municipal water user groups 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 at the inception of the project to review the population and water demand data; the supply, surpluses, and shortages; and management strategies. Meetings of the Planning Group were well attended by the members and non-voting members, but participation by the general public has been limited. One public hearing was held to receive public comments on the Initially Prepared Plan. 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 2011 Regional Water Plan and have since been implemented, as well as providing a summary comparison of the 2016 Regional Water Plan to the 2011 Regional Water Plan with respect to population, demands, water availability and supplies, water needs, and water management strategies.

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APPENDIX ES.A

TWDB DB17 Report
WUG Category Summary

Water User Group (WUG) Category Summary

REGION P	2020	2030	2040	2050	2060	2070
MUNICIPAL						
POPULATION	29,054	29,891	30,458	30,943	31,364	31,723
DEMANDS (acre-feet per year)	5,468	5,471	5,458	5,483	5,455	5,516
EXISTING SUPPLIES (acre-feet per year)	5,717	5,717	5,717	5,717	5,717	5,717
NEEDS (acre-feet per year)*	0	0	0	0	0	0
COUNTY-OTHER						
POPULATION	21,435	22,177	22,679	23,110	23,482	23,799
DEMANDS (acre-feet per year)	2,529	2,513	2,488	2,501	2,536	2,572
EXISTING SUPPLIES (acre-feet per year)	2,708	2,708	2,708	2,708	2,708	2,708
NEEDS (acre-feet per year)*	0	0	0	0	0	0
MANUFACTURING						
DEMANDS (acre-feet per year)	1,255	1,323	1,388	1,444	1,547	1,658
EXISTING SUPPLIES (acre-feet per year)	1,843	1,843	1,843	1,843	1,843	1,843
NEEDS (acre-feet per year)*	0	0	0	0	0	0
MINING						
DEMANDS (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
LIVESTOCK						
DEMANDS (acre-feet per year)	3,866	3,866	3,866	3,866	3,866	3,866
EXISTING SUPPLIES (acre-feet per year)	3,866	3,866	3,866	3,866	3,866	3,866
NEEDS (acre-feet per year)*	0	0	0	0	0	0
IRRIGATION						
DEMANDS (acre-feet per year)	217,846	217,846	217,846	217,846	217,846	217,846
EXISTING SUPPLIES (acre-feet per year)	167,561	167,561	167,561	167,561	167,561	167,561
NEEDS (acre-feet per year)*	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)
REGION TOTALS						
POPULATION	50,489	52,068	53,137	54,053	54,846	55,522
DEMANDS (acre-feet per year)	233,596	232,971	232,531	232,167	231,820	231,778
EXISTING SUPPLIES (acre-feet per year)	184,331	184,331	184,331	184,331	184,331	184,331
NEEDS (acre-feet per year)*	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)

*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.

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APPENDIX ES.B

TWDB DB17 Report
WUG Second-Tier Identified Water Needs Summary

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	518	518	518	518	518	518

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

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APPENDIX ES.C

TWDB DB17 Report
Source Water Balance

Source Water Balance (Availability- WUG Supply)

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
GROUNDWATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
GULF COAST AQUIFER	JACKSON	COLORADO-LAVACA	FRESH	5,086	5,086	5,086	5,086	5,086	5,086
GULF COAST AQUIFER	JACKSON	LAVACA	FRESH	3,226	3,226	3,226	3,226	3,226	3,226
GULF COAST AQUIFER	JACKSON	LAVACA-GUADALUPE	FRESH	5,304	5,304	5,304	5,304	5,304	5,304
GULF COAST AQUIFER	LAVACA	GUADALUPE	FRESH	16	16	16	16	16	16
GULF COAST AQUIFER	LAVACA	LAVACA	FRESH	3,092	3,092	3,092	3,085	3,080	3,080
GULF COAST AQUIFER	LAVACA	LAVACA-GUADALUPE	FRESH	358	358	358	358	358	358
GULF COAST AQUIFER	WHARTON	COLORADO	FRESH	48	48	48	48	48	48
GULF COAST AQUIFER	WHARTON	COLORADO-LAVACA	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER	WHARTON	LAVACA	FRESH	0	0	0	0	0	0
GROUNDWATER TOTAL SOURCE WATER BALANCE				**17,130**	**17,130**	**17,130**	**17,123**	**17,118**	**17,118**

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SURFACE WATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
TEXANA LAKE/RESERVOIR	RESERVOIR	LAVACA	FRESH	832	832	832	832	832	832
SURFACE WATER TOTAL SOURCE WATER BALANCE				**832**	**832**	**832**	**832**	**832**	**832**
REGION P TOTAL SOURCE WATER BALANCE				**17,962**	**17,962**	**17,962**	**17,955**	**17,950**	**17,950**

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APPENDIX ES.D

TWDB DB17 Report
WUG Unmet Needs Summary

Water User Group (WUG) Unmet Needs Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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

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APPENDIX ES.E

TWDB DB17 Reports
Recommended WUG Water Management Strategies
Recommended Water Management Strategy
Projects with Capital Costs

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
EDNA	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	33	33	33	33	33	33	$100	$100
EL CAMPO	K	DROUGHT MANAGEMENT	DEMAND REDUCTION	1	1	1	1	1	1	$50	$50
EL CAMPO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	86	87	89	91	93	95	$100	$100
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	DEMAND REDUCTION	109	170	237	333	329	336	$347	$347
EL CAMPO - UNASSIGNED WATER VOLUMES	P	DIRECT REUSE - EL CAMPO	P | DIRECT REUSE	560	560	560	560	560	560	$896	$896
GANADO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	54	54	53	53	53	54	$100	$100
HALLETTSVILLE	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	46	45	44	44	43	43	$100	$100
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	DEMAND REDUCTION	31	49	66	89	111	134	$334	$334
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	AQUIFER STORAGE AND RECOVERY	P | GULF COAST AQUIFER ASR FRESH/BRACKISH | JACKSON COUNTY	14,163	14,163	14,163	14,163	14,163	14,163	$1641	$1641
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LAVACA OFF-CHANNEL RESERVOIR	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	6,963	6,963	6,963	6,963	6,963	6,963	$867	$867
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH GROUNDWATER	P | GULF COAST AQUIFER | JACKSON COUNTY	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH SURFACE WATER	P | NAVIDAD RIVER TIDAL FRESH/BRACKISH	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
MOULTON	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	37	36	35	35	35	35	$100	$100
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	DEMAND REDUCTION	9	13	18	25	31	38	$355	$355
SHINER	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	49	48	47	46	46	46	$100	$100
SHINER	P	MUNICIPAL CONSERVATION - SHINER	DEMAND REDUCTION	23	37	49	65	86	104	$342	$342
YOAKUM	L	MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION	42	51	26	7	56	64	$0	$0
YOAKUM	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	19	18	18	18	15	15	$100	$100
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	DEMAND REDUCTION	37	54	74	95	33	62	$357	$357
Region P Total RecommendedWMS Supplies				28,714	28,834	28,928	29,073	29,103	29,198		

Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
EL CAMPO	N	MUNICIPAL CONSERVATION - EL CAMPO	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$243,652	2020
EL CAMPO	N	REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$3,272,000	2020
HALLETTSVILLE	N	MUNICIPAL CONSERVATION - HALLETTSVILLE	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$62,313	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - ON FARM	ON FARM IRRIGATION CONSERVATION	$20,833,000	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - TAILWATER RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$22,561,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$130,169,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$31,393,000	2020
MOULTON	N	MUNICIPAL CONSERVATION - MOULTON	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$20,750	2020
SHINER	N	MUNICIPAL CONSERVATION - SHINER	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$50,357	2020
YOAKUM	N	MUNICIPAL CONSERVATION - YOAKUM	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$85,984	2020

Region P Total Recommended Capital Cost	**$331,904,056**

***Projects with a capital cost of zero are excluded from the report list.**

APPENDIX ES.F

TWDB DB17 Reports
Alternative WUG Water Management Strategies
Alternative Water Management Strategy Projects
with Capital Costs

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
			Region P Total Alternative WMS Supplies								

Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR -- ALTERNATIVE SITE	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020

Region P Total Alternative Capital Cost	**$123,213,000**

***Projects with a capital cost of zero are excluded from the report list.**

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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 and 2011 Regional Water Plans (compiled by TWDB into the 2007 and 2012 State Water Plans, respectively. The fourth cycle of regional water planning produced an "initially prepared" Regional Water Plan that was required to be submitted to the TWDB by May 1, 2015, and is to be finalized and adopted and submitted to the TWDB in late 2015. Subsequently, by January 5, 2017, the TWDB will prepare the 2017 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

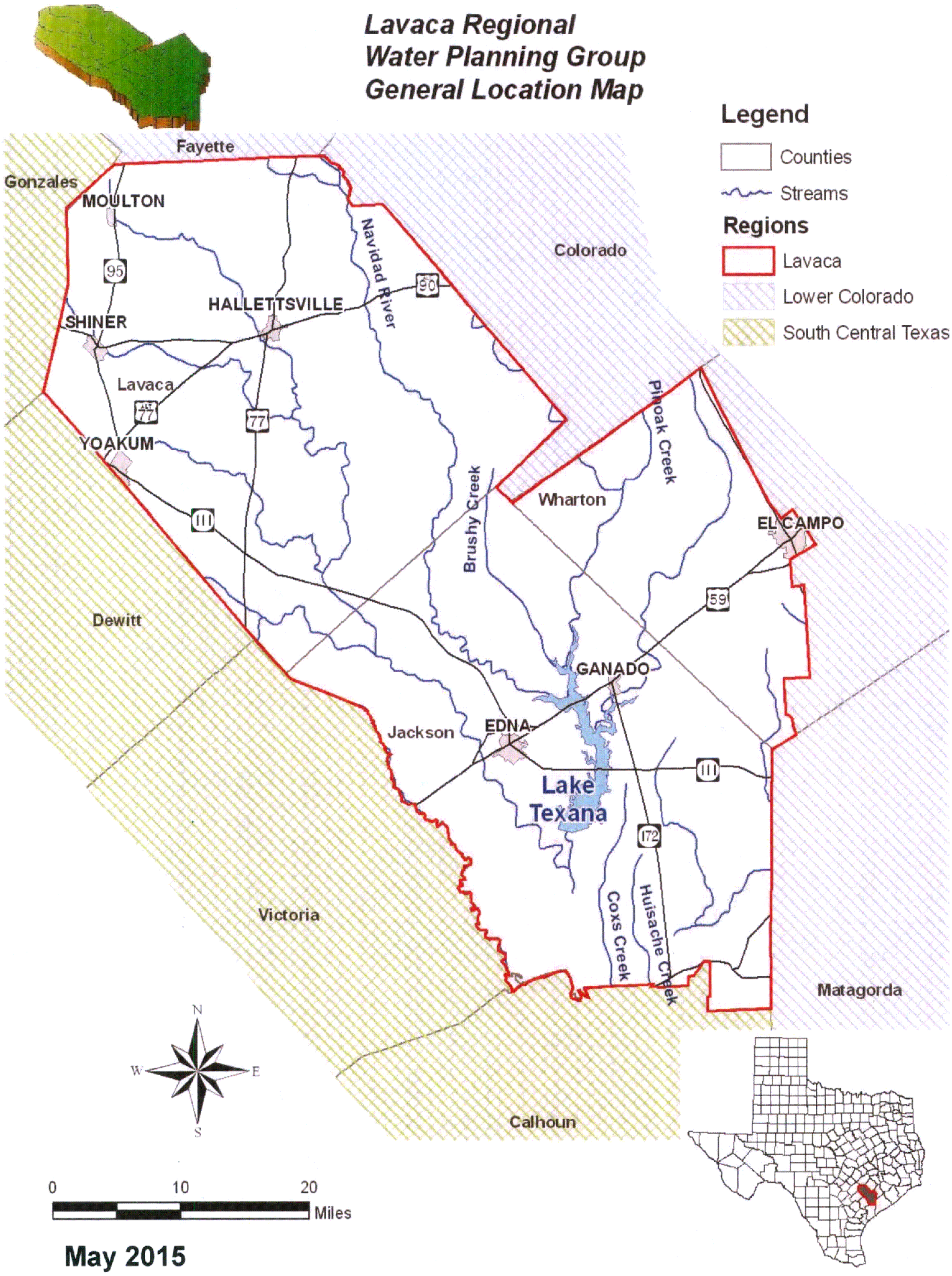
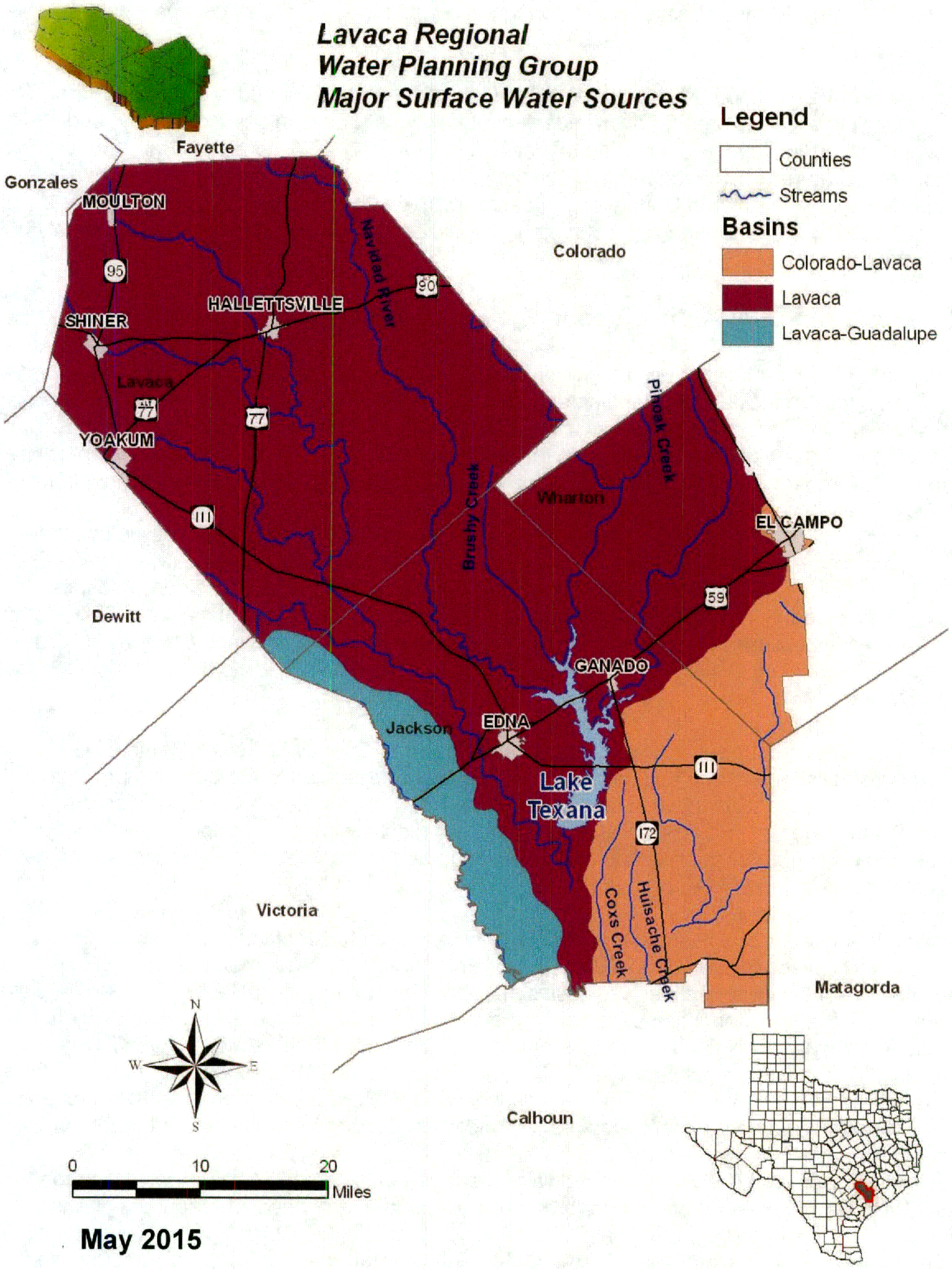


Figure 1-2
Major Surface Water Sources



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 290 days in Jackson County, 280 days in Lavaca County, and 266 days in Wharton County. The mean rainfall is approximately 40.8 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.

1.2.1 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 member 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 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, and then again on November 10, 2014. An updated groundwater management plan for the Texana GCD was approved by TWDB on February 25, 2011. The Lavaca County GCD was created by the 80th Texas Legislature on May 25, 2007 but has not received local support, and so 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 and operation, metal fabrication and tooling, sheet-metal works, plastics manufacturing, agribusiness, and tourism associated with Lake Texana and its recreational areas. 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 2012.

The economy of Lavaca County includes varied manufacturing, leather goods, agribusiness, oil and gas production, and tourism. The major agricultural interests in Lavaca County include livestock (especially beef cattle), eggs, poultry, hay, rice, corn, tree nuts, and grain sorghum, with a market value of approximately $61.9 million in 2012.

The economy of Wharton County includes petroleum production, and other minerals, agribusiness, hunting leases, and varied manufacturing. The major agricultural interests in Wharton County include rice, grain sorghum, cotton, corn, eggs, turfgrass, beef cattle, hay and soybeans; with a market value of approximately $373.6 million for the entire county in 2012 (the county is only partially contained in the Lavaca Region).

According the US Census Bureau, the 2008-2012 median household income was approximately $47,591 for Jackson County, $42,934 for Lavaca County, and $40,988 for all of Wharton County. The Texas median household income was approximately $51,563 during the same period.

Unemployment in 2013 was approximately 5.1 percent in Jackson County, 4.4 percent in Lavaca County, and 6.0 percent in Wharton County (Texas Workforce Commission. Labor Force Statistics for Texas Counties 2000-Present (2013).
http://www.txcip.org/tac/census/morecountyinfo.php?MORE=1042).

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
Jackson	$1,416,741,983	$2,459,407,498
Lavaca	$2,335,053,537	$4,209,668,856
Wharton	$2,651,668,721	$4,532,539,863

Source: *Texas Almanac* 2008-2009 and 2013-2014
(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 2010 Water Use Survey Estimate, irrigated agriculture constitutes over 91 percent of the total water use in the Lavaca Region. Municipal water accounts for five percent, the second largest share of use categories in the region. Livestock use in the Lavaca Region accounted for less than 3 percent of 2010 use and manufacturing and mining water use make up approximately 1 percent of 2010 use.

The LRWPG elected to perform an update of agricultural demand projections as part of developing the 2011 Regional Water Plan. This analysis was again utilized in determining projections for the 2016 Regional Water Plan, because the data appears to still be reflective of irrigation activities in the region. Detailed information was obtained from sources including the Coastal Bend GCD, the U.S. Government Farm Service Agency, and the South Texas Watermaster. An expected demand condition for the year 2010 was developed using historical planted acreage and, where possible, measured data regarding application rates for the irrigation of rice and other crops. The results generally showed that the anticipated 2010 water use for irrigation in the LRWPA was similar to the projections developed in the 2006 RWP, although the makeup of that demand varied due to a greater level of production for crops other than rice. The study projected 2010 water demands for irrigation in Jackson, Lavaca, and Wharton counties of 59,801 Ac-Ft, 8,357 Ac-Ft, and 149,688 Ac-Ft, respectively.

The *Agricultural Water Demands Analysis* investigated trends in crop production and water usage for the area and developed long-term projections for the planning cycle. The study determined that no single factor such as climate, water source, use of conservation practices, crop price, the prospect of biofuels, or new markets for rice pointed toward a conclusive growth or reduction of agricultural water demand in the foreseeable future. Recent increases in the price for rice have also been met with increased production costs that make any long-term trend difficult to project. Therefore the projections were assumed to carry throughout the current planning horizon for all decades from 2020 to 2070 as a peak demand condition.

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, 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 unfeasible. 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 more than 90 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 Chapter 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 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 Wholesale Water Providers

A wholesale water provider is an entity that delivers and sells a significant amount of raw or treated water on a wholesale basis. The Lavaca-Navidad River Authority (LNRA) is the only wholesale water provider located in the Lavaca Region.

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, 85,468 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
- 41,840 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
- 30,800 ac-ft firm yield to Formosa Plastics in Calhoun County
- 594 ac-ft firm yield to the Calhoun County Navigation District in Calhoun County
- 56 ac-ft firm yield held in reserve

Of the annual acre-feet contracted to the City of Corpus Christi, 10,400 ac-ft was sold on a temporary basis and can be recalled for use in Jackson County when needed.

A total of 1,032 ac-ft firm yield is committed to Inteplast (manufacturing), located 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 2016 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 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.

There are few water quality concerns in the Lavaca Basin. *Table 1–3* lists the concerns found in the 2010 and 2012 Texas Water Quality Inventory conducted by TCEQ. The concerns are as follows:

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 2010-2012 indicates that there are portion of two classified stream segments with a concern for DO, based on the State Stream Standards Criteria in the Lavaca Regional Water Planning Area (*Table 1–3* and *Table 1–4).*

Table 1–3 Stream Segment Uses and Water Quality Criteria in the Lavaca River Basin 2012

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
1605[2]	Navidad River Above Lake Texana	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 2012; Water Quality Criteria accurate as of 2012.

[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[*,1,3]	Concern[2]	Concern[1,2,3]			
1602A	Big Brushy Creek		Concern[1,2]	Concern[3]			
1602B	Rocky Creek	Concern[*,1,3]	Concern[2]	Concern[2]			
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						

* The Upper 29 miles of Segment 1602 in Lavaca County and Rocky Creek have been identified as being of concern for depressed Dissolved Oxygen (DO) levels.
[1]Source: TCEQ 2010 Texas Water Quality Inventory
[2]Indicated by LNRA
[3]Source: TCEQ 2012 Texas Water Quality Inventory

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 standard 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 2010-2012 data from TCEQ and LNRA, there are four portions of stream segments with a concern for nutrients in the Lavaca Regional Water Planning Area (Table 1–3 and 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 nine 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 (462 acres), Brackenridge Main Event Center Complex (187 acres), Texana Park (575 acres), sailing, and canoeing. 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. Brackenridge Recreation Complex opened a new event center as well as many other recreational facilities in 2009. 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.

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*
False spike mussel	*Quadrula mitchelli*
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 fatmucket	*Lampsilis bracteata*
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*
Brown Pelican	*Pelecanus occidentalis*
crayfish	*Cambarellus texanus*
Creeper (squawfoot)	*Strophitus undulatus*
Green beebalm	*Monarda viridissima*
Gulf Saltmarsh snake	*Nerodia clarkii*
Henslow's Sparrow	*Ammodramus henslowii*
Mountain Plover	*Charadrius montanus*
Plains spotted skunk	*Spilogale putorius interrupta*
Sharpnose shiner	*Notropis oxyrhynchus*
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*
Snowy Plover	*Charadrius alexandrinus*
Southeastern Snowy Plover	*Charadrius alexandrinus tenuirostris*
Southern Crawfish Frog	*Lithobates areolatus areolatus*
Sprague's Pipit	*Anthus spragueii*
Texas diamondback terrapin	*Malaclemys terrapin littoralis*
Threeflower broomweed	*Thurovia triflora*
Welder machaeranthera	*Psilactis heterocarpa*
Western Burrowing Owl	*Athene cunicularia hypugaea*

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 April 2014).

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 2016 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 <u>average</u> 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:

- 22 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, 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.

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. Since 2011, the Lower Colorado River Authority has cut-off water to irrigators in the Lower Colorado Basin, resulting in increased groundwater pumping. It is unclear how this increased pumping will impact municipalities in the Lavaca Region but will be monitored in coming years.

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 2010-2013 water loss audit information was provided to the LRWPG by TWDB. Six public utilities in the LRWPA submitted water loss audit data as part of the required 2010 submittal to TWDB. Limited data was submitted in 2011-2013, so the 2010 data is used for this report. Total loss rates for the utilities within the LRWPA were found to vary from 4.3 to 35.8 percent, with the City of Ganado having the lowest reported percentage, and the City of Shiner 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 4.9 to 35.5 percent, with the City of Edna having the lowest reported percentage, and the City of Shiner having the highest.

Table 1-6 below summarizes the 2010 water audit data available for the Lavaca Regional Water Planning Area, which includes 6 submitted water audits.

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

<table>
<tr><td rowspan="9">Region P
6 Audits Submitted</td><td rowspan="9">System Input Volume
698,463,914</td><td rowspan="4">Authorized Consumption
565,212,908
80.9%</td><td rowspan="2">Billed Consumption
556,116,139
79.6%</td><td>Billed Metered
554,559,500
79.4%</td><td rowspan="2">Revenue Water
556,116,139
79.6%</td></tr>
<tr><td>Billed Unmetered
1,556,639
0.2%</td></tr>
<tr><td rowspan="2">Unbilled Consumption
9,096,769
1.3%</td><td>Unbilled Metered
671,520
0.1%</td><td rowspan="7">Non-revenue Water
142,347,775
20.4%</td></tr>
<tr><td>Unbilled Unmetered
8,425,249
1.2%</td></tr>
<tr><td rowspan="5">Water Loss
133,251,006
19.1%</td><td rowspan="3">Apparent Loss
26,744,810
3.8%</td><td>Unauthorized Consumption
1,626,410
0.2%</td></tr>
<tr><td>Customer Meter Accuracy Loss
6,988,700
1.0%</td></tr>
<tr><td>Systematic Data Handling Discrepency
18,129,700
2.6%</td></tr>
<tr><td rowspan="2">Real Loss
106,506,197
15.2%</td><td>Reported Breaks and Leaks
22,506,811
3.2%</td></tr>
<tr><td>Unreported Loss
83,999,386
12.0%</td></tr>
</table>

Source: 2010 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.

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APPENDIX 1A

Sources Used

Document	Description/Importance
Texas Almanac: 2013-2014, 2008-2009.	Provides background information and statistics on Texas and each county.
TWDB. *2012 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.
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: 2014].	Lists endangered, threatened, and rare species for each county.
Lavaca-Navidad River Authority. *Lavaca-Navidad River Authority Basin Summary Report, Texas Clean Rivers Program 2012* http://www.lnra.org/docs/water-quality-program/2012_final_bsrsm.pdf	Summarizes Stream Segment Uses and Water Quality Criteria in the Lavaca River Basin in 2012.
Texas Clean Rivers Program and TCEQ. 2010. *Draft 2010 Texas Water Quality Inventory*	Summarizes the water quality issues for each segment of the Texas river basins.
Texas Clean Rivers Program and TCEQ. 2012. *Draft 2010 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 2004.

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APPENDIX 1B

TWDB DB17 Reports

Water User Group (WUG) Category Summary

REGION P	2020	2030	2040	2050	2060	2070
MUNICIPAL						
POPULATION	29,054	29,891	30,458	30,943	31,364	31,723
DEMANDS (acre-feet per year)	5,468	5,471	5,458	5,483	5,455	5,516
EXISTING SUPPLIES (acre-feet per year)	5,717	5,717	5,717	5,717	5,717	5,717
NEEDS (acre-feet per year)*	0	0	0	0	0	0
COUNTY-OTHER						
POPULATION	21,435	22,177	22,679	23,110	23,482	23,799
DEMANDS (acre-feet per year)	2,529	2,513	2,488	2,501	2,536	2,572
EXISTING SUPPLIES (acre-feet per year)	2,708	2,708	2,708	2,708	2,708	2,708
NEEDS (acre-feet per year)*	0	0	0	0	0	0
MANUFACTURING						
DEMANDS (acre-feet per year)	1,255	1,323	1,388	1,444	1,547	1,658
EXISTING SUPPLIES (acre-feet per year)	1,843	1,843	1,843	1,843	1,843	1,843
NEEDS (acre-feet per year)*	0	0	0	0	0	0
MINING						
DEMANDS (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
LIVESTOCK						
DEMANDS (acre-feet per year)	3,866	3,866	3,866	3,866	3,866	3,866
EXISTING SUPPLIES (acre-feet per year)	3,866	3,866	3,866	3,866	3,866	3,866
NEEDS (acre-feet per year)*	0	0	0	0	0	0
IRRIGATION						
DEMANDS (acre-feet per year)	217,846	217,846	217,846	217,846	217,846	217,846
EXISTING SUPPLIES (acre-feet per year)	167,561	167,561	167,561	167,561	167,561	167,561
NEEDS (acre-feet per year)*	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)
REGION TOTALS						
POPULATION	50,489	52,068	53,137	54,053	54,846	55,522
DEMANDS (acre-feet per year)	233,596	232,971	232,531	232,167	231,820	231,778
EXISTING SUPPLIES (acre-feet per year)	184,331	184,331	184,331	184,331	184,331	184,331
NEEDS (acre-feet per year)*	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)	(50,285)

*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.

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Water User Group (WUG) Population

REGION P	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY						
COLORADO-LAVACA BASIN						
COUNTY-OTHER	2,236	2,315	2,348	2,376	2,393	2,404
COLORADO-LAVACA BASIN TOTAL POPULATION	**2,236**	**2,315**	**2,348**	**2,376**	**2,393**	**2,404**
LAVACA BASIN						
EDNA	5,707	5,907	5,992	6,062	6,106	6,134
GANADO	2,079	2,152	2,183	2,208	2,224	2,235
COUNTY-OTHER	4,105	4,250	4,310	4,361	4,392	4,412
LAVACA BASIN TOTAL POPULATION	**11,891**	**12,309**	**12,485**	**12,631**	**12,722**	**12,781**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	479	495	503	508	512	514
LAVACA-GUADALUPE BASIN TOTAL POPULATION	**479**	**495**	**503**	**508**	**512**	**514**
JACKSON COUNTY TOTAL POPULATION	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	33	33	33	33	33	33
GUADALUPE BASIN TOTAL POPULATION	**33**	**33**	**33**	**33**	**33**	**33**
LAVACA BASIN						
HALLETTSVILLE	2,550	2,550	2,550	2,550	2,550	2,550
MOULTON	886	886	886	886	886	886
SHINER	2,070	2,070	2,070	2,070	2,070	2,070
YOAKUM	3,678	3,678	3,678	3,678	3,678	3,678
COUNTY-OTHER	10,041	10,041	10,041	10,041	10,041	10,041
LAVACA BASIN TOTAL POPULATION	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	5	5	5	5	5	5
LAVACA-GUADALUPE BASIN TOTAL POPULATION	**5**	**5**	**5**	**5**	**5**	**5**
LAVACA COUNTY TOTAL POPULATION	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**
WHARTON COUNTY						
COLORADO BASIN						
EL CAMPO	1,656	1,733	1,795	1,848	1,897	1,941
COUNTY-OTHER	177	217	249	277	304	327
COLORADO BASIN TOTAL POPULATION	**1,833**	**1,950**	**2,044**	**2,125**	**2,201**	**2,268**
COLORADO-LAVACA BASIN						
EL CAMPO	10,138	10,611	10,990	11,317	11,621	11,889
COUNTY-OTHER	760	986	1,166	1,322	1,464	1,592
COLORADO-LAVACA BASIN TOTAL POPULATION	**10,898**	**11,597**	**12,156**	**12,639**	**13,085**	**13,481**
LAVACA BASIN						
EL CAMPO	290	304	314	324	332	340

Water User Group (WUG) Population

REGION P	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
LAVACA BASIN						
COUNTY-OTHER	3,599	3,835	4,024	4,187	4,338	4,471
LAVACA BASIN TOTAL POPULATION	**3,889**	**4,139**	**4,338**	**4,511**	**4,670**	**4,811**
WHARTON COUNTY TOTAL POPULATION	**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**

Water User Group (WUG) Demand

REGION P	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY						
COLORADO-LAVACA BASIN						
COUNTY-OTHER	229	226	222	220	220	221
MANUFACTURING	666	686	705	721	766	815
MINING	10	11	8	6	4	3
LIVESTOCK	228	228	228	228	228	228
IRRIGATION	18,061	18,061	18,061	18,061	18,061	18,061
COLORADO-LAVACA BASIN TOTAL DEMAND	**19,194**	**19,212**	**19,224**	**19,236**	**19,279**	**19,328**
LAVACA BASIN						
EDNA	885	887	877	877	881	885
GANADO	270	270	267	266	267	268
COUNTY-OTHER	421	417	406	403	404	406
MANUFACTURING	4	4	4	4	5	5
MINING	39	40	30	22	14	10
LIVESTOCK	708	708	708	708	708	708
IRRIGATION	36,370	36,370	36,370	36,370	36,370	36,370
LAVACA BASIN TOTAL DEMAND	**38,697**	**38,696**	**38,662**	**38,650**	**38,649**	**38,652**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	50	49	48	47	48	48
MINING	21	22	17	12	8	6
LIVESTOCK	98	98	98	98	98	98
IRRIGATION	5,370	5,370	5,370	5,370	5,370	5,370
LAVACA-GUADALUPE BASIN TOTAL DEMAND	**5,539**	**5,539**	**5,533**	**5,527**	**5,524**	**5,522**
JACKSON COUNTY TOTAL DEMAND	**63,430**	**63,447**	**63,419**	**63,413**	**63,452**	**63,502**
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	5	4	4	4	4	4
LIVESTOCK	20	20	20	20	20	20
GUADALUPE BASIN TOTAL DEMAND	**25**	**24**	**24**	**24**	**24**	**24**
LAVACA BASIN						
HALLETTSVILLE	606	594	584	579	578	578
MOULTON	183	178	175	174	173	173
SHINER	485	475	467	462	462	462
YOAKUM	755	735	719	710	619	619
COUNTY-OTHER	1,235	1,189	1,150	1,129	1,125	1,125
MANUFACTURING	490	531	571	605	653	705
MINING	2,544	1,860	1,416	977	537	297
LIVESTOCK	1,982	1,982	1,982	1,982	1,982	1,982
IRRIGATION	8,357	8,357	8,357	8,357	8,357	8,357
LAVACA BASIN TOTAL DEMAND	**16,637**	**15,901**	**15,421**	**14,975**	**14,486**	**14,298**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	1	1	1	1	1	1
LIVESTOCK	41	41	41	41	41	41
LAVACA-GUADALUPE BASIN TOTAL DEMAND	**42**	**42**	**42**	**42**	**42**	**42**
LAVACA COUNTY TOTAL DEMAND	**16,704**	**15,967**	**15,487**	**15,041**	**14,552**	**14,364**

Water User Group (WUG) Demand

REGION P	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
COLORADO BASIN						
EL CAMPO	313	320	325	331	339	347
COUNTY-OTHER	21	27	30	33	37	40
COLORADO BASIN TOTAL DEMAND	**334**	**347**	**355**	**364**	**376**	**387**
COLORADO-LAVACA BASIN						
EL CAMPO	1,916	1,956	1,987	2,026	2,076	2,123
COUNTY-OTHER	99	123	141	160	176	192
MANUFACTURING	95	102	108	114	123	133
MINING	6	7	5	4	2	1
LIVESTOCK	174	174	174	174	174	174
IRRIGATION	21,642	21,642	21,642	21,642	21,642	21,642
COLORADO-LAVACA BASIN TOTAL DEMAND	**23,932**	**24,004**	**24,057**	**24,120**	**24,193**	**24,265**
LAVACA BASIN						
EL CAMPO	55	56	57	58	60	61
COUNTY-OTHER	468	477	486	504	521	535
MINING	12	12	9	6	5	3
LIVESTOCK	615	615	615	615	615	615
IRRIGATION	128,046	128,046	128,046	128,046	128,046	128,046
LAVACA BASIN TOTAL DEMAND	**129,196**	**129,206**	**129,213**	**129,229**	**129,247**	**129,260**
WHARTON COUNTY TOTAL DEMAND	**153,462**	**153,557**	**153,625**	**153,713**	**153,816**	**153,912**
REGION P TOTAL DEMAND	**233,596**	**232,971**	**232,531**	**232,167**	**231,820**	**231,778**

Source Availability

REGION P

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
				2020	2030	2040	2050	2060	2070
GULF COAST AQUIFER	JACKSON	COLORADO-LAVACA	FRESH	23,615	23,615	23,615	23,615	23,615	23,615
GULF COAST AQUIFER	JACKSON	LAVACA	FRESH	41,927	41,927	41,927	41,927	41,927	41,927
GULF COAST AQUIFER	JACKSON	LAVACA-GUADALUPE	FRESH	10,844	10,844	10,844	10,844	10,844	10,844
GULF COAST AQUIFER	LAVACA	GUADALUPE	FRESH	41	41	41	41	41	41
GULF COAST AQUIFER	LAVACA	LAVACA	FRESH	19,944	19,944	19,944	19,937	19,932	19,932
GULF COAST AQUIFER	LAVACA	LAVACA-GUADALUPE	FRESH	400	400	400	400	400	400
GULF COAST AQUIFER	WHARTON	COLORADO	FRESH	441	441	441	441	441	441
GULF COAST AQUIFER	WHARTON	COLORADO-LAVACA	FRESH	11,549	11,549	11,549	11,549	11,549	11,549
GULF COAST AQUIFER	WHARTON	LAVACA	FRESH	87,763	87,763	87,763	87,763	87,763	87,763
GROUNDWATER TOTAL SOURCE AVAILABILITY				**196,524**	**196,524**	**196,524**	**196,517**	**196,512**	**196,512**

REGION P

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
				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 TOTAL SOURCE AVAILABILITY				**74,500**	**74,500**	**74,500**	**74,500**	**74,500**	**74,500**
REGION P TOTAL SOURCE AVAILABILITY				**271,024**	**271,024**	**271,024**	**271,017**	**271,012**	**271,012**

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Water User Group (WUG) Existing Water Supply

REGION P	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070
JACKSON COUNTY							
COLORADO-LAVACA BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	229	229	229	229	229	229
MANUFACTURING	P | TEXANA LAKE/RESERVOIR	1,000	1,000	1,000	1,000	1,000	1,000
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	11	11	11	11	11	11
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	228	228	228	228	228	228
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	18,061	18,061	18,061	18,061	18,061	18,061
COLORADO-LAVACA BASIN TOTAL EXISTING SUPPLY		**19,529**	**19,529**	**19,529**	**19,529**	**19,529**	**19,529**
LAVACA BASIN							
EDNA	P | GULF COAST AQUIFER | JACKSON COUNTY	887	887	887	887	887	887
GANADO	P | GULF COAST AQUIFER | JACKSON COUNTY	270	270	270	270	270	270
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	421	421	421	421	421	421
MANUFACTURING	P | GULF COAST AQUIFER | JACKSON COUNTY	5	5	5	5	5	5
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	40	40	40	40	40	40
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	708	708	708	708	708	708
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	36,370	36,370	36,370	36,370	36,370	36,370
LAVACA BASIN TOTAL EXISTING SUPPLY		**38,701**	**38,701**	**38,701**	**38,701**	**38,701**	**38,701**
LAVACA-GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	50	50	50	50	50	50
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	22	22	22	22	22	22
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	98	98	98	98	98	98
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	5,370	5,370	5,370	5,370	5,370	5,370
LAVACA-GUADALUPE BASIN TOTAL EXISTING SUPPLY		**5,540**	**5,540**	**5,540**	**5,540**	**5,540**	**5,540**
JACKSON COUNTY TOTAL EXISTING SUPPLY		**63,770**	**63,770**	**63,770**	**63,770**	**63,770**	**63,770**
LAVACA COUNTY							
GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	5	5	5	5	5	5
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	20	20	20	20	20	20
GUADALUPE BASIN TOTAL EXISTING SUPPLY		**25**	**25**	**25**	**25**	**25**	**25**
LAVACA BASIN							
HALLETTSVILLE	P | GULF COAST AQUIFER | LAVACA COUNTY	606	606	606	606	606	606
MOULTON	P | GULF COAST AQUIFER | LAVACA COUNTY	183	183	183	183	183	183
SHINER	P | GULF COAST AQUIFER | LAVACA COUNTY	485	485	485	485	485	485
YOAKUM	P | GULF COAST AQUIFER | LAVACA COUNTY	755	755	755	755	755	755
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	1,235	1,235	1,235	1,235	1,235	1,235
MANUFACTURING	P | GULF COAST AQUIFER | LAVACA COUNTY	705	705	705	705	705	705
MINING	P | GULF COAST AQUIFER | LAVACA COUNTY	2,544	2,544	2,544	2,544	2,544	2,544
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	1,982	1,982	1,982	1,982	1,982	1,982
IRRIGATION	P | GULF COAST AQUIFER | LAVACA COUNTY	8,357	8,357	8,357	8,357	8,357	8,357
LAVACA BASIN TOTAL EXISTING SUPPLY		**16,852**	**16,852**	**16,852**	**16,852**	**16,852**	**16,852**
LAVACA-GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	1	1	1	1	1	1
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	41	41	41	41	41	41
LAVACA-GUADALUPE BASIN TOTAL EXISTING SUPPLY		**42**	**42**	**42**	**42**	**42**	**42**

Water User Group (WUG) Existing Water Supply

REGION P	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LAVACA COUNTY TOTAL EXISTING SUPPLY		**16,919**	**16,919**	**16,919**	**16,919**	**16,919**	**16,919**
WHARTON COUNTY							
COLORADO BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	347	347	347	347	347	347
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	40	40	40	40	40	40
COLORADO BASIN TOTAL EXISTING SUPPLY		**387**	**387**	**387**	**387**	**387**	**387**
COLORADO-LAVACA BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	2,123	2,123	2,123	2,123	2,123	2,123
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	192	192	192	192	192	192
MANUFACTURING	P | GULF COAST AQUIFER | WHARTON COUNTY	133	133	133	133	133	133
MINING	P | GULF COAST AQUIFER | WHARTON COUNTY	7	7	7	7	7	7
LIVESTOCK	P | GULF COAST AQUIFER | WHARTON COUNTY	174	174	174	174	174	174
IRRIGATION	P | GULF COAST AQUIFER | WHARTON COUNTY	8,863	8,863	8,863	8,863	8,863	8,863
COLORADO-LAVACA BASIN TOTAL EXISTING SUPPLY		**11,492**	**11,492**	**11,492**	**11,492**	**11,492**	**11,492**
LAVACA BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	61	61	61	61	61	61
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	535	535	535	535	535	535
MINING	P | GULF COAST AQUIFER | WHARTON COUNTY	12	12	12	12	12	12
LIVESTOCK	P | GULF COAST AQUIFER | WHARTON COUNTY	615	615	615	615	615	615
IRRIGATION	K | COLORADO RUN-OF-RIVER	4,000	4,000	4,000	4,000	4,000	4,000
IRRIGATION	P | GULF COAST AQUIFER | WHARTON COUNTY	86,540	86,540	86,540	86,540	86,540	86,540
LAVACA BASIN TOTAL EXISTING SUPPLY		**91,763**	**91,763**	**91,763**	**91,763**	**91,763**	**91,763**
WHARTON COUNTY TOTAL EXISTING SUPPLY		**103,642**	**103,642**	**103,642**	**103,642**	**103,642**	**103,642**
	REGION P TOTAL EXISTING SUPPLY	**184,331**	**184,331**	**184,331**	**184,331**	**184,331**	**184,331**

Source Water Balance (Availability- WUG Supply)

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
GROUNDWATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
GULF COAST AQUIFER	JACKSON	COLORADO-LAVACA	FRESH	5,086	5,086	5,086	5,086	5,086	5,086
GULF COAST AQUIFER	JACKSON	LAVACA	FRESH	3,226	3,226	3,226	3,226	3,226	3,226
GULF COAST AQUIFER	JACKSON	LAVACA-GUADALUPE	FRESH	5,304	5,304	5,304	5,304	5,304	5,304
GULF COAST AQUIFER	LAVACA	GUADALUPE	FRESH	16	16	16	16	16	16
GULF COAST AQUIFER	LAVACA	LAVACA	FRESH	3,092	3,092	3,092	3,085	3,080	3,080
GULF COAST AQUIFER	LAVACA	LAVACA-GUADALUPE	FRESH	358	358	358	358	358	358
GULF COAST AQUIFER	WHARTON	COLORADO	FRESH	48	48	48	48	48	48
GULF COAST AQUIFER	WHARTON	COLORADO-LAVACA	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER	WHARTON	LAVACA	FRESH	0	0	0	0	0	0
GROUNDWATER TOTAL SOURCE WATER BALANCE				**17,130**	**17,130**	**17,130**	**17,123**	**17,118**	**17,118**

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SURFACE WATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
TEXANA LAKE/RESERVOIR	RESERVOIR	LAVACA	FRESH	832	832	832	832	832	832
SURFACE WATER TOTAL SOURCE WATER BALANCE				**832**	**832**	**832**	**832**	**832**	**832**
REGION P TOTAL SOURCE WATER BALANCE				**17,962**	**17,962**	**17,962**	**17,955**	**17,950**	**17,950**

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Water User Group (WUG) Needs/Surplus

REGION P	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY						
COLORADO-LAVACA BASIN						
COUNTY-OTHER	0	3	7	9	9	8
MANUFACTURING	334	314	295	279	234	185
MINING	1	0	3	5	7	8
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA BASIN						
EDNA	2	0	10	10	6	2
GANADO	0	0	3	4	3	2
COUNTY-OTHER	0	4	15	18	17	15
MANUFACTURING	1	1	1	1	0	0
MINING	1	0	10	18	26	30
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	1	2	3	2	2
MINING	1	0	5	10	14	16
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	0	1	1	1	1	1
LIVESTOCK	0	0	0	0	0	0
LAVACA BASIN						
HALLETTSVILLE	0	12	22	27	28	28
MOULTON	0	5	8	9	10	10
SHINER	0	10	18	23	23	23
YOAKUM	0	20	36	45	136	136
COUNTY-OTHER	0	46	85	106	110	110
MANUFACTURING	215	174	134	100	52	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-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	19	13	10	7	3	0
COLORADO-LAVACA BASIN						
EL CAMPO	207	167	136	97	47	0
COUNTY-OTHER	93	69	51	32	16	0
MANUFACTURING	38	31	25	19	10	0
MINING	1	0	2	3	5	6
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(12,779)	(12,779)	(12,779)	(12,779)	(12,779)	(12,779)

Water User Group (WUG) Needs/Surplus

REGION P	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
LAVACA BASIN						
EL CAMPO	6	5	4	3	1	0
COUNTY-OTHER	67	58	49	31	14	0
MINING	0	0	3	6	7	9
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(37,506)	(37,506)	(37,506)	(37,506)	(37,506)	(37,506)

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	518	518	518	518	518	518

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

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Water User Group (WUG) Second-Tier Identified Water Need

REGION P	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
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
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
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-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
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
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION P	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
LAVACA BASIN						
EL CAMPO	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	518	518	518	518	518	518

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

Water User Group (WUG) Management Supply Factor

REGION P	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, LAVACA	1.0	1.0	1.1	1.1	1.1	1.1
EDNA	1.0	1.0	1.0	1.0	1.0	1.0
EL CAMPO	1.2	1.2	1.2	1.2	1.2	1.2
GANADO	1.2	1.2	1.2	1.2	1.2	1.2
HALLETTSVILLE	1.1	1.2	1.2	1.3	1.3	1.4
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
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	1.5	1.5	1.4	1.4	1.3	1.2
MANUFACTURING, LAVACA	1.4	1.3	1.2	1.2	1.1	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
MOULTON	1.3	1.3	1.3	1.4	1.4	1.5
SHINER	1.1	1.2	1.2	1.3	1.3	1.4
YOAKUM	1.1	1.1	1.1	1.1	1.3	1.3

*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.

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
EDNA	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	33	33	33	33	33	33	$100	$100
EL CAMPO	K	DROUGHT MANAGEMENT	DEMAND REDUCTION	1	1	1	1	1	1	$50	$50
EL CAMPO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	86	87	89	91	93	95	$100	$100
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	DEMAND REDUCTION	109	170	237	333	329	336	$347	$347
EL CAMPO - UNASSIGNED WATER VOLUMES	P	DIRECT REUSE - EL CAMPO	P | DIRECT REUSE	560	560	560	560	560	560	$896	$896
GANADO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	54	54	53	53	53	54	$100	$100
HALLETTSVILLE	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	46	45	44	44	43	43	$100	$100
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	DEMAND REDUCTION	31	49	66	89	111	134	$334	$334
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	AQUIFER STORAGE AND RECOVERY	P | GULF COAST AQUIFER ASR FRESH/BRACKISH | JACKSON COUNTY	14,163	14,163	14,163	14,163	14,163	14,163	$1641	$1641
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LAVACA OFF-CHANNEL RESERVOIR	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	6,963	6,963	6,963	6,963	6,963	6,963	$867	$867
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH GROUNDWATER	P | GULF COAST AQUIFER | JACKSON COUNTY	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH SURFACE WATER	P | NAVIDAD RIVER TIDAL FRESH/BRACKISH	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
MOULTON	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	37	36	35	35	35	35	$100	$100
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	DEMAND REDUCTION	9	13	18	25	31	38	$355	$355
SHINER	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	49	48	47	46	46	46	$100	$100
SHINER	P	MUNICIPAL CONSERVATION - SHINER	DEMAND REDUCTION	23	37	49	65	86	104	$342	$342
YOAKUM	L	MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION	42	51	26	7	56	64	$0	$0
YOAKUM	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	19	18	18	18	15	15	$100	$100
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	DEMAND REDUCTION	37	54	74	95	33	62	$357	$357
			Region P Total RecommendedWMS Supplies	28,714	28,834	28,928	29,073	29,103	29,198		

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Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
EL CAMPO	N	MUNICIPAL CONSERVATION - EL CAMPO	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$243,652	2020
EL CAMPO	N	REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$3,272,000	2020
HALLETTSVILLE	N	MUNICIPAL CONSERVATION - HALLETTSVILLE	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$62,313	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - ON FARM	ON FARM IRRIGATION CONSERVATION	$20,833,000	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - TAILWATER RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$22,561,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$130,169,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$31,393,000	2020
MOULTON	N	MUNICIPAL CONSERVATION - MOULTON	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$20,750	2020
SHINER	N	MUNICIPAL CONSERVATION - SHINER	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$50,357	2020
YOAKUM	N	MUNICIPAL CONSERVATION - YOAKUM	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$85,984	2020

Region P Total Recommended Capital Cost	**$331,904,056**

***Projects with a capital cost of zero are excluded from the report list.**

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
			Region P Total Alternative WMS Supplies								

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Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR – ALTERNATIVE SITE	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020

Region P Total Alternative Capital Cost	**$123,213,000**

***Projects with a capital cost of zero are excluded from the report list.**

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Water User Group (WUG) Unmet Needs Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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

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Water User Group (WUG) Unmet Needs

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

*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.

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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 2 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 DB17. This information is contained within the following tables.

- *Table 2-1* – Lavaca Region Water User Group Population by City, Collective Reporting Unit, Individual Retail Public Utility, and Rural County
- *Table 2-2* – Water Demand by City, Basin and Category
- *Table 2-7* – Lavaca Region Water Demands on LNRA (Wholesale Water Provider)
- *Table 2-9* – Lavaca-Navidad River Authority Water Demands (AFY) by County and Basin

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, and 2011. The Lavaca Regional Water Planning Group contracted with AECOM to prepare the 2016 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. 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.

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[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 2016 Regional Water Planning effort.

2.2.1 General

The Texas Water Development Board (TWDB) distributed draft non-municipal water demand projections via an October 2011 memorandum for review by the Lavaca Regional Water Planning Group (Lavaca RWPG). A second TWDB memorandum in March 2013 accompanied the TWDB's draft recommended population projections and associated municipal water demand projections. These communications also described the projection methodologies and specific steps a regional planning group must follow in making projection revision requests, 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 fall 2013.

TWDB rules require that projection analyses be performed for each identified municipal and non-municipal water user group (WUG.) Municipal water user groups include municipalities with a population of 500 or more, individual utilities providing more than 280 acre-feet per year of water for municipal use, and Collective Reporting Units consisting of group utilities having a common association. All smaller communities and rural areas are combined and referred to as a "county-other" water user group for each county (i.e., Lavaca County-Other, etc.) 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 requires that regions designate wholesale water providers (WWP), which are persons or entities having contracts to sell more than 1,000 acre-feet of water wholesale. The Lavaca Regional Water Planning Group (Lavaca RWPG) has designated the Lavaca-Navidad River Authority (LNRA) as the only wholesale 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 municipalities 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 irrigation, manufacturing, and mining demand projections. No revisions were requested to the TWDB draft projections for population, municipal demands, livestock demands, and steam-electric demands. The detailed methodologies and resulting finalized 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.

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[2] TWDB Exhibit C General Guidelines for Regional Water Plan Development (2011-2016)

As with other projections during this planning effort, TWDB staff distributed draft population data and projections for planning group review. In a projection process independent of regional and state water planning, the Texas State Data Center/Office of the State Demographer developed county-level population projections from 2011 to 2050. These projections utilized the 2010 U.S. Census Data and recent and projected demographic trends and served as the TWDB base data for municipal population projections. The TWDB staff further extrapolated the State Demographer projections to 2060 and 2070 to meet the planning horizon requirements of the 2017 State Water Plan. TWDB staff then disaggregated population projections for municipal water user groups, which include entities and water systems of a certain threshold size as discussed in the introduction to *Section 2.2.1*. County-other population is a sum of populations not designated within a specific municipal water user group for each county.

The population projections indicate that the population of the Lavaca Region will increase approximately 13 percent from 49,000 in the year 2010 to 55,522 in the year 2070. Population in Jackson County is projected to increase 11.5 percent over the planning horizon from the US Census count of 14,075 in 2010 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 31 percent population increase, from 15,662 in 2010 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.

Some municipalities in the region, notably the City of Edna in Jackson County, expressed concern to the Lavaca RWPG that their population was growing more rapidly than projected. However, these revision requests could not be supported with data which meets the TWDB requirements. As a result, no revision requests were submitted to the TWDB regarding the draft population projections. In addition, these long-term projections do not reflect the rapid, and sometimes short-term, population growth that may occur in areas near mining and hydraulic fracturing activities.

The draft TWDB population and municipal water demand projections were formally approved by the Lavaca RWPG at the July 23, 2013 meeting, with no recommended revisions. The population and water demand projections were formally adopted by the TWDB and the projections were incorporated into the TWDB online database (DB17). 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 (DB17)."

2.2.3 Municipal Water Demand

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 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.

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 projections range from 7,997 acre-feet per year in 2020 to 8,088 acre-feet per year in 2070.

These projections were adopted by the TWDB for use in the 2016 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 (DB17)."

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

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 a result, specialized irrigation demands are essential to anticipating agricultural needs and ensuring a viable water supply for agricultural operations in the future. For this reason, TWDB allowed the Lavaca Region to utilize the region-specific March 2009 report *Agricultural Water Demands Analysis.* This report contains the most detailed estimates of irrigation projections for the Lavaca Region available to date. Additional information regarding the development of this methodology can be found in *Appendix A* of the *Agricultural Water Demands Analysis* report.

A breakdown of the irrigation water demands by county and crop type that were used to determine the irrigation demand projections presented in the *Agricultural Water Demands Analysis* and the 2011 Lavaca Regional Water Plan is provided in *Table 2-4*. Rice irrigation accounts for a majority of the projected irrigation demands in the Lavaca Region, making up 87 percent of total irrigation demands. Rice irrigation is proportionally highest in Lavaca County; while its overall demand is low compared to the other counties in the Lavaca Region. Demand for other crops in Lavaca County is very small. Overall regional demand is dominated by Wharton County, which represents the highest irrigation demands for all crops except turfgrass. The Lavaca Region portion of Wharton County makes up 69 percent of total regional agricultural irrigation demand.

A number of factors were considered in viewing how the overall regional water irrigation demand could change over the planning horizon (to year 2070). These included weather, water source, crop price, production costs, market projections, fuel cost and biofuel demand, and farm policy impacts. No one factor indicated a trend of either increasing or decreasing potential for rice production in the Lavaca Region. No factors point to either the conversion of current rice acreage to other crops or the reversion of land that has transitioned to other uses back to the growth of rice.

Thus, irrigation water demand estimates for the Lavaca Region were maintained at the same level as in the 2011 Lavaca Regional Water Plan. The TWDB total irrigation water demand for the region is projected to be 217,846 acre-feet per year for all decades from 2020 through 2070. The original TWDB draft projections for the 2016 Plan were significantly lower than the projections in the 2011 Lavaca Regional Water Plan, so the Lavaca Region requested a revision upward to be consistent with previous planning cycles. The adopted projections are provided in *Table 2-2* as well as *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB17)."

The current Plan shows water demands in excess of the 2001 and 2006 Regional Water Plans for the majority of non-rice crops, with the exceptions being corn and turfgrass. The proportion of estimated total irrigation demands for rice is similar to the 2001 Regional Water Plan as well. Rice irrigation represents 87 percent of the total irrigation demand while this percentage was found to be 86 and 93 percent in the 2001 and 2006 Plans, respectively. Correspondingly, there has been an estimated increase in the relative demand for first crop rice. From the 2001 Plan to the present, first crop rice estimates have increased from 71 to 81 percent of total rice demand (61 to 70 percent of total irrigation demand). This information is summarized in *Table 2-5.*

The agricultural irrigation demand estimates presented in the 2016 Regional Water Plan are subject to influence by a number of different factors. Future fuel and production costs, federal farm policy, and trends in domestic and international commodity markets all have the potential to create shifts in planted acreage and, in turn, water demands. However, as indicated earlier, there is currently no clear indication of either a growth or decline in Lavaca Region agricultural irrigation demands. For this reason, the irrigation demand projections (initially utilized for the 2010 decade) are recommended for use throughout the planning horizon from 2020 to 2070.

2.2.5 Steam-Electric Water Demand

There are currently no steam-electric power generation facilities in the region. With the development of the Eagle Ford Play in South Texas, locating a gas fire generating facility in the region may be seen as a viable investment. While the steam-electric water demand for the Lavaca Region is zero throughout the period from 2020 to 2070 in this Plan, it is acknowledged that there may be steam-electric demands in the region in the near future. Future regional water plans will address those demands, but Chapter 5 of this plan will consider water management strategies for LNRA that may supply those future demands.

2.2.6 Manufacturing Water Demand

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. Manufacturing water use projections that were developed by the TWDB were used as the default projections for the Lavaca Region. In developing draft manufacturing demand projections, TWDB staff utilized 2004-2008 data from TWDB's Water Use Survey. In counties where reported employment from the companies returning surveys was low compared to manufacturing employment data reported by the Bureau of Economic Analysis, surveyed water use was adjusted to account for non-responses. The rate of change for projections from the 2011 Regional Water Plans was then applied to the new base year estimate.

On July 23, 2013 the Lavaca RWPG voted to submit a revision request to the TWDB draft manufacturing water demands to reflect the existing demand and expected growth in Jackson County that the draft projections did not show. The Lavaca RWPG did not request manufacturing revisions for Lavaca or Wharton Counties. TWDB staff accommodated this revision request and the TWDB-adopted manufacturing water demand for the Lavaca Region is projected to increase from 1,255 to 1,658 acre-feet per year from 2020 to 2070. The adopted projections are provided in *Table 2-2* as well as in *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB17)." It is acknowledged that there may be additional manufacturing demands in the region in the near future that have not been included in this plan. Future regional water plans will address those demands, but Chapter 5 of this plan will consider water management strategies for LNRA that may supply those future demands.

2.2.7 Mining Water Demand

TWDB mining water usage 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. The Lavaca Region requested revisions to TWDB draft mining projections on March 8, 2013, including using higher mining demand projections from previous Bureau of Economic Geology estimates for certain counties. The TWDB staff accommodated this revision request. The mining water demand by decade for the Lavaca Region is 2,632 acre-feet per year in the year 2020 and declines to 320 acre-feet per year in 2070. The adopted projections are provided in *Table 2-2* as well as *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB17)."

2.2.8 Livestock Water Demand

The TWDB livestock water demand projections utilized an average of TWDB's 2005-2009 livestock water use estimates as a base. 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 2011 Regional Water Plans was then applied to the new base. The Lavaca Region made no revision requests to county livestock demand projections. The livestock water demand by decade for the Lavaca Region is 3,866 acre-feet per year, and was held constant for all decades from 2020 to 2070. The adopted projections are provided in *Table 2-2* as well as *Appendix 2B* "Population and Water Demand Data Reports from Texas Water Development Board (DB17)."

2.3 Wholesale Water Providers

The sole Wholesale Water Provider (WWP) in the Lavaca Regional Water Planning Area 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 2-7* 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 2-8*. *Table 2-9* displays data from the TWDB database related to water demands on LNRA by county and basin, considering category of water use. In addition to the existing supplies from Lake Texana, LNRA is currently studying the development of water supplies to meet an additional 10,000 acre-feet per year of demand for an existing LNRA industrial customer located in Region L. This demand is located outside of the Lavaca Region and thus there is no change in manufacturing water demand for LRWPA associated with this increase. 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 City, Collective Reporting Unit, Individual Retail Public Utility, and Rural County

Region	Water User Group	County Name	P2010 (1)	P2020	P2030	P2040	P2050	P2060	P2070	Region Split Pop.(2)	County Split Pop.(3)
P	EDNA	JACKSON	5,499	5,707	5,907	5,992	6,062	6,106	6,134		
P	GANADO	JACKSON	2,003	2,079	2,152	2,183	2,208	2,224	2,235		
P	COUNTY-OTHER	JACKSON	6,573	6,820	7,060	7,161	7,245	7,297	7,330		
		JACKSON Total	**14,075**	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**		
P	HALLETTSVILLE	LAVACA	2,550	2,550	2,550	2,550	2,550	2,550	2,550		
P	MOULTON	LAVACA	886	886	886	886	886	886	886		
P	SHINER	LAVACA	2,069	2,070	2,070	2,070	2,070	2,070	2,070		
P	YOAKUM	LAVACA	3,677	3,678	3,678	3,678	3,678	3,678	3,678	P	P
P	COUNTY-OTHER	LAVACA	10,081	10,079	10,079	10,079	10,079	10,079	10,079		
		LAVACA Total	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**		
P	COUNTY-OTHER	WHARTON	4,085	4,536	5,038	5,439	5,786	6,106	6,390	P	
P	EL CAMPO	WHARTON	11,577	12,084	12,648	13,099	13,489	13,850	14,170	P	
		WHARTON Total	**15,662**	**16,620**	**17,686**	**18,538**	**19,275**	**19,956**	**20,560**	***P***	
		LRWPA TOTAL	**49,000**	**50,489**	**52,068**	**53,137**	**54,053**	**54,846**	**55,522**		

1) The year 2010 population for cities and county totals are from the 2010 Census. For utilities, TWDB staff estimated the population served by the utility in 2010. The County-Other population was derived by summing all of the city and utility population within a county and subtracting it from the county total population.

2) 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.

3) 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.

Projections last updated July 2013

Table 2-2
Water Demand by City, Basin and Category

WUG Name	WUG Basin	WUG County	Water Demand (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
COUNTY-OTHER	COLORADO-LAVACA	JACKSON	229	226	222	220	220	221
COUNTY-OTHER	LAVACA	JACKSON	421	417	406	403	404	406
COUNTY-OTHER	LAVACA-GUADALUPE	JACKSON	50	49	48	47	48	48
EDNA	LAVACA	JACKSON	885	887	877	877	881	885
GANADO	LAVACA	JACKSON	270	270	267	266	267	268
IRRIGATION	COLORADO-LAVACA	JACKSON	18,061	18,061	18,061	18,061	18,061	18,061
IRRIGATION	LAVACA	JACKSON	36,370	36,370	36,370	36,370	36,370	36,370
IRRIGATION	LAVACA-GUADALUPE	JACKSON	5,370	5,370	5,370	5,370	5,370	5,370
LIVESTOCK	COLORADO-LAVACA	JACKSON	228	228	228	228	228	228
LIVESTOCK	LAVACA	JACKSON	708	708	708	708	708	708
LIVESTOCK	LAVACA-GUADALUPE	JACKSON	98	98	98	98	98	98
MANUFACTURING	COLORADO-LAVACA	JACKSON	666	686	705	721	766	815
MANUFACTURING	LAVACA	JACKSON	4	4	4	4	5	5
MINING	COLORADO-LAVACA	JACKSON	10	11	8	6	4	3
MINING	LAVACA	JACKSON	39	40	30	22	14	10
MINING	LAVACA-GUADALUPE	JACKSON	21	22	17	12	8	6
COUNTY-OTHER	GUADALUPE	LAVACA	5	4	4	4	4	4
COUNTY-OTHER	LAVACA	LAVACA	1,235	1,189	1,150	1,129	1,125	1,125
COUNTY-OTHER	LAVACA-GUADALUPE	LAVACA	1	1	1	1	1	1
HALLETTSVILLE	LAVACA	LAVACA	606	594	584	579	578	578
IRRIGATION	LAVACA	LAVACA	8,357	8,357	8,357	8,357	8,357	8,357
LIVESTOCK	GUADALUPE	LAVACA	20	20	20	20	20	20
LIVESTOCK	LAVACA	LAVACA	1,982	1,982	1,982	1,982	1,982	1,982
LIVESTOCK	LAVACA-GUADALUPE	LAVACA	41	41	41	41	41	41
MANUFACTURING	LAVACA	LAVACA	490	531	571	605	653	705
MINING	LAVACA	LAVACA	2,544	1,860	1,416	977	537	297
MOULTON	LAVACA	LAVACA	183	178	175	174	173	173
SHINER	LAVACA	LAVACA	485	475	467	462	462	462

Table 2-2
Water Demand by City, Basin, and Category (Continued)

WUG Name	WUG Basin	WUG County	Water Demand (ac-ft/yr)					
			2020	2030	2040	2050	2060	2070
YOAKUM	LAVACA	LAVACA	755	735	719	710	619	619
COUNTY-OTHER	COLORADO	WHARTON	21	27	30	33	37	40
COUNTY-OTHER	COLORADO-LAVACA	WHARTON	99	123	141	160	176	192
COUNTY-OTHER	LAVACA	WHARTON	468	477	486	504	521	535
EL CAMPO	COLORADO	WHARTON	313	320	325	331	339	347
EL CAMPO	COLORADO-LAVACA	WHARTON	1,916	1,956	1,987	2,026	2,076	2,123
EL CAMPO	LAVACA	WHARTON	55	56	57	58	60	61
IRRIGATION	COLORADO-LAVACA	WHARTON	21,642	21,642	21,642	21,642	21,642	21,642
IRRIGATION	LAVACA	WHARTON	128,046	128,046	128,046	128,046	128,046	128,046
LIVESTOCK	COLORADO-LAVACA	WHARTON	174	174	174	174	174	174
LIVESTOCK	LAVACA	WHARTON	615	615	615	615	615	615
MANUFACTURING	COLORADO-LAVACA	WHARTON	95	102	108	114	123	133
MINING	COLORADO-LAVACA	WHARTON	6	7	5	4	2	1
MINING	LAVACA	WHARTON	12	12	9	6	5	3

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	92	87	84	83	82	82
EDNA	JACKSON	138	134	131	129	129	129
GANADO	JACKSON	116	112	109	107	107	107
COUNTY-OTHER	LAVACA	110	106	102	100	100	100
HALLETTSVILLE	LAVACA	212	208	204	202	202	202
MOULTON	LAVACA	184	179	176	174	174	174
SHINER	LAVACA	209	205	201	199	199	199
YOAKUM	LAVACA	183	178	174	172	150	150
COUNTY-OTHER	WHARTON	116	111	108	107	107	107
EL CAMPO	WHARTON	169	165	161	160	159	159

Table 2-4
Breakdown of Lavaca Region Irrigation Demands by County and Crop Type

Water Use Category	Total Water Demand (ac-ft)			Percentage of County Irrigation Demand (%)			Region P Total	
							Water Demand	
	LRWPA Wharton Co.	Jackson Co.	Lavaca Co.	Wharton Co.	Jackson Co.	Lavaca Co.	(%)	(ac-ft)
				Rice				
GW Source	107,526	51,261	7,848	71.8	85.7	93.9	76.5	166,634
SW Source	17,572	4,073	429	11.7	6.8	5.1	10.1	22,074
Total Rice	125,097	55,333	8,277	83.6	92.5	99.0	**86.6**	**188,708**
Cotton Irr.	5,262	1,233	3	3.5	2.1	0.0	3.0	6,498
Corn Irr.	5,399	654	0	3.6	1.1	0.0	2.8	6,053
Milo Irr.	4,544	0	0	3.0	0.0	0.0	2.1	4,544
Soybean Irr.	2,306	0	44	1.5	0.0	0.5	1.1	2,350
Turf Irr.	429	1,304	0	0.3	2.2	0.0	0.8	1,732
Crop Irr.	143,037	58,524	8,324	95.6	97.9	99.6	**96.3**	**209,885**
Waterfowl	2,355	144	33	1.6	0.2	0.4	1.2	2,531
Aquaculture	4,296	1,133	0	2.9	1.9	0.0	2.5	5,430
Total Irr.	149,688	59,801	8,357	100.0	100.0	100.0	**100.0**	**217,846**

Table 2-5
Irrigation Demands for Current and Previous Regional Water Plans

Crop	2001 Plan (acre-feet)	2006 RWP (acre-feet)	2011 Plan (acre-feet)	2016 Plan (acre-feet)
Aquaculture	0	2,260	5,430	5,430
Corn	15,187	2,421	6,053	6,053
Cotton	5,832	3,758	6,498	6,498
Sorghum	4,077	1,883	4,544	4,544
Soybeans	1,219	338	2,350	2,350
Turfgrass	5,750	3,250	1,732	1,732
Waterfowl	802	877	2,531	2,531
1st Crop Rice				
Groundwater	110,549	141,492	135,153	135,153
Surface Water	27,381	15,131	17,340	17,340
2nd Crop Rice				
Groundwater	46,430	39,642	31,481	31,481
Surface Water	9,583	7,640	4,734	4,734
Total	**226,810**	**218,693**	**217,846**	**217,846**

Table 2-6
Summary of Methodology Used for Revised Projections –
Jackson, Lavaca, Wharton Counties

	Category	TWDB Default	Other	Notes
Jackson	Municipal	X		
	Livestock	X		
	Irrigation		X	Keep 2011 Lavaca Regional Water Plan projections.
	Manufacturing		X	Demand was increased to 2011 Lavaca Regional Water Plan numbers to acknowledge existing demands and allow for expected growth.
	Mining		X	The greater value of all previous Bureau of Economic Geology studies was utilized.
	Steam-Electric	X		
Lavaca	Municipal	X		
	Livestock	X		
	Irrigation		X	Keep 2011 Lavaca Regional Water Plan projections.
	Manufacturing	X		
	Mining		X	The greater value of all previous Bureau of Economic Geology studies was utilized.
	Steam-Electric	X		
Wharton	Municipal	X		
	Livestock	X		
	Irrigation		X	Keep 2011 Lavaca Regional Water Plan projections.
	Manufacturing	X		
	Mining		X	The greater value of all previous Bureau of Economic Geology studies was utilized.
	Steam-Electric	X		

Table 2-7
Lavaca Region Water Demands* on Lavaca-Navidad River Authority (Wholesale Water Provider)

WUG Name	WUG Basin	WUG County	WUG ID	City ID	Water Demand (ac-ft/yr)					
					2020	2030	2040	2050	2060	2070
Manufacturing	Colorado-Lavaca	Jackson	2960	1001	666	686	705	721	766	815

*Contract value equal to 1,032 acre-feet/year

Table 2-8
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)	41,840
City of Corpus Christi (interruptible supply)	12,000
City of Point Comfort	178
Formosa Plastics Corporation	30,800
Inteplast Corporation	1,032
TOTAL	**86,500**

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

Table 2-9
Lavaca-Navidad River Authority Water Demands (AFY) by County and Basin (Based on TWDB DB17 Data)

Buyer Entity	Buyer WUG Category	Buyer Entity Primary Region	Buyer Entity Split Region	Buyer Entity Split County	Buyer Entity Split Basin	PWS 2020	PWS 2030	PWS 2040	PWS 2050	PWS 2060	PWS 2070
CORPUS CHRISTI	MUNICIPAL	N	N	NUECES	NUECES	12	13	156	268	380	476
CORPUS CHRISTI	MUNICIPAL	N	N	NUECES	NUECES-RIO GRANDE	143	153	1,793	3,087	4,372	5,477
MANUFACTURING, CALHOUN	MANUFACTURING	L	L	CALHOUN	COLORADO-LAVACA	16,857	16,857	16,857	16,857	16,857	16,857
MANUFACTURING, CALHOUN	MANUFACTURING	L	L	CALHOUN	LAVACA-GUADALUPE	13,793	13,793	13,793	13,793	13,792	13,793
MANUFACTURING, JACKSON	MANUFACTURING	P	P	JACKSON	COLORADO-LAVACA	1,000	1,000	1,000	1,000	1,000	1,000
POINT COMFORT	MUNICIPAL	L	L	CALHOUN	COLORADO-LAVACA	178	178	178	178	178	178

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APPENDIX 2A

Sample Correspondence to Water User Groups

March 14, 2013

Subject: **Lavaca Regional Water Planning Group Projected Population and Water Demand for 2016 Regional Water Plan**

Dear Water User Group Representative:

We are writing this letter on behalf of the Lavaca Regional Water Planning Group (LRWPG). AECOM is the consultant for the LRWPG and we are currently engaged in the process of preparing the 2016 Regional Water Plan (RWP) for the region. This plan is submitted to the Texas Water Development Board (TWDB) and will be used to compile the 2017 State Water Plan (SWP).

As part of the 2016 RWP, 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 and the projections of these populations are used to estimate future water demands.

The development of representative demand projections is crucial for the planning process because these demands and available water supplies are used to generate an overview of potential shortages for the future. Once these shortages are identified, strategies will be assigned to meet future needs. Identifying these needs is an essential step in properly allocating water management strategies that will eventually be written into the SWP. Projects must be consistent with the SWP to be eligible for State funding and permitting.

The draft population projections that have been provided by the TWDB for the 2016 RWP 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.

The LRWPG has requested that information regarding this planning cycle's projections be provided to each WUG so that corrections may be made as necessary. The table below shows the current water demands and projected populations for your WUG for the next 50 years:

2016 RWP Projections	2020	2030	2040	2050	2060	2070
WUG Projected Population:						
WUG Projected Water Demand:						

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

1. The numbers represent reasonable projections and require no revision, or

2. You would like to revise your projections and <u>*can provide information to support your request*</u>, such as a planning level study of your water system.

If **no** revisions are requested, **no** response is necessary. Justifiable reasons for revisions to these population projections include:

DRAFT

- population estimates of the Texas State Data Center, or other credible sources, are greater than projected populations;
- population growth rates for a sub-county area as tabulated by the Texas SDC over the most recent five years is substantially greater than growth rates reported by the U.S. Census Bureau between 2000 and 2010;
- cities have annexed additional land since the 2010 Census; or
- water utilities have expanded their service areas since last updated by the Texas Commission on Environmental Quality.

Municipal water demands may be adjusted for WUGs with revised population projections. Similarly, if acceptable data sources indicate that a measured gallons per capita per day from years prior to 2011 *is more representative of drought of record conditions*, the TWDB will consider formal requests for revisions.

You may also contact me directly regarding your request. My contact information is located at the conclusion of this letter. In order to meet the timeline of this planning round, we would like to receive all responses by **April 12, 2013**. Information received by this date will be incorporated into projections that will be reviewed and considered for approval by the LRWPG at their scheduled May 14th, 2013 meeting. WUGs are highly encouraged to submit recommended changes (if needed) by April 12th to guarantee consideration for approval at the May 14th meeting.

The consultant team is working with the WUGs in the region to ensure that the 2016 RWP accurately reflects the current and future water supply plans for the WUGs. This effort is an attempt to reduce the need for plan amendments and to ease the process for obtaining funding for vital infrastructure improvements. Therefore, your input in this matter is crucial to our planning and we appreciate any assistance you may be able to provide.

If you have any questions regarding this matter or wish to discuss further, please feel free to call me at (512) 472-4519 or email me at Jaime.Burke@aecom.com.

Sincerely,

Jaime Burke, P.E.
Project Manager

c: Project File

APPENDIX 2B

Population and Water Demand Data Reports from Texas Water Development Board (DB17)

Water User Group (WUG) Population

REGION P	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY						
COLORADO-LAVACA BASIN						
COUNTY-OTHER	2,236	2,315	2,348	2,376	2,393	2,404
COLORADO-LAVACA BASIN TOTAL POPULATION	**2,236**	**2,315**	**2,348**	**2,376**	**2,393**	**2,404**
LAVACA BASIN						
EDNA	5,707	5,907	5,992	6,062	6,106	6,134
GANADO	2,079	2,152	2,183	2,208	2,224	2,235
COUNTY-OTHER	4,105	4,250	4,310	4,361	4,392	4,412
LAVACA BASIN TOTAL POPULATION	**11,891**	**12,309**	**12,485**	**12,631**	**12,722**	**12,781**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	479	495	503	508	512	514
LAVACA-GUADALUPE BASIN TOTAL POPULATION	**479**	**495**	**503**	**508**	**512**	**514**
JACKSON COUNTY TOTAL POPULATION	**14,606**	**15,119**	**15,336**	**15,515**	**15,627**	**15,699**
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	33	33	33	33	33	33
GUADALUPE BASIN TOTAL POPULATION	**33**	**33**	**33**	**33**	**33**	**33**
LAVACA BASIN						
HALLETTSVILLE	2,550	2,550	2,550	2,550	2,550	2,550
MOULTON	886	886	886	886	886	886
SHINER	2,070	2,070	2,070	2,070	2,070	2,070
YOAKUM	3,678	3,678	3,678	3,678	3,678	3,678
COUNTY-OTHER	10,041	10,041	10,041	10,041	10,041	10,041
LAVACA BASIN TOTAL POPULATION	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**	**19,225**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	5	5	5	5	5	5
LAVACA-GUADALUPE BASIN TOTAL POPULATION	**5**	**5**	**5**	**5**	**5**	**5**
LAVACA COUNTY TOTAL POPULATION	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**	**19,263**
WHARTON COUNTY						
COLORADO BASIN						
EL CAMPO	1,656	1,733	1,795	1,848	1,897	1,941
COUNTY-OTHER	177	217	249	277	304	327
COLORADO BASIN TOTAL POPULATION	**1,833**	**1,950**	**2,044**	**2,125**	**2,201**	**2,268**
COLORADO-LAVACA BASIN						
EL CAMPO	10,138	10,611	10,990	11,317	11,621	11,889
COUNTY-OTHER	760	986	1,166	1,322	1,464	1,592
COLORADO-LAVACA BASIN TOTAL POPULATION	**10,898**	**11,597**	**12,156**	**12,639**	**13,085**	**13,481**
LAVACA BASIN						
EL CAMPO	290	304	314	324	332	340

Water User Group (WUG) Population

REGION P	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
LAVACA BASIN						
COUNTY-OTHER	3,599	3,835	4,024	4,187	4,338	4,471
LAVACA BASIN TOTAL POPULATION	**3,889**	**4,139**	**4,338**	**4,511**	**4,670**	**4,811**
WHARTON COUNTY TOTAL POPULATION	**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**

Water User Group (WUG) Demand

REGION P	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
JACKSON COUNTY						
COLORADO-LAVACA BASIN						
COUNTY-OTHER	229	226	222	220	220	221
MANUFACTURING	666	686	705	721	766	815
MINING	10	11	8	6	4	3
LIVESTOCK	228	228	228	228	228	228
IRRIGATION	18,061	18,061	18,061	18,061	18,061	18,061
COLORADO-LAVACA BASIN TOTAL DEMAND	**19,194**	**19,212**	**19,224**	**19,236**	**19,279**	**19,328**
LAVACA BASIN						
EDNA	885	887	877	877	881	885
GANADO	270	270	267	266	267	268
COUNTY-OTHER	421	417	406	403	404	406
MANUFACTURING	4	4	4	4	5	5
MINING	39	40	30	22	14	10
LIVESTOCK	708	708	708	708	708	708
IRRIGATION	36,370	36,370	36,370	36,370	36,370	36,370
LAVACA BASIN TOTAL DEMAND	**38,697**	**38,696**	**38,662**	**38,650**	**38,649**	**38,652**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	50	49	48	47	48	48
MINING	21	22	17	12	8	6
LIVESTOCK	98	98	98	98	98	98
IRRIGATION	5,370	5,370	5,370	5,370	5,370	5,370
LAVACA-GUADALUPE BASIN TOTAL DEMAND	**5,539**	**5,539**	**5,533**	**5,527**	**5,524**	**5,522**
JACKSON COUNTY TOTAL DEMAND	**63,430**	**63,447**	**63,419**	**63,413**	**63,452**	**63,502**
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	5	4	4	4	4	4
LIVESTOCK	20	20	20	20	20	20
GUADALUPE BASIN TOTAL DEMAND	**25**	**24**	**24**	**24**	**24**	**24**
LAVACA BASIN						
HALLETTSVILLE	606	594	584	579	578	578
MOULTON	183	178	175	174	173	173
SHINER	485	475	467	462	462	462
YOAKUM	755	735	719	710	619	619
COUNTY-OTHER	1,235	1,189	1,150	1,129	1,125	1,125
MANUFACTURING	490	531	571	605	653	705
MINING	2,544	1,860	1,416	977	537	297
LIVESTOCK	1,982	1,982	1,982	1,982	1,982	1,982
IRRIGATION	8,357	8,357	8,357	8,357	8,357	8,357
LAVACA BASIN TOTAL DEMAND	**16,637**	**15,901**	**15,421**	**14,975**	**14,486**	**14,298**
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	1	1	1	1	1	1
LIVESTOCK	41	41	41	41	41	41
LAVACA-GUADALUPE BASIN TOTAL DEMAND	**42**	**42**	**42**	**42**	**42**	**42**
LAVACA COUNTY TOTAL DEMAND	**16,704**	**15,967**	**15,487**	**15,041**	**14,552**	**14,364**

Water User Group (WUG) Demand

REGION P	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
COLORADO BASIN						
EL CAMPO	313	320	325	331	339	347
COUNTY-OTHER	21	27	30	33	37	40
COLORADO BASIN TOTAL DEMAND	**334**	**347**	**355**	**364**	**376**	**387**
COLORADO-LAVACA BASIN						
EL CAMPO	1,916	1,956	1,987	2,026	2,076	2,123
COUNTY-OTHER	99	123	141	160	176	192
MANUFACTURING	95	102	108	114	123	133
MINING	6	7	5	4	2	1
LIVESTOCK	174	174	174	174	174	174
IRRIGATION	21,642	21,642	21,642	21,642	21,642	21,642
COLORADO-LAVACA BASIN TOTAL DEMAND	**23,932**	**24,004**	**24,057**	**24,120**	**24,193**	**24,265**
LAVACA BASIN						
EL CAMPO	55	56	57	58	60	61
COUNTY-OTHER	468	477	486	504	521	535
MINING	12	12	9	6	5	3
LIVESTOCK	615	615	615	615	615	615
IRRIGATION	128,046	128,046	128,046	128,046	128,046	128,046
LAVACA BASIN TOTAL DEMAND	**129,196**	**129,206**	**129,213**	**129,229**	**129,247**	**129,260**
WHARTON COUNTY TOTAL DEMAND	**153,462**	**153,557**	**153,625**	**153,713**	**153,816**	**153,912**
REGION P TOTAL DEMAND	**233,596**	**232,971**	**232,531**	**232,167**	**231,820**	**231,778**

APPENDIX 2C

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

Savings for Municipal WUGs in Region P by County - in ACFT (for 2016 RWP)

Region	County	EntityName	2020	2030	2040	2050	2060	2070
P	JACKSON	COUNTY-OTHER, JACKSON	72.12	107.39	134.59	150.14	153.66	154.44
P	JACKSON	EDNA	61.75	92.63	116.72	128.34	131.32	131.99
P	JACKSON	GANADO	21.38	31.7	39.56	44.07	45.17	45.41
P	LAVACA	COUNTY-OTHER, LAVACA	103.3	149.7	188.65	209.99	213.72	213.72
P	LAVACA	HALLETTSVILLE	25.88	37.7	47.7	53.16	54.1	54.1
P	LAVACA	MOULTON	9.32	13.64	17.31	18.44	18.77	18.77
P	LAVACA	SHINER	21.4	31.09	39.26	43.68	44.43	44.43
P	LAVACA	YOAKUM	0	0	0	0	77.99	77.99
P	WHARTON	COUNTY-OTHER, WHARTON	52.28	84.76	110.89	120.1	128.72	135.06
P	WHARTON	EL CAMPO	126.01	190.27	242.98	275.15	287.32	294.43
P Total			**493.44**	**738.88**	**937.66**	**1,043.07**	**1,155.20**	**1,170.34**

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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. Primary surface water sources are the Navidad and Lavaca Rivers and Lake Texana.

Much of the regional water demand is supplied by groundwater. Approximately 97 percent of the existing water supplies come from groundwater. The Gulf Coast aquifer 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 3 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 DB17. DB17 reports that contain this information are identified below and are located in the appendix accompanying this chapter.

- Source Availability
- Existing Water Supply
- Source Water Balance

Some of the information contained within this chapter is based on information published in *Chapter 1 – Description of the Region.* 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. 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 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.

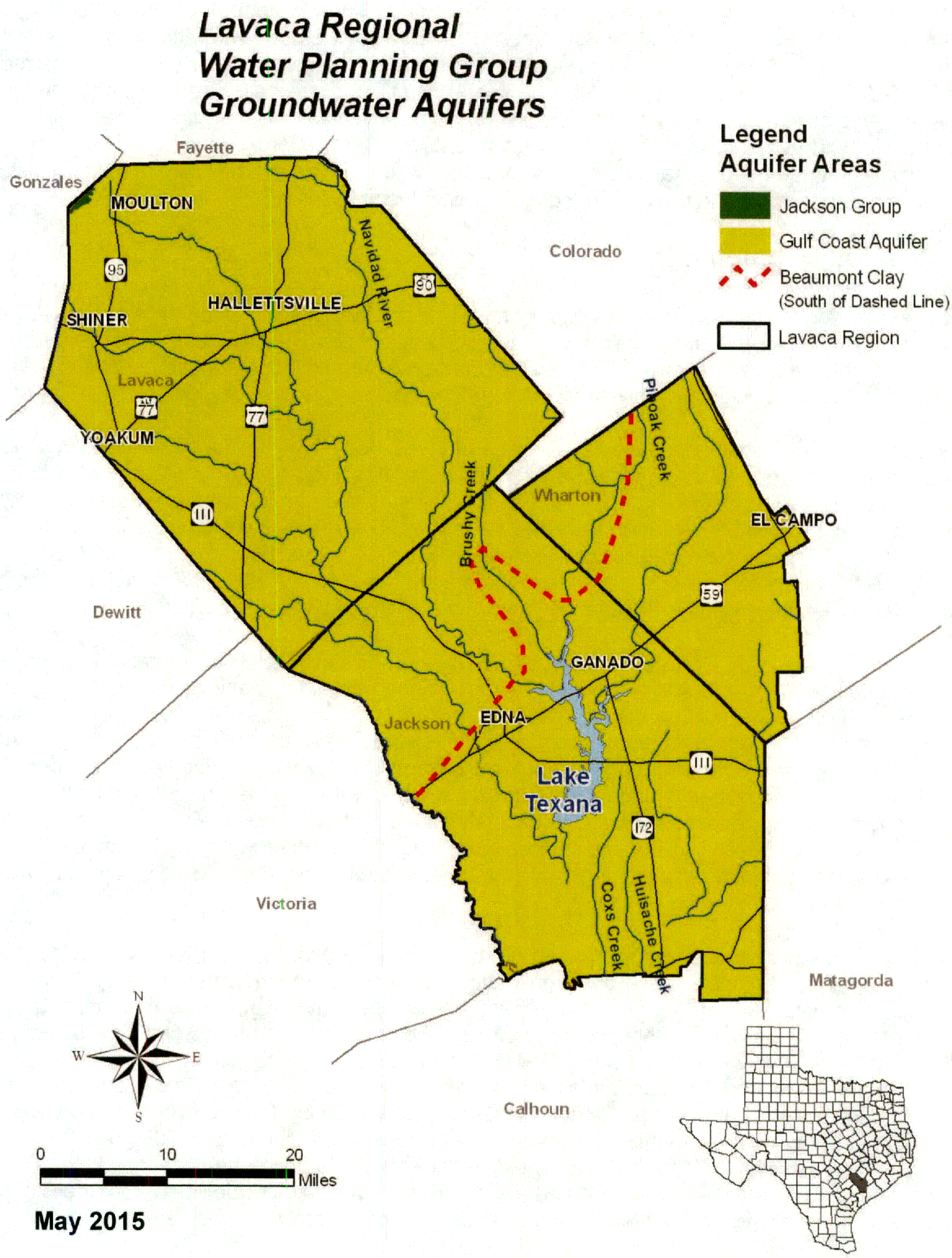
Recharge to the aquifers is principally from the infiltration of precipitation and streamflow. Average annual rainfall in the LRWPA ranges from about 32 to 42 inches per year. The eastern portion of the region experiences the upper end of the average annual rainfall amounts.

The geographic coverage of the Gulf Coast aquifer within the Lavaca Region is shown in *Figure 3-1*. The area includes the Jasper, Evangeline, and Chicot aquifer formations. The Gulf Coast Aquifer 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, the Lavaca Region pumped approximately 216,000 ac-ft of groundwater for these purposes. Agricultural irrigation accounts for approximately 95 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 3.3 percent of the groundwater pumped. Less than two 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 ultimately impact domestic wells in the Lavaca Region.

The Gulf Coast aquifer 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 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).

As discussed in the 2006 RWP, a Central Gulf Coast Groundwater Availability Model (GAM) was developed for the Central Gulf Coast aquifer 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.

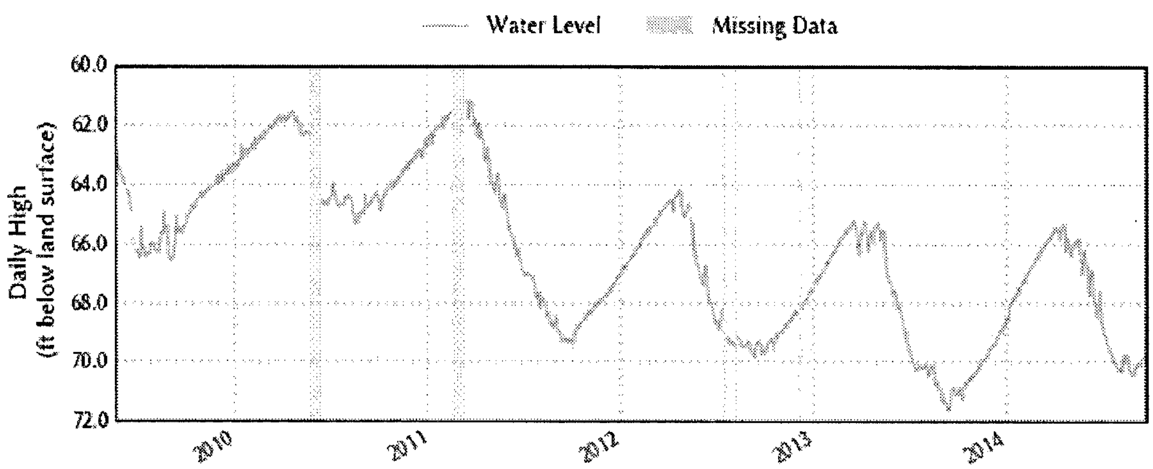
Based on the GAM discussed in the 2006 RWP, the estimated transmissivity for the Chicot aquifer in the LRWPA ranges from less than 15,000 gallons per day per foot (gpd/ft) near the outcrop up to 220,000 gpd/ft near southern Wharton County and eastern Jackson County. The Evangeline aquifer transmissivity 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. Data in TWDB Report 289, combined with water level changes since about 1970, indicate that the potentiometric head in the Chicot aquifer has declined about 20 feet to possibly 80 or 120 feet since 1900 as a result of the pumping that has occurred in the area. For the Evangeline aquifer, about 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. Historical well levels are discussed extensively in the 2011 Lavaca RWP, as well as earlier versions of the Plan. Water levels have remained relatively stable in the region, with some declines and some increases over the last several decades. The drought that has occurred throughout the last few years has shown a period of decline.

Figure 3-2 below shows the steady water level decline since 2010 for Well 66-53-406 in the western part of Wharton County. While the decline is relatively small (approximately 4 – 5 feet), prolonged drought combined with potential continued increased pumping in neighboring regions could result in larger water level declines that could impact some domestic wells in the region.

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



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. Additional information on water quality can be found in the 2006 RWP.

3.2.5 Water Level Monitoring Program for the LRWPA

The 2006 RWP included a detailed description of the Water Level Monitoring Program for the LRWPA. 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. Additional information on the Water Level Monitoring Program can be found in the 2006 RWP.

3.2.6 Subsidence Effects

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. 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. 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. Subsidence since the 1970s is estimated to have been relatively minor in the LRWPA. Additional information is available in the 2006 RWP.

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 4.6 percent, or 8,425 ac-ft of the existing supplies in the LRWPA. Within the LRWPA, Jackson County accounts for approximately 22.0 percent, or 1,857 ac-ft of the region's municipal groundwater usage; Lavaca County accounts for 38.8 percent, or 3,270 ac-ft; and Wharton County accounts for 39.1 percent, or 3,298 ac-ft. There are ten major municipal users scattered throughout THE LRWPA. The major municipal users in Jackson County are the Towns of Edna and Ganado and the County-Other category with approximately 48, 14, and 38 percent of the county's municipal groundwater usage, respectively. Municipal users represent cities, communities, and water districts with a population over 500 as well as public water systems with an annual usage of 280 ac-ft/yr or approximately 250 million gallons per day (mgd), while County-Other represents cities, communities, or districts with a population less than 500, water systems with a usage of less than 280 ac-ft/yr, parks, campgrounds, and areas supplied by domestic wells. The major municipal users in Lavaca County are Hallettsville, Moulton, Shiner, Yoakum, and County-Other with approximately 18, 6, 15, 23, and 38 percent of the county's municipal groundwater usage, respectively. The major municipal users in Wharton County are El Campo and County-Other with approximately 77 and 23 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 96 percent or 207,820 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 42 percent; Lavaca County, 5 percent; and Wharton County, 53 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 small 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 89 percent of the water supplied for irrigated agriculture. 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.

As noted in Chapter 2 of this report, estimates of agricultural irrigation demand remain the same from values presented in the 2011 RWP. Projected agricultural irrigation demands for the 2020 through 2070 planning horizon are 59,801 ac-ft/yr for Jackson County, 8,357 ac-ft/yr for Lavaca County, and 149,688 ac-ft/yr for the portion of Wharton County within THE LRWPA.

3.3 Groundwater Availability for the Central Gulf Coast Aquifer

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. Desired future conditions are essentially management goals for each aquifer. The DFC for the Central Gulf Coast Aquifer, adopted by GMA 15 on July 14, 2010, is summarized as follows:

- No more than 12 feet of average drawdown by 2060 relative to 1999 conditions.

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 MAG being documented in TWDB report GR 10-028_MAG, dated November 18, 2011. The report provides the MAG values for the Lavaca Region by county and basin, as shown in the table below.

Table 3-1 Modeled Available Groundwater (MAG) Volumes for the Lavaca Region

Region	County	Basin	Year					
			2010	2020	2030	2040	2050	2060
P	Jackson	Colorado-Lavaca	23,615	23,615	23,615	23,615	23,615	23,615
		Lavaca	41,927	41,927	41,927	41,927	41,927	41,927
		Lavaca-Guadalupe	10,844	10,844	10,844	10,844	10,844	10,844
		County Total	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***
P	Lavaca	Guadalupe	41	41	41	41	41	41
		Lavaca	19,944	19,944	19,944	19,944	19,937	19,932
		Lavaca-Guadalupe	400	400	400	400	400	400
		County Total	***20,385***	***20,385***	***20,385***	***20,385***	***20,378***	***20,373***
P	Wharton	Colorado	441	441	441	441	441	441
		Colorado-Lavaca	11,549	11,549	11,549	11,549	11,549	11,549
		Lavaca	87,763	87,763	87,763	87,763	87,763	87,763
		County Total	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***

Because the MAG values are currently only identified through 2060, and the 2016 planning cycle period is 2020-2070, the Lavaca Regional Water Planning Group agreed that the 2070 groundwater availability numbers would equal the 2060 MAG values. Thus, the availability numbers for the Gulf Coast Aquifer within the Lavaca Region used for planning purposes are shown in *Table 3-2* below.

Table 3-2 Lavaca Region Groundwater Availability for Gulf Coast Aquifer

County	Basin	Year					
		2020	2030	2040	2050	2060	2070
Jackson	Colorado-Lavaca	23,615	23,615	23,615	23,615	23,615	23,615
	Lavaca	41,927	41,927	41,927	41,927	41,927	41,927
	Lavaca-Guadalupe	10,844	10,844	10,844	10,844	10,844	10,844
	County Total	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***	***76,386***
Lavaca	Guadalupe	41	41	41	41	41	41
	Lavaca	19,944	19,944	19,944	19,937	19,932	19,932
	Lavaca-Guadalupe	400	400	400	400	400	400
	County Total	***20,385***	***20,385***	***20,385***	***20,378***	***20,373***	***20,373***
Wharton	Colorado	441	441	441	441	441	441
	Colorado-Lavaca	11,549	11,549	11,549	11,549	11,549	11,549
	Lavaca	87,763	87,763	87,763	87,763	87,763	87,763
	County Total	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***	***99,753***

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 2006 RWP using the TCEQ Water Availability Model (WAM) for the river basins within the LRWPA. An updated version of the model was not available during the water supply modeling timeframe of the 2011 or 2016 planning cycle, so the model used for the 2006 RWP is still appropriate. 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. Drought of Record for most of Texas occurred in the 1950s and is reflected in the historical dataset for each basin. 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.

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 2016 Lavaca RWP. Individual water right appropriations of rivers and creeks in the LRWPA were included in *Table 7A* in *Appendix 7A* in the 2006 RWP.

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.

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. Because of the recent drought where LCRA sought emergency relief from the LCRA Water Management Plan, RWPG members were more comfortable assuming a lesser amount was physically available for supplies. The amount of existing water supplies from this source was listed as 4,000 ac-ft in the 2016 Lavaca RWP.

3.5 Wholesale Water Providers

The only WWP in the LRWPA is the Lavaca-Navidad River Authority (LNRA), which holds rights to the firm yield of Lake Texana. 41,840 ac-ft of this water is contracted for use by Corpus Christi and its surrounding service area. Of this amount, 10,400 ac-ft is on an interruptible basis and can be recalled by LNRA for use in Jackson County. Another 30,800 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 is the only use of water from Lake Texana that is used within the LRWPA. This contract is assigned to the Colorado-Lavaca Basin of Jackson County for manufacturing use. This contract amount exceeds the projected manufacturing water use within the basin for the planning period. In addition to the existing supplies from Lake Texana, LNRA is currently studying the development of water supplies to meet an additional 10,000 ac-ft/yr of demand for an existing LNRA industrial customer located in Region L. This demand is located outside of the LRWPA and thus there is no change in manufacturing water demand for the LRWPA associated with this increase. The customer owns property in both regions and is contemplating development inside 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 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.

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 wholesale water provider, LNRA, are legally and physically available under drought of record conditions. The methodology used for allocating existing water supplies in the 2016 Lavaca RWP involved making minor updates to the existing supply allocation from the 2011 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 Colorado-Lavaca Basin (12,779 ac-ft/yr shortage) and Lavaca Basin (37,506 ac-ft/yr shortage.) These projected shortages remain constant across the planning horizon.

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APPENDIX 3A

TWDB DB17 Reports

Source Availability

REGION P									
				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
GROUNDWATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
GULF COAST AQUIFER	JACKSON	COLORADO-LAVACA	FRESH	23,615	23,615	23,615	23,615	23,615	23,615
GULF COAST AQUIFER	JACKSON	LAVACA	FRESH	41,927	41,927	41,927	41,927	41,927	41,927
GULF COAST AQUIFER	JACKSON	LAVACA-GUADALUPE	FRESH	10,844	10,844	10,844	10,844	10,844	10,844
GULF COAST AQUIFER	LAVACA	GUADALUPE	FRESH	41	41	41	41	41	41
GULF COAST AQUIFER	LAVACA	LAVACA	FRESH	19,944	19,944	19,944	19,937	19,932	19,932
GULF COAST AQUIFER	LAVACA	LAVACA-GUADALUPE	FRESH	400	400	400	400	400	400
GULF COAST AQUIFER	WHARTON	COLORADO	FRESH	441	441	441	441	441	441
GULF COAST AQUIFER	WHARTON	COLORADO-LAVACA	FRESH	11,549	11,549	11,549	11,549	11,549	11,549
GULF COAST AQUIFER	WHARTON	LAVACA	FRESH	87,763	87,763	87,763	87,763	87,763	87,763
GROUNDWATER TOTAL SOURCE AVAILABILITY				**196,524**	**196,524**	**196,524**	**196,517**	**196,512**	**196,512**

REGION P									
				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SURFACE WATER	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 TOTAL SOURCE AVAILABILITY				**74,500**	**74,500**	**74,500**	**74,500**	**74,500**	**74,500**
REGION P TOTAL SOURCE AVAILABILITY				**271,024**	**271,024**	**271,024**	**271,017**	**271,012**	**271,012**

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Water User Group (WUG) Existing Water Supply

REGION P	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
		2020	2030	2040	2050	2060	2070
JACKSON COUNTY							
COLORADO-LAVACA BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	229	229	229	229	229	229
MANUFACTURING	P | TEXANA LAKE/RESERVOIR	1,000	1,000	1,000	1,000	1,000	1,000
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	11	11	11	11	11	11
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	228	228	228	228	228	228
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	18,061	18,061	18,061	18,061	18,061	18,061
COLORADO-LAVACA BASIN TOTAL EXISTING SUPPLY		**19,529**	**19,529**	**19,529**	**19,529**	**19,529**	**19,529**
LAVACA BASIN							
EDNA	P | GULF COAST AQUIFER | JACKSON COUNTY	887	887	887	887	887	887
GANADO	P | GULF COAST AQUIFER | JACKSON COUNTY	270	270	270	270	270	270
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	421	421	421	421	421	421
MANUFACTURING	P | GULF COAST AQUIFER | JACKSON COUNTY	5	5	5	5	5	5
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	40	40	40	40	40	40
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	708	708	708	708	708	708
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	36,370	36,370	36,370	36,370	36,370	36,370
LAVACA BASIN TOTAL EXISTING SUPPLY		**38,701**	**38,701**	**38,701**	**38,701**	**38,701**	**38,701**
LAVACA-GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | JACKSON COUNTY	50	50	50	50	50	50
MINING	P | GULF COAST AQUIFER | JACKSON COUNTY	22	22	22	22	22	22
LIVESTOCK	P | GULF COAST AQUIFER | JACKSON COUNTY	98	98	98	98	98	98
IRRIGATION	P | GULF COAST AQUIFER | JACKSON COUNTY	5,370	5,370	5,370	5,370	5,370	5,370
LAVACA-GUADALUPE BASIN TOTAL EXISTING SUPPLY		**5,540**	**5,540**	**5,540**	**5,540**	**5,540**	**5,540**
JACKSON COUNTY TOTAL EXISTING SUPPLY		**63,770**	**63,770**	**63,770**	**63,770**	**63,770**	**63,770**
LAVACA COUNTY							
GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	5	5	5	5	5	5
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	20	20	20	20	20	20
GUADALUPE BASIN TOTAL EXISTING SUPPLY		**25**	**25**	**25**	**25**	**25**	**25**
LAVACA BASIN							
HALLETTSVILLE	P | GULF COAST AQUIFER | LAVACA COUNTY	606	606	606	606	606	606
MOULTON	P | GULF COAST AQUIFER | LAVACA COUNTY	183	183	183	183	183	183
SHINER	P | GULF COAST AQUIFER | LAVACA COUNTY	485	485	485	485	485	485
YOAKUM	P | GULF COAST AQUIFER | LAVACA COUNTY	755	755	755	755	755	755
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	1,235	1,235	1,235	1,235	1,235	1,235
MANUFACTURING	P | GULF COAST AQUIFER | LAVACA COUNTY	705	705	705	705	705	705
MINING	P | GULF COAST AQUIFER | LAVACA COUNTY	2,544	2,544	2,544	2,544	2,544	2,544
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	1,982	1,982	1,982	1,982	1,982	1,982
IRRIGATION	P | GULF COAST AQUIFER | LAVACA COUNTY	8,357	8,357	8,357	8,357	8,357	8,357
LAVACA BASIN TOTAL EXISTING SUPPLY		**16,852**	**16,852**	**16,852**	**16,852**	**16,852**	**16,852**
LAVACA-GUADALUPE BASIN							
COUNTY-OTHER	P | GULF COAST AQUIFER | LAVACA COUNTY	1	1	1	1	1	1
LIVESTOCK	P | GULF COAST AQUIFER | LAVACA COUNTY	41	41	41	41	41	41
LAVACA-GUADALUPE BASIN TOTAL EXISTING SUPPLY		**42**	**42**	**42**	**42**	**42**	**42**

Water User Group (WUG) Existing Water Supply

REGION P	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LAVACA COUNTY TOTAL EXISTING SUPPLY		**16,919**	**16,919**	**16,919**	**16,919**	**16,919**	**16,919**
WHARTON COUNTY							
COLORADO BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	347	347	347	347	347	347
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	40	40	40	40	40	40
COLORADO BASIN TOTAL EXISTING SUPPLY		**387**	**387**	**387**	**387**	**387**	**387**
COLORADO-LAVACA BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	2,123	2,123	2,123	2,123	2,123	2,123
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	192	192	192	192	192	192
MANUFACTURING	P | GULF COAST AQUIFER | WHARTON COUNTY	133	133	133	133	133	133
MINING	P | GULF COAST AQUIFER | WHARTON COUNTY	7	7	7	7	7	7
LIVESTOCK	P | GULF COAST AQUIFER | WHARTON COUNTY	174	174	174	174	174	174
IRRIGATION	P | GULF COAST AQUIFER | WHARTON COUNTY	8,863	8,863	8,863	8,863	8,863	8,863
COLORADO-LAVACA BASIN TOTAL EXISTING SUPPLY		**11,492**	**11,492**	**11,492**	**11,492**	**11,492**	**11,492**
LAVACA BASIN							
EL CAMPO	P | GULF COAST AQUIFER | WHARTON COUNTY	61	61	61	61	61	61
COUNTY-OTHER	P | GULF COAST AQUIFER | WHARTON COUNTY	535	535	535	535	535	535
MINING	P | GULF COAST AQUIFER | WHARTON COUNTY	12	12	12	12	12	12
LIVESTOCK	P | GULF COAST AQUIFER | WHARTON COUNTY	615	615	615	615	615	615
IRRIGATION	K | COLORADO RUN-OF-RIVER	4,000	4,000	4,000	4,000	4,000	4,000
IRRIGATION	P | GULF COAST AQUIFER | WHARTON COUNTY	86,540	86,540	86,540	86,540	86,540	86,540
LAVACA BASIN TOTAL EXISTING SUPPLY		**91,763**	**91,763**	**91,763**	**91,763**	**91,763**	**91,763**
WHARTON COUNTY TOTAL EXISTING SUPPLY		**103,642**	**103,642**	**103,642**	**103,642**	**103,642**	**103,642**
REGION P TOTAL EXISTING SUPPLY		**184,331**	**184,331**	**184,331**	**184,331**	**184,331**	**184,331**

Source Water Balance (Availability- WUG Supply)

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
GROUNDWATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
GULF COAST AQUIFER	JACKSON	COLORADO-LAVACA	FRESH	5,086	5,086	5,086	5,086	5,086	5,086
GULF COAST AQUIFER	JACKSON	LAVACA	FRESH	3,226	3,226	3,226	3,226	3,226	3,226
GULF COAST AQUIFER	JACKSON	LAVACA-GUADALUPE	FRESH	5,304	5,304	5,304	5,304	5,304	5,304
GULF COAST AQUIFER	LAVACA	GUADALUPE	FRESH	16	16	16	16	16	16
GULF COAST AQUIFER	LAVACA	LAVACA	FRESH	3,092	3,092	3,092	3,085	3,080	3,080
GULF COAST AQUIFER	LAVACA	LAVACA-GUADALUPE	FRESH	358	358	358	358	358	358
GULF COAST AQUIFER	WHARTON	COLORADO	FRESH	48	48	48	48	48	48
GULF COAST AQUIFER	WHARTON	COLORADO-LAVACA	FRESH	0	0	0	0	0	0
GULF COAST AQUIFER	WHARTON	LAVACA	FRESH	0	0	0	0	0	0
GROUNDWATER TOTAL SOURCE WATER BALANCE				**17,130**	**17,130**	**17,130**	**17,123**	**17,118**	**17,118**

REGION P									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SURFACE WATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
TEXANA LAKE/RESERVOIR	RESERVOIR	LAVACA	FRESH	832	832	832	832	832	832
SURFACE WATER TOTAL SOURCE WATER BALANCE				**832**	**832**	**832**	**832**	**832**	**832**
REGION P TOTAL SOURCE WATER BALANCE				**17,962**	**17,962**	**17,962**	**17,955**	**17,950**	**17,950**

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Chapter 4– Identification of Water Needs

This chapter describes the analysis performed to identify water user groups (WUGs) with 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 WWPs 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 233,596 ac-ft/yr in the year 2020 and are projected to decrease to 231,820 ac-ft/yr and 231,778 ac-ft/yr in years 2060 and 2070, respectively. This is approximately 0.86 percent greater than the 2060 demand projected in the 2011 LRWPA RWP, which was 229,854 ac-ft/yr. Total water supplies allocated to WUGs in the region were estimated at 184,331 ac-ft/yr for all planning periods between the years 2020 and 2070.

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 steam-electric and manufacturing demands in the region in the near future. Currently, LNRA does not have sufficient water supplies to meet the potential demands, and as such, would show water needs if those demands had been identified earlier in the planning process. Chapter 5 discusses potential water management strategies that could be developed to increase LNRA's water supplies.

The sum of the projected shortages in the *WUG Needs Report* in *Appendix 4A* remains at 50,285 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. In addition, the Plan focuses on maximum rice production during dry years, which may indicate that the current level of demand does not reach this maximum level.

LNRA, the wholesale water provider in the region, has 0 acre-feet of projected water needs through 2070 in the 2016 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 Colorado-Lavaca Basin and Lavaca Basin will experience shortages in the planning area with a combined deficit 50,285 ac-ft/yr from 2020 through 2070. There are no municipal shortages anticipated for LRWPA through the year 2070.

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APPENDIX 4A

WUG Needs Report and WWP 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	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	12,779	12,779	12,779	12,779	12,779	12,779
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	37,506	37,506	37,506	37,506	37,506	37,506
WHARTON	LAVACA	LIVESTOCK	0	0	0	0	0	0
WHARTON	LAVACA	MINING	0	0	0	0	0	0
REGION P TOTAL NEEDS			50,285	50,285	50,285	50,285	50,285	50,285

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

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

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

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

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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 LRWPA with shortages. This chapter (Chapter 5) describes the analysis regarding the evaluation, and selection of appropriate water management strategies for the LRWPA. Water management strategies have been defined for each of the identified future water shortages within LRWPA 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

In past planning cycles, the Lavaca Regional Water Planning Group (LRWPG) and their consultants identified the existence of sufficient quantities of groundwater stored in the Gulf Coast aquifer within the limits of the region to support short-term increases in pumping. Because of the sensitivity of agricultural producers to the price of the water, additional 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.

In this planning cycle, 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. Based on this restriction, the LRWPG had to consider new water management strategies to meet Irrigation water needs in the region.

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 WMS.

Currently, non-municipal users in the LRWPA 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.

5.1.1 Potential Water Management Strategies

The potential water management strategies considered in the 2016 RWP are as follows:

- Drought Management
- Municipal Conservation
- Irrigation Conservation
- Reuse
- Lane City Reservoir (Region K strategy)
- Lavaca Off-Channel Reservoir
- Aquifer Storage and Recovery
- LNRA Desalination
- Expand Use of Groundwater

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. The majority of the remaining 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 2016 Lavaca Regional Water Plan to help meet irrigation needs. The recommended conservation measures for irrigation are discussed more fully in the Conservation section of this chapter (*Section 5.2*), but include On-Farm Conservation and Tail Water Recovery. The recommended conservation measures are focused on Wharton County (Lavaca Basin and Colorado-Lavaca Basin), where irrigation needs have been identified, but the LRWPG supports conservation for irrigation in the remainder of the region as well.

On-farm conservation measures include a combination of land leveling, multiple inlets, moisture 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 moisture 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 41,338 ac-ft/yr in Wharton County for all planning decades. These savings assume 50 percent of unimproved land will be improved with land-leveling, multiple inlets, and irrigation pipelines, and that 25 percent of non-rice acreage will be improved with moisture meters.

Unit costs for on-farm conservation measures are $76/ac-foot of water savings. Total construction costs are $20.8 million, with total capital costs of $23.7 million. Annual costs are approximately $3.15 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.

Tail water recovery is also recommended as a water management strategy. According to the Natural Resources Conservation Service, tail water recovery is defined 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 8,429 ac-ft/yr in Wharton County for all planning decades. These savings assume 10 percent of unimproved land will be improved with tail water recovery systems.

Unit costs for tail water recovery are $423/ac-foot of water savings. Total construction costs are $22.6 million, with total capital costs of $25.8 million. Annual costs are approximately $3.56 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.

Environmental Impacts

Water conservation for irrigation reduces streamflow from irrigation return flows. Further discussion is included in *Section 5.2.2.3.*

Impacts to Agriculture

Conservation reduces demand for irrigation water while supporting agriculture. These strategies reduce agricultural demands by 49,767 ac-ft/yr, bringing their demands closer to the amount of available water in the county. Costs would be the other impact. Cost savings of approximately $44 per ac-ft from reduced pumping would occur, but costs to implement the conservation measures could be as high as $423 per ac-ft. Funding options would need to be available to farmers, or some other economic benefit would need to exist to encourage local participation.

5.1.2.2 Lane City Reservoir (Region K strategy)

The Lane City Reservoir is a strategy for the Lower Colorado River Authority (LCRA) in Region K. The reservoir will be off the main channel of the Colorado River, near Lane City, in Wharton County and is expected to add 90,000 acre-feet per year to LCRA's firm water supply.

The proposed project includes construction of a 40,000 acre-foot off-channel water reservoir, a new river outfall, a new re-lift pump station, and upgrades to the existing pump station and canal system. The project will use existing surface water rights to increase the LCRA's overall available water supply.

The reservoir holding capacity will be approximately 40,000 acre-feet of water at a time and could potentially be filled, released, and refilled multiple times within a year, allowing LCRA to capture large periodic stream flows which are typical of the lower Colorado Basin. The enhanced operational flexibility will assist the LCRA in optimizing both water quantity and quality for all uses, notably for downstream customers and environmental needs.

Presently the LCRA releases Highland Lakes' water to industrial and agricultural customers near the coast and to fulfill environmental flow requirements. The Lane City Reservoir will lessen the need for Highland Lakes' releases and improve the reliability and efficiency of water for downstream uses. The Garwood Irrigation Division has approximately 16 percent of its area in the Lavaca Region, with a total surface water availability from the Colorado River of 16,000 AFY of the total 100,000 AFY contracted availability for irrigation water use in Garwood. The Garwood water right is the most senior water right in the Colorado Basin, so the water for Garwood is normally 100 percent firm. The recent emergency curtailment measures by the LCRA have called into question the firmness of the Garwood available water, and only 4,000 AFY was shown as an existing supply for the Lavaca Region in Chapter 3.

Firm Yield

The Lane City Reservoir will reduce the need for emergency curtailment measures in the future and will therefore increase the availability of water supplies under the Garwood water right. This strategy will ensure the remaining 12,000 AFY of contracted water can be supplied during drought conditions. The water will not come directly from the reservoir itself, but will be a combination of Colorado run-of-river water and releases from the Highland Lakes, as needed. This water will help meet the irrigation shortage in the Lavaca Basin of Wharton County. Additional water losses are not associated with this strategy for Region P.

Opinion of Probable Costs

The capital cost of this strategy is applied to LCRA in Region K. The cost to the Lavaca Region is limited to the cost to the irrigators' to purchase and divert water under their existing contract. This cost is estimated to be $33 per acre-foot.

Environmental Impacts

There are no anticipated environmental impacts located within the Lavaca Region. Please see the 2016 Region K Water Plan for a discussion of environmental impacts within Region K.

Impacts to Agriculture

Impacts from this strategy to agriculture in the Lavaca Region are positive, by providing a more reliable source of water during drought conditions. This strategy can provide 12,000 ac-ft/yr of water during drought conditions.

Impacts to Navigation

The proposed off-channel reservoir scenarios would have no impact on navigation.

5.1.3 Recommended Strategies for Wholesale 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, Aquifer Storage and Recovery, and Desalination. All three are discussed in detail in this section.

5.1.3.1 Lavaca Off-Channel Reservoir

The Lavaca-Navidad River Authority (LNRA) has 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 for implementation including either the West Off-Channel Reservoir Project or the East Off-Channel Reservoir Project Alternative B. LNRA's Strategic Resource Management Plan (revised 2013) includes the development of an off-channel option as the preferred approach. A summary of the strategy is provided in this Plan. Additional details regarding the strategy scenarios can be found in the above-mentioned *Lavaca River Water Supply Project Feasibility Study*.

In both cases of the West Off-Channel and East Off-Channel B Reservoirs, the minimum facility requirements would include the storage reservoir and associated pump stations to deliver water from the river to the 25,000 acre-foot reservoir. Diversion points and conceptual level pipeline alignments are different in each scenario. Two pump stations are required for both off-channel alternatives, including a Lavaca River diversion pump station to divert flows and an off-channel reservoir pump station 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 the off-channel reservoir 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. 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 West Off-Channel Reservoir project includes a diversion dam structure (North Diversion Dam) on the Lavaca River, a raw water diversion pump station on the Lavaca River, a raw water diversion pipeline from the diversion pump station to the off-channel reservoir, the West Off-Channel Reservoir, a raw water delivery pump station at the off-channel reservoir, and a raw water delivery pipeline from the West Off-Channel Reservoir to the existing LNRA East Delivery System pipeline serving customers to the south.

The East Off-Channel Reservoir Alternative B project utilizes an alternative diversion dam on the Lavaca River referred to as the South Diversion, a raw water diversion pump station on the Lavaca River, a raw water diversion pipeline from the diversion pump station to the off-channel reservoir, the East Off-Channel Reservoir, a raw water delivery pump station at the off-channel reservoir, and a raw water delivery pipeline from the East Off-Channel Reservoir to the existing LNRA East Delivery System pipeline serving customers to the south.

The site location for the recommended version of this strategy is the East Alternative B site. *Section 5.1.5.2.*describes the alternative version of the strategy, where the site location is identified as the West location.

Firm Yield

The firm yield of the Lavaca Off-Channel Reservoir 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. Additions and changes to the Base Lavaca WAM to create the strategy analysis are in *Appendix 5F*.

The firm yield of the reservoir was determined to be approximately 16,963 acre-feet/year. This firm yield would increase LNRA's supply as a wholesale water provider. A portion of the yield is identified to meet existing manufacturing water needs in Region L, Calhoun County. The remaining yield would be available to meet potential water needs for municipal, industrial, or other water users within the Lavaca Region, 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.

Opinion of Probable Costs

Costs for the construction of the off-channel reservoir scenarios are provided in the attached Appendix. Costs assumed the more expensive East Off-Channel Alternative B, which is within approximately 10% of the cost of the West Off-Channel scenario. The costs were taken from the *Lavaca River Water Supply Project Feasibility Study,* and the costs were converted from December 2010 to September 2013. Actual costs could vary significantly due to project implementation requirements. Construction costs were estimated to be $123.2 million, with total capital costs being approximately $177.5 million. Annual costs were determined to be $14.7 million, with a unit cost of $867. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D.*

Issues and Considerations

The off-channel reservoir alternatives minimize challenges to implementation as compared to the 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 Impacts

The proposed off-channel reservoir scenarios would have substantially less impacts on valuable habitat than the considered on-channel reservoir option. In the off-channel scenarios, 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 scenarios appears to have minimal or no impact on threatened and endangered species.

Since the *Lavaca River Water Supply Project Feasibility Study (Study),* completed in 2011, the TCEQ has adopted new environmental flow standards that apply to new or amended water rights permits.

These standards were not included as part of the 2011 *Study* analysis, so a re-evaluation of the potential firm yield was completed using the new standards for the 2016 Lavaca Regional Water Plan.

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 that needs to be met is the Bay and Estuary Freshwater Inflow standards for the Lavaca Bay System. The Standards are identified in the table below. Projects requiring new water rights permits shall not cause or contribute to an impairment of the inflow regimes described below.

Table 5-1 Bay and Estuary Freshwater Inflow Standards for the Lavaca Bay System

Inflow Regime	Spring Inflow Quantity (af)	Fall Inflow Quantity (af)	Intervening Inflow Quantity (af)	Annual Strategy Frequency
Subsistence	13,500	9,600	6,900	96%
Base Dry	55,080	39,168	28,152	82%
Base Average	127,980	91,080	65,412	46%
Base Wet	223,650	158,976	114,264	28%

af=acre feet

The Lavaca off-channel reservoir project was modeled so that the model incorporating the strategy either met or exceeded the required annual strategy frequency for each seasonal period; or if the Base Lavaca WAM did not meet the required annual strategy frequency, then the strategy model did not decrease it further. The frequency attainment results are shown below for the Base WAM and the Strategy WAM, respectively.

Table 5-2 Comparison of WAM Results for the Lavaca Off-Channel Reservoir

Base WAM Results

	Subsistence		Base Dry		Base Avg		Base Wet	
Onset Period	Count	%	Count	%	Count	%	Count	%
Springtime	51	89%	45	79%	38	67%	25	44%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	52	91%	45	79%	39	68%

Lavaca OCR Results

	Subsistence		Base Dry		Base Avg		Base Wet	
Onset Period	Count	%	Count	%	Count	%	Count	%
Springtime	51	89%	45	79%	37	65%	24	42%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	52	91%	45	79%	38	67%

As a result of developing a reservoir to capture and store flow from the river, up to 25,000 ac-ft/yr would be diverted to storage in any given year. Additionally, the new reservoir could provide up to 1,200 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 1,200 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 Aquifer Storage and Recovery

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 scope of work for this strategy also included looking at the feasibility of using overpass pits for infiltration. It was determined that this would not be a feasible way of increasing water supply for the region and was not evaluated further.

Site Location and Conditions

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 for this report. 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/year. Fresh water is expected to occur down to approximately -500 feet msl. Below -600 feet msl, TDS concentrations may range from 1,500 mg/l to 5,000 mg/L.

Project Yield

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 acre-feet/year 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 14,163 acre-feet/year. Modifications to the assumptions, such as authorized diversion and infrastructure size, could modify the resulting yield. Additions and changes to the Base Lavaca WAM to create the strategy analysis are in *Appendix 5F*. 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 feet/year, 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 firm yield would increase LNRA's supply as a wholesale 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 capital cost estimate was developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2013 dollars. The Cost Estimating Tool was also used to determine operating costs.

The capital cost for this strategy is primarily driven by the cost of a water treatment facility and raw and finished water transmission mains.

In September 2013 values, the probable cost for LNRA to meet all of its planning horizon identified water supply needs is approximately $181,928,000. This would result in a total annual cost (including operations and maintenance of approximately $23,237,000 per year. The opinion of probable unit cost of water is $1,641 per acre foot, or approximately $5.03 per 1,000 gallons. The TWDB Costing Tool Cost Summary is provided in *Appendix 5D*.

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.

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. The Standards are identified earlier in *Table 5-1*. Projects requiring new water rights permits shall not cause or contribute to an impairment of the inflow regimes described below.

The LNRA ASR project was modeled so that the model incorporating the strategy either met or exceeded the required annual strategy frequency for each seasonal period; or if the Base Lavaca WAM did not meet the required annual strategy frequency, then the strategy model did not decrease it further. The frequency attainment results are shown below for the Base WAM and the Strategy WAM, respectively.

Table 5-3 Comparison of WAM Results for LNRA Aquifer Storage and Recovery

Base WAM Results

	Subsistence		Base Dry		Base Avg		Base Wet	
Onset Period	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Springtime	51	89%	45	79%	38	67%	25	44%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	52	91%	45	79%	39	68%

LNRA ASR Strategy

	Subsistence		Base Dry		Base Avg		Base Wet	
Onset Period	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Springtime	51	89%	45	79%	36	63%	24	42%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	50	88%	45	79%	38	67%

As described, this project could remove up to 25,000 ac-ft/yr of streamflow from the Lavaca River.

Impacts to Agriculture

The proposed off-channel reservoir scenarios 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.

5.1.3.3 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 the largest single raw water user in the area, Formosa Plastics, show future demands totaling 10,000 acre-feet per year, 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 just downstream of Lake Texana.

Site Location and Conditions

At a November 2012 Board Meeting, NRS Engineers presented three (3) options of site locations. Two (2) options were based on desalination of the brackish groundwater supply in the vicinity of the Formosa Plastics owned property and one (1) 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 unknown quantity of brackish surface water that would be available.

For the 2016 Regional Water Plan, the desalination strategy using the combination of brackish groundwater and brackish surface water will be evaluated. Available groundwater under the MAG and additional brackish surface water volumes will be used for sizing potential water supply strategies. Based on these criteria, the LNRA Desalination strategy will consist of:

- Obtain a groundwater pumping contract with the Texana Groundwater Conservation District (TGCD), construction of groundwater wells, a desalination plant, raw and finished water transmission lines, and a concentrate disposal line. In addition, a microfiltration treatment train would be included for treatment of brackish surface water, construction of a river intake works, river pump station, east drain reservoir, and sludge lagoon.

Project Yield

The largest landowner controlling the largest contiguous parcel of property in the study area is Formosa Plastics. The property is located in the Lavaca Basin in Jackson County. For groundwater, after accounting for existing supplies being used, the available yield for groundwater in this basin is approximately 3,226 acre-feet/year (2.8 MGD Average) for all planning decades. This groundwater yield value was used for this analysis in place of the estimated groundwater yields proposed by NRS Engineers. For surface water, the available yield was estimated to be equivalent to the proposed groundwater yield of approximately 3,226 acre-feet/year (2.8 MGD Average) for all planning decades. This volume of water was verified as available using an unmodified version of the TCEQ Lavaca River WAM Run 3 while meeting SB3 environmental flow requirements. 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. Total yield for this strategy is estimated to be 6,452 acre-feet/year (5.6 MGD Average) for all planning decades. This yield volume allows for an approximate 10% water loss, due to concentrate disposal. If additional groundwater or surface water is available, yield would increase.

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, costs were developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2013 dollars. The Cost Estimating Tool was also used to determine operating costs.

The capital cost for this strategy is primarily driven by the cost of a water treatment facility and the well field. In September 2013 values, the probable capital cost for LNRA to meet all of its planning horizon identified water supply needs is approximately $44.2 million. This would result in a total annual cost (including operations and maintenance of approximately $8,833,000 per year. The opinion of probable unit cost of water is $1,369 per acre-foot. If larger amounts of groundwater or surface water are available, unit costs would 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 would be the TCEQ and the Texana Groundwater Conservation District. Brackish groundwater wells are subject to permitting requirements. The primary regulatory requirements include TCEQ's administration of surface water diversion permitting; and the regulation of pumping of groundwater by the GCD.

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 Groundwater Conservation District 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 disposing the brine in Lavaca Bay.

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 has been 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. Further evaluation would still be needed to determine these types of effects on bay and estuary releases.

Impacts to Agriculture

There should be no impacts to agriculture from this strategy.

5.1.4 Recommended Strategies for Municipalities

The municipalities in the region have no identified water needs, as all of their projected water demands are met. Even so, the LRWPG is recommending drought management, municipal conservation, and reuse as water management strategies in the 2016 Regional Water Plan.

5.1.4.1 Drought Management

The LCRWPG is recommending Drought Management as a water management strategy for all municipalities with a Drought Contingency Plan, regardless of water needs. The purpose for recommending drought management is to encourage municipalities 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 municipality's Drought Contingency Plan, 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 municipality:

Table 5-4 Drought Management Water Demand Reductions

WUG	COUNTY	BASIN	Demand Reduction (AFY)	Demand Reduction (AFY)	Demand Reduction (AFY)	Demand Reduction (AFY)	Demand Reduction (AFY)	Demand Reduction (AFY)
			2020	2030	2040	2050	2060	2070
EDNA	JACKSON	LAVACA	33	33	33	33	33	33
GANADO	JACKSON	LAVACA	54	54	53	53	53	54
HALLETTSVILLE	LAVACA	LAVACA	46	45	44	44	43	43
MOULTON	LAVACA	LAVACA	37	36	35	35	35	35
SHINER	LAVACA	LAVACA	49	48	47	46	46	46
YOAKUM	LAVACA	LAVACA	19	18	18	18	15	15
EL CAMPO	WHARTON	COLORADO	12	12	12	13	13	13
EL CAMPO	WHARTON	COLORADO-LAVACA	72	73	75	76	78	80
EL CAMPO	WHARTON	LAVACA	2	2	2	2	2	2

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/acre-foot.

No environmental impacts are anticipated from municipalities implementing their Drought Contingency Plans. No impacts to agriculture are anticipated, either. Water loss is not associated with drought management.

5.1.4.2 Municipal Conservation

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 LCRWPA. First, WUGs were required to meet the following criteria to be chosen for conservation measures:

- Be a municipal WUG.
- Have a year 2020 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 2020 GPCD is greater than 140
  - 5% GPCD reduction per decade until 140 GPCD is reached.
- If the 2020 GPCD is less than 140
  - No conservation considered

This method follows 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 WCITF. Conservation was applied immediately in 2020.

The new per capita usage for each decade was then used along with the WUG population to determine the new 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 demand reductions as shown in the table below.

Table 5-5 Municipal Conservation Water Demand Reductions

WUG	COUNTY	BASIN	Demand Reduction (AFY) 2020	Demand Reduction (AFY) 2030	Demand Reduction (AFY) 2040	Demand Reduction (AFY) 2050	Demand Reduction (AFY) 2060	Demand Reduction (AFY) 2070
HALLETTSVILLE	LAVACA	LAVACA	31	49	66	89	111	134
MOULTON	LAVACA	LAVACA	9	13	18	25	31	38
SHINER	LAVACA	LAVACA	23	37	49	65	86	104
YOAKUM	LAVACA	LAVACA	37	54	74	95	33	62
EL CAMPO	WHARTON	COLORADO	15	23	34	46	47	48
EL CAMPO	WHARTON	COLORADO-LAVACA	91	143	197	279	273	280
EL CAMPO	WHARTON	LAVACA	3	4	6	8	9	8

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 capital costs were developed. The unit cost is presented as an average, with some conservation measures being more expensive and some being less.

Capital 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 the leak detection and repair portion of the capital costs were estimated using information from City of Austin on their current expenditures for water line replacements, and applied proportionally to the municipalities in the Lavaca Region by comparing populations. Smart meters were assumed a cost of $100 per home, with the assumption that 50 percent of homes would implement this strategy in the first decade. Non-capital cost conservation measures were included in the total costs at an average of $250/acre-foot of water savings. The following table provides the estimated capital, project, annual, and unit costs for the applicable municipalities. The capital costs shown can provide the full demand reduction volumes listed.

Table 5-6 Municipal Conservation Costs

WUG	COUNTY	BASIN	Capital Cost $	Project Cost $	Annual Cost $	Unit Cost $
HALLETTSVILLE	LAVACA	LAVACA	$62,313	$62,313	$10,356	$334
MOULTON	LAVACA	LAVACA	$20,750	$20,750	$3,198	$355
SHINER	LAVACA	LAVACA	$50,357	$50,357	$7,876	$342
YOAKUM	LAVACA	LAVACA	$85,984	$85,984	$13,193	$357
EL CAMPO	WHARTON	MULTIPLE	$243,652	$243,652	$37,804	$347

Many of the non-capital cost measures include, but are not limited to, drought tolerant landscape, smart water meters, 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. 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.

Environmental and other impacts, including agricultural, are expected to be negligible.

5.1.4.3 Reuse

The City of El Campo is currently planning to produce a Type 1 wastewater effluent that could be used by the City or sold to potential customers. As such, they requested to have their reuse project as a recommended water management strategy in the 2016 Lavaca Regional Water Plan.

The City of 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 acre-feet/year, beginning in 2020. Water losses are assumed to be negligible. Currently, the City has no identified users of the effluent, but is moving forward with installing a sand filtration system.

For costing purposes, the sand filtration system and five miles of 8" transmission pipeline were assumed. Costs were developed using the Texas Water Development Board (TWDB) Cost Estimating Tool in September 2013 dollars. Capital costs were calculated to be approximately $4.7 million. Annual costs were calculated at $502,000 per year, for a unit cost of $896/acre-foot.

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 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 has included an alternative strategy in the 2016 Lavaca Regional Water Plan for additional use of groundwater for irrigation, as well as an alternative strategy version of the Lavaca Off-Channel Reservoir project for LNRA that assumes a different location.

5.1.5.1 Expand Use of Groundwater

The majority of water demands in the Lavaca Regional Water Planning Area (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. In previous Lavaca Regional Water Plans (through 2011), "conjunctive use of groundwater" was identified as the only economically viable water management strategy to meet shortages within the Region. However new requirements for the current planning cycle stipulate that regions are prohibited from utilizing conjunctive use, overdrafting, or any groundwater strategy that would utilize more groundwater than is calculated as available.

For the 2016 Regional Plans, 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 worked together to determine the DFC for the Central Gulf Coast Aquifer. The DFC was adopted on July 14, 2010 and states that no more than 12 feet of average drawdown can occur by 2060 relative to 1999 conditions.

This strategy proposes to use additional groundwater during drier years only, beginning in 2020, to meet irrigation needs in Wharton County (12,779 acre-feet a year in the Colorado-Lavaca Basin and 37,506 acre-feet a year in the Lavaca Basin.) Water losses are assumed to be negligible.

Cost

A unit cost of $44 per acre-foot was calculated as the additional pumping cost for estimated additional drawdown due to overdrafting. No capital costs were assumed. As an additional cost for pumping water would be experienced by all groundwater users in the LRWPA, the unit cost was multiplied over the demand for the entire region and then divided over the total amount of irrigation shortages to determine this value. Only a portion of this cost would be paid by the irrigators experiencing the shortage. This cost would only be assessed when needed. It is further assumed that surface water would be used when available and 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. Thus, this strategy would have negligible impacts on current streamflow levels. If increased use continues over a long period of time, there is a potential for land subsidence with attendant environmental effects. This is an alternative strategy that is not currently recommended. It could only become a recommended strategy if the MAG restrictions placed on the aquifer were modified, or the rules for regional water planning were changed.

Impacts on other Water Resources of the State

The Gulf Coast Aquifer underlying Wharton County has a sufficient amount of 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 50,285 ac-ft/yr. Additionally, wildlife habitat will benefit from sustained return flows in drought.

5.1.5.2 Lavaca Off-Channel Reservoir Alternative Site

An alternative version of this strategy (see *Section 5.1.3.1* for a description of the Recommended version) identifies the West location for the project site rather than the East Alternative B site. See the *Lavaca River Water Supply Project Feasibility Study*, completed in 2011 by Freese & Nichols, Inc., for additional details. Costs and impacts of the alternative strategy are as described in *Section 5.1.3.1*.

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

Drought management was considered as a strategy to meet irrigation water needs in Wharton County. The strategy's assumption was that 75% of rice producers would not produce a second, or ratoon, crop during a drought year. Water savings from this strategy were calculated to be 23,295 acre-feet/year for Wharton County.

The costs associated with the strategy were $286 per acre-foot, based on an updated version of the socioeconomic analysis of unmet needs that was included in the 2011 Lavaca Regional Water Plan. This cost was used due to the fact that a second crop is an important part of the local economy, and not being able to grow one is essentially the same as not meeting water needs.

Due to the negative economic impacts to agriculture, the LRWPG decided not to recommend drought management as a strategy in the 2016 Lavaca Regional Water Plan.

5.1.6.2 Conservation (Sprinkler Irrigation)

Conversion from field flooding to Low-Energy Precision Application (LEPA) sprinkler irrigation for rice farming was considered as a conservation strategy for meeting irrigation needs. The assumptions included that 10 percent of current acreage would be modified with a conservative water savings of 0.5 acre-feet per acre. The water savings yield determined for Wharton County from this strategy was 2,618 acre-feet/year.

Costs for the strategy were assumed using a study performed for Region A on water management strategies for reducing irrigation demands. The cost for converting to sprinkler irrigation, updated to September 2013 dollars, was $310 per acre modified. Project costs, annual costs, and unit costs were determined using the TWDB Cost Estimating Tool. Unit costs were calculated to be $94 per acre-foot of water savings.

The LRWPG determined not to recommend this particular strategy due to the expectation that the strategy was unlikely to be implemented within the region.

5.1.6.3 Conservation (Crop Conversion)

Conversion from rice farming to a less water-intensive crop was considered as a conservation strategy for meeting irrigation needs. The assumptions were that 2,000 acres of rice would be converted to milo (for costing purposes), with a water savings of 3.5 acre-feet per acre. Total water savings estimated for Wharton County from this strategy was 7,000 acre-feet/year.

Costs for this strategy looked at economic data from the Texas A&M AgriLife Extension Service and compared direct and indirect costs of each crop and equipment needs for making a change. Costs for lower revenues were also accounted for. A unit cost of $61 per acre-foot of water savings was determined.

The LRWPG determined not to recommend this particular strategy due to the expectation that the strategy was unlikely to be implemented within the region without economic benefit to the farmer.

5.1.7 Strategy Allocation

The recommended management strategies to meet irrigation water needs were applied to meet the irrigation shortages in the Colorado-Lavaca Basin and Lavaca Basin in Wharton County. This is shown in *Appendix 5C*.

5.2 Water Conservation

The 2016 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, and for several municipalities 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 encourages municipalities to follow their Water Conservation Plans. Templates for developing Water Conservation Plans can be found on the TCEQ website at https://www.tceq.texas.gov/permitting/water_rights/conserve.html/#plans. Conservation is recommended as a strategy for several municipalities in the region, with the potential demand reductions as shown in the table below.

Table 5-7 Municipal Conservation Water Demand Reductions (Conservation Section)

WUG	COUNTY	BASIN	Demand Reduction (AFY) 2020	Demand Reduction (AFY) 2030	Demand Reduction (AFY) 2040	Demand Reduction (AFY) 2050	Demand Reduction (AFY) 2060	Demand Reduction (AFY) 2070
HALLETTSVILLE	LAVACA	LAVACA	31	49	66	89	111	134
MOULTON	LAVACA	LAVACA	9	13	18	25	31	38
SHINER	LAVACA	LAVACA	23	37	49	65	86	104
YOAKUM	LAVACA	LAVACA	37	54	74	95	33	62
EL CAMPO	WHARTON	COLORADO	15	23	34	46	47	48
EL CAMPO	WHARTON	COLORADO-LAVACA	91	143	197	279	273	280
EL CAMPO	WHARTON	LAVACA	3	4	6	8	9	8

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 capital costs were developed. The unit cost is presented as an average, with some conservation measures being more expensive and some being less.

Capital 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 the leak detection and repair portion of the capital costs were estimated using information from City of Austin on their current expenditures for water line replacements, and applied proportionally to the municipalities in the Lavaca Region by comparing populations. Smart meters were assumed a cost of $100 per home, with the assumption that 50 percent of homes would implement this strategy in the first decade. Non-capital cost conservation measures were included in the total costs at an average of $250/acre-foot of water savings. The following table provides the estimated capital, project, annual, and unit costs for the applicable municipalities. The capital costs shown can provide the full demand reduction volumes listed.

Table 5-8 Municipal Conservation Costs (Conservation Section)

WUG	COUNTY	BASIN	Capital Cost	Project Cost	Annual Cost	Unit Cost
			$	$	$	$
HALLETTSVILLE	LAVACA	LAVACA	$62,313	$62,313	$10,356	$334
MOULTON	LAVACA	LAVACA	$20,750	$20,750	$3,198	$355
SHINER	LAVACA	LAVACA	$50,357	$50,357	$7,876	$342
YOAKUM	LAVACA	LAVACA	$85,984	$85,984	$13,193	$357
EL CAMPO	WHARTON	MULTIPLE	$243,652	$243,652	$37,804	$347

Many of the non-capital cost measures include, but are not limited to, drought tolerant landscape, smart water meters, 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. 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.

Environmental and other impacts are expected to be negligible.

5.2.2 Irrigation Conservation

Conservation is recommended as a water management strategy to meet irrigation water needs in Wharton County. There are some issues with irrigation conservation in the region that have been discussed in previous regional water plans. 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. As noted previously by several of the group members, 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.

As noted in the 2006 RWP, 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 of 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. Impacts are discussed further in *Sections 5.2.2.3* and *5.2.2.4*.

Additionally, the high cost of conservation and the lack of funds to pay for it make large scale conservation projects unlikely. 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 LRWPA are managed prevent such programs from having substantial effects. A large portion of the irrigated acreage within LRWPA 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. This is discussed in greater detail in the *Agricultural Water Demands Analysis* developed as part of the 2011 Regional Water Planning Process.

5.2.2.1 On-Farm Conservation

On-farm conservation measures include a combination of land leveling, multiple inlets, moisture 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 moisture 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 41,338 ac-ft/yr in Wharton County for all planning decades. These savings assume 50 percent of unimproved land will be improved with land-leveling, multiple inlets, and irrigation pipelines, and that 25 percent of non-rice acreage will be improved with moisture meters. For land with combined multiple inlets and land leveling with approximately 50% of rice acreage ratoon cropped, conservation savings would be 1.23 acre-feet per acre. 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 acre-feet per ditch mile. An assumed length of pipeline per acre of field of 25 feet was used, as recommended by L. G. Raun, Jr. Moisture meters were assumed to provide a water savings of 25 percent.

Unit costs for on-farm conservation measures are $76/ac-foot of water savings. Total capital costs are $23.7 million. Annual costs are approximately $3.15 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.

Local information on current 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, and costs were updated to September 2013 dollars. *Table 5-9* lists a summary of current local conservation costs. In general, costs without grant funding or low-interest loans are prohibitive to implementation.

Table 5-9
Estimated Unit Cost of
Agricultural Conservation Improvements

Improvement	Improvement Cost per Acre
Land Leveling	$445
Multiple Inlets	$85
Reduced Levee Interval	Minimal
Irrigation Pipeline	$200

5.2.2.2 Tail Water Recovery

Tail water recovery is also recommended as a water management strategy. According to the Natural Resources Conservation Service, tail water recovery is defined 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 8,429 ac-ft/yr in Wharton County for all planning decades. These savings assume 10 percent of unimproved land will be improved with tail water recovery systems.

Unit costs for tail water recovery are $423/ac-foot of water savings. The costs were determined using the LCRA Water Supply for Agriculture report, taking the report's 2010 construction costs, converting to the amount of acreage for the Lavaca Region, and then updating to September 2013 dollars. Total capital costs are $25.8 million. Annual costs are approximately $3.56 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.

5.2.2.3 Extent and Timing of Flows from Rice Culture

As part of the 2006 RWP development process, telephone interviews were conducted with L. G. Raun, Jr., representing primarily groundwater rice irrigation, and Ronald Gertson, representing primarily surface water rice irrigation. These two individuals were chosen based on their experience and knowledge of overall farming practices in the area as well as the fact that they both currently serve on RWPG boards. Estimated flows were remarkably similar. Both individuals indicated that water is used in the early spring, approximately in February, to flush the fields. This water is to provide a suitable environment for the seeds to be planted and to prevent weeds from getting a head start in the fields. Both individuals estimated approximately 1.5 inches per flush and two flushes as being needed to properly prepare the seedbed. This represents the amount of water that will be seen as runoff from the fields as the water drains off the fields prior to planting.

The next increment of return flow occurs during the harvest. The rice fields are drained just prior to the harvest, and whatever water remains is discharged during that time. Both individuals estimated that 90 percent of the fields are drained in July and that the amount of water drained varies between 3 and 4 in/ac. The fields are kept flooded right up to the time of harvest to keep red rice from getting a foothold in the area and reducing the quality of the harvest.

The rice plants that are used for the ratoon crop are already in the field, so there is less need to flush and more need to just flood the fields to maintain the proper weed control. The final increment of water from the fields to the streams is the draining of the fields for the harvesting of the ratoon crop. Once again, the fields are kept full right up to the time of draining. Approximately 50 percent of the water for a ratoon crop is drained in September and the remaining 50 percent is drained in October.

Since both the March and September/October time frames coincide with times when the streams traditionally have more flow in them, the July time period was analyzed. July tends to be quite dry while, at the same time, July has more fields being drained than at any other time with an estimated 90 percent of the acreage being drained at that time.

The TWDB map of irrigated lands for year 2000 was downloaded primarily to determine the spatial distribution of the acreage throughout the region. The individual parcels were then increased in size so that the total acreage reflected the acreage used for determining the irrigation water demands for LRWPA. Each irrigated parcel was then assigned to a control point in the model if possible. There were some instances where acreage was located in a coastal basin and there were no usable control points to assign the return flows to.

Once the locations were determined, a spreadsheet table was developed to calculate the potential runoff under various conditions. For the purposes of this spreadsheet, it was assumed that the flow coming off the fields was 3 inches per first-crop acre prior to conservation measures being applied, and that flow was reduced by 50 percent to 1.5 inches per first-crop acre after precision leveling and installation of multiple inlets.

Thirty-six control points from the model were examined to determine the potential influence of agricultural return flows during the months of June and July. Two points, Southeast and Northeast, were not included as no naturalized flow data existed for these two points, even though each point would receive notable amounts of return flow during these months. Of the 36 remaining points, it was observed that 7, or nearly 20 percent, of the points would receive irrigation return flows in both June and July when the minimum naturalized flow would be zero. These flows represent an important contribution to these stream systems that would be dry during DOR conditions. These flows would contribute to the Lavaca River at two WAM control points, Sandy Creek at two control points, and Pinoak Creek at three control points. Two other model control points in Lavaca County and Jackson

County would receive flow from irrigation returns in July, when the minimum streamflow would be zero under DOR conditions. These flows would likely be considerable as they occur in July when approximately 90 percent of rice fields are drained in preparation for harvest. Additionally, 13 other points located in Wharton County experience irrigation return flows during the month of June when streams would otherwise be dry in a DOR. These flows are made up of discharges from only 10 percent of the rice fields in the basin and would be smaller than the July flows but would still contribute water to stream habitat.

Results of the 2006 RWP also showed that 22 of the 36 control points receive irrigation return flows from rice-planted fields that are greater than the minimum DOR flow for the month of June. Eighteen control points will receive more irrigation return than naturalized streamflow in the month of July during a DOR. In comparison, with conservation applied, it was anticipated that 20 and 14 control points would receive return flows that surpass naturalized flow for the months of June and July, respectively. Overall, conservation would reduce the volume of return flows by half that contribute to the health of streams in LRWPA during dry conditions, following the assumptions presented here.

5.2.2.4 Impacts of Irrigation Return Flows

The analysis above was performed to determine whether or not there is a significant impact upon in-stream flows in LRWPA from rice return flows. This analysis has shown 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. 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 of 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.

Subsequent to the 2006 RWP, the LRWPA has experienced a prolonged period of drought, including exceptionally dry conditions for the first half of 2009. Several LRWPG members, including L. G. Raun Jr. (referenced above) indicated that many of the streams in the region have been dry except for short periods immediately following releases of water from rice fields; these flows are of short duration and do not extend far downstream of the discharge point. In addition, releases of water have been extremely rare during the ongoing drought. As such, the conclusions of the 2006 plan regarding irrigation return flows may need to be re-examined during future planning rounds.

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	Conjunctive Use	Acquisition of available 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	other
Irrigation, Wharton	*50,285*	PF	PF	nPF	nPF	nPF	PF	PF	nPF	nPF	nPF	PF	

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)

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APPENDIX 5B

Potential Management Strategies and Impacts

Lavaca Region
Potentially Feasible Water Management Strategy Screening (for 2016 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	First rice crop only, no second (ratoon) crop	Yes	$963,248	$286.00	3,368	2020	Colorado-Lavaca	No	Reduced return flows for stream/B&E; reduced habitat for winter migratory birds	None expected	Negative economic impacts to farmers	1	0	1	0	-1	-1	1	1	-1	0	0	1
2	Drought Management	Irrigation, Wharton	First rice crop only, no second (ratoon) crop	Yes	$5,699,122	$286.00	19,927	2020	Lavaca	No	Reduced return flows for stream/B&E; reduced habitat for winter migratory birds	None expected	Negative economic impacts to farmers	1	0	1	0	-1	-1	1	1	-1	0	0	1
3	Drought Management	EDNA	Reduce water demands following Drought Continengency Plan	No	$3,300	$100.00	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
4	Drought Management	GANADO	Reduce water demands following Drought Continengency Plan	No	$5,400	$100.00	54	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	HALLETTSVILLE	Reduce water demands following Drought Continengency Plan	No	$4,550	$100.00	46	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	MOULTON	Reduce water demands following Drought Continengency Plan	No	$3,700	$100.00	37	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	SHINER	Reduce water demands following Drought Continengency Plan	No	$4,900	$100.00	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
8	Drought Management	YOAKUM	Reduce water demands following Drought Continengency Plan	No	$1,900	$100.00	19	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
9	Drought Management	EL CAMPO	Reduce water demands following Drought Continengency Plan	No	$9,500	$100.00	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
10	Drought Management	Manufacturing, Jackson County	Reduce water demands following LNRA Drought Contingency Plan	No	$100,163	$2,443.00	41	2020	COLORADO-LAVACA	No	Minimal	None expected	Potential economic / production impacts	-1	0	1	0	0	-1	1	1	0	0	0	1
11	Lavaca Off-Channel Reservoir	LNRA (WWP)	Construct off-channel reservoir off of Lavaca River to capture flows not needed for senior water rights or the environment	Yes	$177,485,000	$867.00	16,963	2020	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 (WWP)	Desalination of brackish groundwater in Jackson County	Yes	$44,252,000	$1,369.00	6,452	2020	Lavaca	No	Increased return flows for stream/B&E	Wellfield, treatment plant, and transmission line construction	Brine disposal in Bay. Yield limited by MAG	-1	0	1	1	0	0	-1	1	0	0	0	1
13	LNRA Aquifer Storage and Recovery	LNRA (WWP)	Diverting excess flows downstream of Lake Texana,	Yes	$181,906,000	$1,641.00	14,163	2020	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	Reuse	EL CAMPO	Reuse portion of wastewater effluent for municipal and/or agricultural purposes	No	$4,664,000	$896.00	560	2020	Multiple	No	Reduction of 50% 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
15	Lane City Reservoir (Region K)	Irrigation, Wharton	Construction of LCRA Lane City Reservoir would firm up available Garwood water for irrigation	Yes	$396,000	$33.00	12,000	2020	Lavaca	No	Firm water for irrigation would increase return flows to the streams.	None expected	None expected	1	0	0	0	0	0	0	1	1	0	0	3
16	Conservation - Municipal	HALLETTSVILLE	If 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	$62,313	$334	134	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	None expected	1	0	1	0	-1	0	1	1	0	0	0	3
17	Conservation - Municipal	MOULTON	If 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	$20,750	$355	38	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	None expected	1	0	1	0	-1	0	1	1	0	0	0	3
18	Conservation - Municipal	SHINER	If 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	$50,357	$342	104	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	None expected	1	0	1	0	-1	0	1	1	0	0	0	3
19	Conservation - Municipal	YOAKUM	If 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	$85,984	$357	62	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	None expected	1	0	1	0	-1	0	1	1	0	0	0	3
20	Conservation - Municipal	EL CAMPO	If 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	$243,652	$347	336	2020	All	No	Reduced return flows for stream/B&E	None expected	None expected	1	0	1	0	-1	0	1	1	0	0	0	3
21	Conservation - Irrigation	Irrigation, Wharton	Crop conversion from rice	Yes	$462,484	$61.00	1,012	2020	Colorado-Lavaca	No	Reduced return flows for stream/B&E; reduced habitat for winter migratory birds	None expected	Social/economic impacts to local farmers		0	1	0	-1	-1	1	1	-1	0	0	0

Lavaca Region
Potentially Feasible Water Management Strategy Screening (for 2016 Lavaca Regional Water Plan)

Screening Matrix Factors (Positive (1), Neutral (0), Negative (-1)): columns Cost through Impacts on Other Management Strategies.

	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	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 - Irrigation**	Irrigation, Wharton	Crop conversion from rice	Yes	$2,736,516	$61.00	5,988	2020	Lavaca	No	Reduced return flows for stream/B&E; reduced habitat for winter migratory birds	None expected	Social/economic impacts to local farmers		0	1	0	-1	-1	1	1	-1	0	0	0
23	**Conservation - Irrigation**	Irrigation, Wharton	Sprinkler irrigation	Yes	$267,262	$94.00	378	2020	Colorado-Lavaca	No	Reduced return flows for stream/B&E	None expected	Capital costs may be cost prohibitive to farmers	1	0	1	0	-1	-1	0	1	0	0	0	1
24	**Conservation - Irrigation**	Irrigation, Wharton	Sprinkler irrigation	Yes	$1,580,738	$94.00	2,239	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	Capital costs may be cost prohibitive to farmers	1	0	1	0	-1	-1	0	1	0	0	0	1
25	**Conservation - Irrigation**	Irrigation, Wharton	On-farm conservation including land leveling, multiple inlets, moisture meters, and irrigation pipelines instead of ditches	Yes	$4,191,346	$76.00	11,000	2020	Colorado-Lavaca	No	Reduced return flows for stream/B&E	None expected	Capital costs may be cost prohibitive to farmers	1	0	1	0	-1	0	0	1	0	0	0	2
26	**Conservation - Irrigation**	Irrigation, Wharton	On-farm conservation including land leveling, multiple inlets, moisture meters, and irrigation pipelines instead of ditches	Yes	$24,857,917	$76.00	30,338	2020	Lavaca	No	Reduced return flows for stream/B&E	None expected	Capital costs may be cost prohibitive to farmers	1	1	1	0	-1	0	0	1	0	0	0	3
27	**Conservation - Irrigation**	Irrigation, Wharton	Tailwater recovery	Yes	$3,724,460	$423.00	1,779	2020	Colorado-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
28	**Conservation - Irrigation**	Irrigation, Wharton	Tailwater recovery	Yes	$22,035,955	$423.00	6,650	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	$562,276	$44.00	12,779	2020	Colorado-Lavaca	No	Increased return flows for stream/B&E	None expected	Long-term increased pumping could negatively impact the aquifer and increase subsidence. Allowance for periods of recharge should be made.	1	1	1	0	0	1	0	0	1	0	0	5
30	**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	$1,122,254	$44.00	25,506	2020	Lavaca	No	Increased return flows for stream/B&E	None expected	Long-term increased pumping could negatively impact the aquifer and increase subsidence. Allowance for periods of recharge should be made.	1	1	1	0	0	1	0	0	1	0	0	5

Rating Criteria for Decision Matrix Factors for Identifying Potential Water Managment Strategies

Category	Rating Criteria -1	Rating Criteria 0	Rating Criteria 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.

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Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**Local Wharton County off-channel reservoir(s) – Lane City Reservoir**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation (Lavaca Basin) – 37,506 acre-feet
Supply Quantity	12,000 acre-feet
Water Source	Colorado ROR
Quality	No Change
Reliability	100 percent
Cost ($/acre-foot)	$33. Calculated as the purchase cost of interruptible water from LCRA. The Lane City reservoir will help to firm up the available run of river water for the Garwood Irrigation District (a portion is in Region P) by increasing the optimization of the LCRA system. Construction cost will be applied to Region K.

Environmental Impacts

No impacts in Lavaca Region. Please see Region K Plan

Impacts on other Water Resources of the State

Available surface water may reduce demands on groundwater.

Impacts on Threats to Agriculture and other Natural Resources of the State

Availability of water for irrigation purposes reduces the threats to agriculture. This strategy can provide 12,000 ac-ft/yr of water during drought conditions. Additionally, wildlife habitat will benefit from sustained return flows in drought.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Strategy	**Municipal Conservation**
Identified WUG/WWP	Hallettsville, Moulton, Shiner, Yoakum, El Campo
Shortage Amount	0 AF for all
Supply Quantity	Hallettsville (134 AF), Moulton (38 AF), Shiner (104 AF), Yoakum (62 AF), El Campo (336 AF)
Water Source	Conservation
Quality	No Change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	$350. Project costs vary by WUG. Capital costs were calculated for measures such as leak detection and repair, and Smart Meters. Additional annual costs were averaged for a variety of non-capital cost measures including incentives/rebates, education/public outreach, and ordinances. The capital costs shown can provide the full demand reduction volumes listed.

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.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Strategy	**Alternative Strategy: Expand Use of the Gulf Coast Aquifer – Wharton County**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation – 50,285 acre-feet
Supply Quantity	50,285 acre-feet/year
Water Source	Wharton County Groundwater
Quality	No Change
Reliability	100 percent
Cost ($/acre-foot)	$44. Calculated as the additional pumping cost for estimated additional drawdown due to overdrafting. As an additional cost for pumping water would be experienced by all groundwater users in the LRWPA, the unit cost was multiplied over the demand for the entire region and then divided over the total amount of irrigation shortages to determine this value. Only a portion of this cost would be paid by the irrigators experiencing the shortage. This cost would only be assessed when needed. It is further assumed that surface water would be used when available and 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. Thus, this strategy would have negligible impacts on current streamflow levels. If increased use continues over a long period of time, there is a potential for land subsidence with attendant environmental effects. This is an alternative strategy that is not currently recommended. It could only become a recommended strategy if the MAG restrictions placed on the aquifer were modified, or the rules for regional water planning were changed.

Impacts on other Water Resources of the State

The Gulf Coast Aquifer underlying Wharton County has a sufficient amount of 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 50,285 ac-ft/yr. Additionally, wildlife habitat will benefit from sustained return flows in drought.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**Reuse of municipal effluent**
Identified WUG/WWP	El Campo
Shortage Amount	None
Supply Quantity	560 acre-feet per year (50% of total effluent)
Water Source	Groundwater based municipal wastewater effluent
Quality	Increased dissolved solids and bacterial content, plus some beneficial nutrients
Reliability	100 percent
Cost ($/acre-foot)	Project Cost is $4,664,000, with a unit cost of $896; Calculated based information from El Campo and assumed transmission distance. Sand filtration system and 5 miles of 8" transmission line were included in costs. TWDB costing tool used.

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.

Socioeconomic Impacts of not meeting Needs

See Costs above and Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Strategy	**Irrigation Conservation – Crop conversion from rice (to milo)**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation – 50,285 acre-feet
Supply Quantity	7,000 acre-feet per year
Water Source	Conservation
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	Total project costs $3,199,000. Unit cost of $61. Capital costs were determined based on assumptions for new farming equipment to be purchased, including sprinkler irrigation equipment. Additional project costs were assumed to incorporate the learning curve for growing a new crop as well incorporating the lower revenue from milo while carrying the debt load from rice.

This strategy was not recommended, so impacts have not been quantified:

Environmental Impacts

Reduced streamflow from irrigation return flows. May minimally reduce habitat for migratory birds.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced.

Impacts on Threats to Agriculture and other Natural Resources of the State

Reduces demand for irrigation water while supporting agriculture. Farmers will not likely convert if there is not an economic benefit. Strategy assumes a relatively small amount of acreage conversion (2,000 acres) so impacts to other natural resources should be minimal.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**Irrigation Conservation – Sprinkler Irrigation**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation – 50,285 acre-feet
Supply Quantity	2,617 acre-feet per year
Water Source	Conservation
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	$94. Total project cost is $1.85 million. Cost assumes 10% of rice irrigation acres would be converted to Low Energy Precision Application (LEPA) sprinkler irrigation.

This strategy was not recommended, so impacts have not been quantified:

Environmental Impacts

Reduced streamflow from irrigation return flows. May reduce habitat for migratory birds.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced.

Impacts on Threats to Agriculture and other Natural Resources of the State

Reduces demand for irrigation water while supporting agriculture. Strategy assumes a relatively small amount of acreage conversion, so impacts to other natural resources should be minimal.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Strategy	**Irrigation Conservation – On-farm Conservation**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation – 50,285 acre-feet
Supply Quantity	41,338 acre-feet per year
Water Source	Conservation
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	$76. Total project cost is $23.7 million. Cost includes capital costs for land leveling, multiple inlets, replacing irrigation ditches with pipelines, and moisture meters. Assumes 50% of unimproved land will be improved for land leveling, multiple inlets, and irrigation pipelines. Assumes 25% of non-rice acreage will be improved with moisture meters. The capital costs shown are associated with the full demand reduction volume listed.

Environmental Impacts

Overall, conservation would reduce the volume of return flows by half that contribute to the health of streams in LRWPA during dry conditions. May reduce habitat for migratory birds.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced.

Impacts on Threats to Agriculture and other Natural Resources of the State

These strategies reduce agricultural demands by 41,338 ac-ft/yr, bringing their demands closer to the amount of available water in the county. Costs would be the other impact. Cost savings of approximately $44 per ac-ft from reduced pumping would occur, but costs to implement the conservation measures would be approximately $76 per ac-ft.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**Irrigation Conservation – Tail water Recovery**
Identified WUG/WWP	Wharton County Irrigation
Shortage Amount	Wharton County Irrigation – 50,285 acre-feet
Supply Quantity	8,429 acre-feet per year
Water Source	Conservation
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	$423. Total project cost is $25.8 million. Cost includes capital costs for creating small on-farm reservoirs to collect a portion of the field return flows for reuse. The capital costs shown are associated with the full demand reduction volume listed.

Environmental Impacts

Overall, conservation would reduce the volume of return flows by half that contribute to the health of streams in LRWPA during dry conditions. May reduce habitat for migratory birds.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced.

Impacts on Threats to Agriculture and other Natural Resources of the State

These strategies reduce agricultural demands by 8,429 ac-ft/yr, bringing their demands closer to the amount of available water in the county. Costs would be the other impact. Cost savings of approximately $44 per ac-ft from reduced pumping would occur, but costs to implement the conservation measures could be as high as $423 per ac-ft.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**Lavaca River Off-Channel Reservoir**
Identified WUG/WWP	LNRA
Shortage Amount	Region L Manufacturing – 10,000 AF Other potential existing and future customers of LNRA within Region P
Supply Quantity	Project firm yield is 16,963 AFY. Project yield based on 25,000 acre-feet of off-channel storage and 200 MGD diversion capacity on the Lavaca River. New TCEQ environmental flow standards are met.
Water Source	Lavaca River
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	Project cost is $177,485,000, with unit cost of $867. Capital costs taken from 2011 Study and updated to September 2013 $. TWDB Costing tool used to calculate other associated costs. Facilities would include approximately 25,000 acre-feet of off-channel storage, a 200 MGD raw water intake and pump station on the Lavaca River, a 10 MGD raw water delivery pump station at the off –channel reservoir, and associated pipelines and appurtenances to pump water from the Lavaca River and deliver to the East and West Pump Stations at Palmetto Bend Reservoir.

Environmental Impacts

Approximately 1,200 acres of agricultural land would be inundated to accommodate the 25,000 acre-feet of off-channel reservoir. However, the new reservoir would also provide some additional habitat to the area. A schedule for freshwater releases will be established during permitting of the project. New TCEQ environmental flow standards are met.

Impacts on other Water Resources of the State

Stress on the groundwater in the area would be reduced. The freshwater release schedule, to be established during permitting, will minimize impacts to other water resources.

Impacts on Threats to Agriculture and other Natural Resources of the State

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 1,200 acres of agricultural land from production but would have minimal influence given the large quantity of agricultural land in the area. The construction of an off-channel reservoir will provide wildlife habitat. See Chapter 1 for list of rare, threatened, and endangered species in the region.

Socioeconomic Impacts of not meeting Needs

See Costs above and Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies

Strategy	**Drought Management**
Identified WUG/WWP	Wharton County Irrigation (Not recommended), Jackson County Manufacturing, Edna, Ganado, Hallettsville, Moulton, Shiner, Yoakum, El Campo
Shortage Amount	Wharton County Irrigation (Colorado-Lavaca Basin) – 12,779 AF Wharton County Irrigation (Lavaca Basin) – 37,506 AF Jackson Manufacturing, Edna, Ganado, Hallettsville, Moulton, Shiner, Yoakum, El Campo – 0 AF
Supply Quantity	For irrigation, strategy assumes that only a first rice crop would be grown, with no ratoon crop. Wharton County Irrigation (Colorado-Lavaca Basin) – 3,368 AF water savings Wharton County Irrigation (Lavaca Basin) – 19,927 AF water savings For manufacturing and municipalities, strategy assumes entity would follow drought contingency plans and reduce demands. Potential water savings: Jackson Manufacturing (41 AF), Edna (33 AF), Ganado (54 AF), Hallettsville (46 AF), Moulton (37 AF), Shiner (49 AF), Yoakum (19 AF) El Campo (95 AF)
Water Source	Drought Management
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	Project costs are $286/AF for Irrigation. The Socioeconomic Analysis of Unmet Needs from the 2011 Lavaca Region Water Plan was used to develop the costs to the irrigators of not being able to grow a second crop, updated to September 2013 $. Costs for Jackson County Manufacturing are $2,443/AF. Since the Lavaca Region had no manufacturing needs in the 2011 Plan, the Socioeconomic Analysis of Unmet Needs in Wharton County from the 2011 Region K Water Plan was used to develop the costs to Manufacturing, updated to September 2013 $. Costs for municipalities were assumed at $100/AF, based on assumed effort for public outreach and enforcement.

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 Irrigation would have negative impacts to agriculture and the local economies. Drought Management for municipalities would have negligible impact to the amount of water available to meet Irrigation needs in Wharton County.

Socioeconomic Impacts of not meeting Needs

See Costs above and Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy **LNRA Desalination**

Identified WUG/WWP LNRA

Shortage Amount Potential existing and future customers of LNRA within Region P

Supply Quantity Project firm yield is 6,452 AFY. Project yield based on groundwater shown to be available under the MAG in Jackson County, Lavaca Basin, and brackish surface water.

Water Source Gulf Coast Aquifer; Brackish Surface Water

Quality Improved water quality, from brackish to fresh-quality.

Reliability 100 percent

Cost ($/acre-foot) Project cost is $44,252,000, with unit cost of $1,369. Currently, brackish groundwater is considered the same as fresh groundwater under the MAG, but unit costs could decrease if the law changed. Capital costs were developed using the TWDB Costing Tool. Facilities would include three 1,000 gpm wells and well transmission piping, an 11.5 MGD (peak) brackish desalination water treatment plant, approximately five miles of transmission pipeline and appurtenances, approximately four miles of concentration discharge piping and appurtenances, finished water pump stations, and a concentrate pump station.

Environmental Impacts
LNRA customers are currently surface water users, so the increased use from groundwater would increase return flows to the streams. Up to 3,226 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 disposing the brine in Lavaca Bay.

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.

Socioeconomic Impacts of not meeting Needs
See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

Lavaca Regional Water Planning Area
Potential Management Strategies for Meeting Shortages

Strategy	**LNRA Aquifer Storage and Recovery**
Identified WUG/WWP	LNRA
Shortage Amount	Potential existing and future customers of LNRA within Region P
Supply Quantity	Project firm yield is 14,163 AFY. Project yield based on available excess flows from Lavaca River, averaged over period of record, while meeting the TCEQ environmental flow standards.
Water Source	Lavaca River
Quality	No change in treated water quality to end user
Reliability	100 percent
Cost ($/acre-foot)	Project cost is $181,928,000, with unit cost of $1,641. Capital costs developed using 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, 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.

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.

Socioeconomic Impacts of not meeting Needs

See Appendix 6A of Final Adopted 2016 Lavaca Regional Water Plan

APPENDIX 5C

Recommended Water Management Strategies for Meeting Irrigation Needs

							Recommended Water Management Strategies (ac-ft/yr)					
WUG Name	County	River Basin	Water Management Strategy Name	Region of Source	Source County Name	Source Name	2020	2030	2040	2050	2060	2070
Shortage/Surplus							(12,779)	(12,779)	(12,779)	(12,779)	(12,779)	(12,779)
IRRIGATION	WHARTON	COLORADO-LAVACA	Conservation (On-Farm, including land-leveling, multipe inlets, moisture meters, and irrigation pipeline)				11,000	11,000	11,000	11,000	11,000	11,000
IRRIGATION	WHARTON	COLORADO-LAVACA	Conservation (Tail Water Recovery)				1,779	1,779	1,779	1,779	1,779	1,779
Remaining Surplus/Shortage							0	0	0	0	0	0
Shortage/Surplus							(37,506)	(37,506)	(37,506)	(37,506)	(37,506)	(37,506)
IRRIGATION	WHARTON	LAVACA	Conservation (On-Farm, including land-leveling, multipe inlets, moisture meters, and irrigation pipeline)				30,338	30,338	30,338	30,338	30,338	30,338
IRRIGATION	WHARTON	LAVACA	Conservation (Tail Water Recovery)				6,650	6,650	6,650	6,650	6,650	6,650
IRRIGATION	WHARTON	LAVACA	Lane City Reservoir (firmed up Garwood WR)	K	Colorado	Colorado ROR	12,000	12,000	12,000	12,000	12,000	12,000
Remaining Surplus/Shortage							**11,482**	**11,482**	**11,482**	**11,482**	**11,482**	**11,482**

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APPENDIX 5D

Water Management Strategy Cost Tables

Cost Estimate Summary
Water Supply Project Option
41518 Prices
El Campo - Water Reuse

Cost based on ENR CCI 9552 for 41518 and a PPI of 187 for 41518

Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (0 MGD)	$1,083,000
Transmission Pipeline (0 in dia., 5 miles)	$882,000
Transmission Pump Station(s) & Storage Tank(s)	$997,000
Well Fields (Wells, Pumps, and Piping)	$0
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$310,000
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$3,272,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,101,000
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)	$158,000
TOTAL COST OF PROJECT	**$4,664,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$390,000
Reservoir Debt Service (5.5 percent, 40 years)	$0
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$58,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant (2.5% of Cost of Facilities)	$0
Pumping Energy Costs (596317 kW-hr @ 0.09 $/kW-hr)	$54,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$502,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 2	560
Annual Cost of Water ($ per acft)	$896
Annual Cost of Water ($ per 1,000 gallons)	$2.75

Note: One or more cost element has been calculated externally

Jaime Burke *2/20/2015*

Cost Estimate Summary *Water Supply Project Option* *41518 Prices* *Various / LNRA - Lavaca OCR*	
Cost based on ENR CCI 9552 for 41518 and a PPI of 187 for 41518	
Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$63,002,000
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (0 MGD)	$21,454,000
Transmission Pipeline (0 in dia., 10 miles)	$33,088,000
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$0
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Integration, Relocations, & Other	$5,669,000
TOTAL COST OF FACILITIES	**$123,213,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$41,470,000
Environmental & Archaeology Studies and Mitigation	$3,523,000
Land Acquisition and Surveying (0 acres)	$3,276,000
Interest During Construction (4% for 1 years with a 1% ROI)	$6,003,000
TOTAL COST OF PROJECT	**$177,485,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$6,918,000
Reservoir Debt Service (5.5 percent, 40 years)	$5,909,000
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$867,000
Dam and Reservoir (1.5% of Cost of Facilities)	$945,000
Water Treatment Plant (2.5% of Cost of Facilities)	$0
Pumping Energy Costs (727187 kW-hr @ 0.09 $/kW-hr)	$65,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$14,704,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	16,963
Annual Cost of Water ($ per acft)	$867
Annual Cost of Water ($ per 1,000 gallons)	$2.66
Note: One or more cost element has been calculated externally	
Joan Portillo	*10/31/2014*

Cost Estimate Summary
Water Supply Project Option
41518 Prices
LNRA - LNRA Aquifer Storage and Recovery

Cost based on ENR CCI 9552 for 41518 and
a PPI of 187 for 41518

Item	Estimated Costs for Facilities
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (66.9 MGD)	$11,961,000
Transmission Pipeline (60 in dia., 22 miles)	$31,076,000
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$10,311,000
Storage Tanks (Other Than at Booster Pump Stations)	$18,184,000
Water Treatment Plant (20 MGD)	$58,637,000
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$130,169,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$44,005,000
Environmental & Archaeology Studies and Mitigation	$871,000
Land Acquisition and Surveying (132 acres)	$709,000
Interest During Construction (4% for 1 years with a 1% ROI)	$6,152,000
TOTAL COST OF PROJECT	**$181,906,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$15,222,000
Reservoir Debt Service (5.5 percent, 40 years)	$0
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$895,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant (2.5% of Cost of Facilities)	$5,864,000
Pumping Energy Costs (13937442 kW-hr @ 0.09 $/kW-hr)	$1,254,000
Purchase of Water (14163 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$23,235,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 2	14,163
Annual Cost of Water ($ per acft)	$1,641
Annual Cost of Water ($ per 1,000 gallons)	$5.03

CW *4/6/2015*

Cost Estimate Summary
Water Supply Project Option
41518 Prices
Lavaca-Navidad River Authority - LNRA Desalination

Cost based on ENR CCI 9552 for 41518 and
a PPI of 187 for 41518

Item	***Estimated Costs for Facilities***
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (5.8 MGD)	$2,774,000
Transmission Pipeline (18 in dia., 3 miles)	$1,245,000
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$3,127,000
Storage Tanks (Other Than at Booster Pump Stations)	$699,000
Two Water Treatment Plants (5.4 MGD and 2.9 MGD)	$23,548,000
Integration, Relocations, & Other	$0
TOTAL COST OF FACILITIES	**$31,393,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$10,925,000
Environmental & Archaeology Studies and Mitigation	$262,000
Land Acquisition and Surveying (36 acres)	$175,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,497,000
TOTAL COST OF PROJECT	**$44,252,000**
ANNUAL COST	
Debt Service (5.5 percent, 20 years)	$3,703,000
Reservoir Debt Service (5.5 percent, 40 years)	$0
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$120,000
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant (2.5% of Cost of Facilities)	$4,710,000
Pumping Energy Costs (3332813 kW-hr @ 0.09 $/kW-hr)	$300,000
Purchase of Water (6452 acft/yr @ 0 $/acft)	$0
TOTAL ANNUAL COST	**$8,833,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 2	6,452
Annual Cost of Water ($ per acft)	$1,369
Annual Cost of Water ($ per 1,000 gallons)	$4.20

CW *4/6/2015*

Cost Estimate Summary
Water Supply Project Option
41518 Prices
Irrigation, Wharton County - On-Farm Conservation

Cost based on ENR CCI 9552 for 41518 and
a PPI of 187 for 41518

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (0 MGD)	$0
Transmission Pipeline (0 in dia., 0 miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$0
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Integration, Relocations, & Other	$20,833,000
TOTAL COST OF FACILITIES	**$20,833,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (10% for pipes & 10% for all other facilities)	$2,083,000
Environmental & Archaeology Studies and Mitigation	$0
Land Acquisition and Surveying (0 acres)	$0
Interest During Construction (4% for 1 years with a 1% ROI)	$803,000
TOTAL COST OF PROJECT	**$23,719,000**
ANNUAL COST	
Debt Service (5.5 percent, 10 years)	$3,147,000
Reservoir Debt Service (5.5 percent, 40 years)	$0
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant (2.5% of Cost of Facilities)	$0
Pumping Energy Costs (0 kW-hr @ 0.09 $/kW-hr)	$0
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,147,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	41,338
Annual Cost of Water ($ per acft)	$76
Annual Cost of Water ($ per 1,000 gallons)	$0.23

Note: One or more cost element has been calculated externally

Jaime Burke *4/6/2015*

Cost Estimate Summary
Water Supply Project Option
41518 Prices
Irrigation, Wharton County - Conservation - Tailwater Recovery

Cost based on ENR CCI 9552 for 41518 and
a PPI of 187 for 41518

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Dam and Reservoir (Conservation Pool acft, acres)	$0
Off-Channel Storage/Ring Dike (Conservation Pool acft, acres)	$0
Terminal Storage (Conservation Pool acft, acres)	$0
Intake Pump Stations (0 MGD)	$0
Transmission Pipeline (0 in dia., 3 miles)	$0
Transmission Pump Station(s) & Storage Tank(s)	$0
Well Fields (Wells, Pumps, and Piping)	$0
Storage Tanks (Other Than at Booster Pump Stations)	$0
Water Treatment Plant (0 MGD)	$0
Integration, Relocations, & Other	$22,561,000
TOTAL COST OF FACILITIES	**$22,561,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (10% for pipes & 10% for all other facilities)	$2,256,000
Environmental & Archaeology Studies and Mitigation	$71,000
Land Acquisition and Surveying (5 acres)	$0
Interest During Construction (4% for 1 years with a 1% ROI)	$872,000
TOTAL COST OF PROJECT	**$25,760,000**
ANNUAL COST	
Debt Service (5.5 percent, 10 years)	$3,418,000
Reservoir Debt Service (5.5 percent, 40 years)	$0
Operation and Maintenance	
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$0
Dam and Reservoir (1.5% of Cost of Facilities)	$0
Water Treatment Plant (2.5% of Cost of Facilities)	$0
Pumping Energy Costs (1617031 kW-hr @ 0.09 $/kW-hr)	$146,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$3,564,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	8,429
Annual Cost of Water ($ per acft)	$423
Annual Cost of Water ($ per 1,000 gallons)	$1.30

Note: One or more cost element has been calculated externally

Jaime Burke *4/6/2015*

APPENDIX 5E

TWDB DB17 Reports

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	518	518	518	518	518	518

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

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Water User Group (WUG) Second-Tier Identified Water Need

REGION P	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
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
LAVACA-GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LAVACA COUNTY						
GUADALUPE BASIN						
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
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-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
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
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION P	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
WHARTON COUNTY						
LAVACA BASIN						
EL CAMPO	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	518	518	518	518	518	518

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

Water User Group (WUG) Unmet Needs Summary

REGION P

	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
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

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

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Water User Group (WUG) Unmet Needs

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

*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.

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
EDNA	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	33	33	33	33	33	33	$100	$100
EL CAMPO	K	DROUGHT MANAGEMENT	DEMAND REDUCTION	1	1	1	1	1	1	$50	$50
EL CAMPO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	86	87	89	91	93	95	$100	$100
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	DEMAND REDUCTION	109	170	237	333	329	336	$347	$347
EL CAMPO - UNASSIGNED WATER VOLUMES	P	DIRECT REUSE - EL CAMPO	P | DIRECT REUSE	560	560	560	560	560	560	$896	$896
GANADO	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	54	54	53	53	53	54	$100	$100
HALLETTSVILLE	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	46	45	44	44	43	43	$100	$100
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	DEMAND REDUCTION	31	49	66	89	111	134	$334	$334
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	AQUIFER STORAGE AND RECOVERY	P | GULF COAST AQUIFER ASR FRESH/BRACKISH | JACKSON COUNTY	14,163	14,163	14,163	14,163	14,163	14,163	$1641	$1641
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LAVACA OFF-CHANNEL RESERVOIR	P | LAVACA RIVER OFF-CHANNEL LAKE/RESERVOIR	6,963	6,963	6,963	6,963	6,963	6,963	$867	$867
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH GROUNDWATER	P | GULF COAST AQUIFER | JACKSON COUNTY	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
LAVACA NAVIDAD RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	P	LNRA DESALINATION - BRACKISH SURFACE WATER	P | NAVIDAD RIVER TIDAL FRESH/BRACKISH	3,226	3,226	3,226	3,226	3,226	3,226	$1369	$1369
MOULTON	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	37	36	35	35	35	35	$100	$100
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	DEMAND REDUCTION	9	13	18	25	31	38	$355	$355
SHINER	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	49	48	47	46	46	46	$100	$100
SHINER	P	MUNICIPAL CONSERVATION - SHINER	DEMAND REDUCTION	23	37	49	65	86	104	$342	$342
YOAKUM	L	MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION	42	51	26	7	56	64	$0	$0
YOAKUM	P	DROUGHT MANAGEMENT	DEMAND REDUCTION	19	18	18	18	15	15	$100	$100
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	DEMAND REDUCTION	37	54	74	95	33	62	$357	$357
Region P Total RecommendedWMS Supplies				28,714	28,834	28,928	29,073	29,103	29,198		

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Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
EL CAMPO	N	MUNICIPAL CONSERVATION - EL CAMPO	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$243,652	2020
EL CAMPO	N	REUSE	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; WATER TREATMENT PLANT EXPANSION	$3,272,000	2020
HALLETTSVILLE	N	MUNICIPAL CONSERVATION - HALLETTSVILLE	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$62,313	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - ON FARM	ON FARM IRRIGATION CONSERVATION	$20,833,000	2020
IRRIGATION, WHARTON	N	IRRIGATION CONSERVATION - TAILWATER RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; PUMP STATION; RESERVOIR CONSTRUCTION	$22,561,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	AQUIFER STORAGE AND RECOVERY	CONVEYANCE/TRANSMISSION PIPELINE; DIVERSION AND CONTROL STRUCTURE; INJECTION WELL; MULTIPLE WELLS/WELL FIELD; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$130,169,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020
LAVACA NAVIDAD RIVER AUTHORITY	Y	LNRA DESALINATION	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD; NEW SURFACE WATER INTAKE; NEW WATER RIGHT/PERMIT; NEW WATER TREATMENT PLANT; PUMP STATION; STORAGE TANK	$31,393,000	2020
MOULTON	N	MUNICIPAL CONSERVATION - MOULTON	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$20,750	2020
SHINER	N	MUNICIPAL CONSERVATION - SHINER	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$50,357	2020
YOAKUM	N	MUNICIPAL CONSERVATION - YOAKUM	METER REPLACEMENT; MUNICIPAL CONSERVATION CAPITAL COST (DOES NOT INCLUDE METER REPLACEMENT OR WATER LOSS); WATER LOSS CONTROL	$85,984	2020

Region P Total Recommended Capital Cost	**$331,904,056**

***Projects with a capital cost of zero are excluded from the report list.**

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

WUG Entity Primary Region: P

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
			Region P Total Alternative WMS Supplies								

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Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: P

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
LAVACA NAVIDAD RIVER AUTHORITY	Y	LAVACA OFF-CHANNEL RESERVOIR – ALTERNATIVE SITE	CONVEYANCE/TRANSMISSION PIPELINE; NEW SURFACE WATER INTAKE; RESERVOIR CONSTRUCTION	$123,213,000	2020

Region P Total Alternative Capital Cost	**$123,213,000**

***Projects with a capital cost of zero are excluded from the report list.**

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Water User Group (WUG) Management Supply Factor

REGION P	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, JACKSON	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, LAVACA	1.0	1.0	1.1	1.1	1.1	1.1
EDNA	1.0	1.0	1.0	1.0	1.0	1.0
EL CAMPO	1.2	1.2	1.2	1.2	1.2	1.2
GANADO	1.2	1.2	1.2	1.2	1.2	1.2
HALLETTSVILLE	1.1	1.2	1.2	1.3	1.3	1.4
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
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	1.5	1.5	1.4	1.4	1.3	1.2
MANUFACTURING, LAVACA	1.4	1.3	1.2	1.2	1.1	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
MOULTON	1.3	1.3	1.3	1.4	1.4	1.5
SHINER	1.1	1.2	1.2	1.3	1.3	1.4
YOAKUM	1.1	1.1	1.1	1.1	1.3	1.3

*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.

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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 2/24/03 Input for Run 3
** Run 3: full diversion amounts, authorized area capacity, no term permits, and one-hundred percent reuse
FO     0       0       0       0       0       0       0
JD    57    1940       1      -1      -1               4
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
**
** AECOM entered use coefficients to meet Base Dry B&E requirements
******************use coefficients for OCR*********************************
**
UCMEDIAN    1960   18360   18360   18360   18360    1960
UC          1960   13056   13056   13056    1960    1960
**
********************************************************************************
** 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
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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
CP DV301	GS300	7	GS300	-1
CP GS300	DV214	1		
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		
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

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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
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
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
CPEDV712  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
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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*********************************
**
CP WQ002    20955                    5          GS300    -2
CP 20955   WQ002A                    5          GS300    -2
CPNEWOCR     OUT                     2    NONE  GS300    -3
CPWQ002A   WQ002B                    5           NONE    -2
CPWQ002B   WQ002C                    5           NONE    -2
CPWQ002C   WQ002D                    5           NONE    -2
CPWQ002D    DV212                    5           NONE    -2
**
**
**** AECOM entered control points for ASR diversion
**
**
CPDVASR1    20956                    5          GS300    -2
CP 20956   WQ001A                    5          GS300    -2
CPNEWASR     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
** 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
**
** Water Right Input
** 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
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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
**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
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
**this water right was modified to reflect diversion from the upstream control point
** to the reservoir with a backup diversion from the downstream control point
WRTDV333      33       319610228   1   1    0.00                           2096_1
WS OS332    12.0    1.00   0.727    0.00
SO                           DV332
IF DV301    8688        19830103       1
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
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
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
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
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
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
WRWDV816     140       319811116   1   1    0.00                         11603906
WSWOS816    20.0    1.00   0.727    0.00
IFWDV815  1269.3   IF81519811116       1
WRWDV815      60       319811116   1   1    0.00                         11603904
IFWDV814   956.1   IF81419811116       1
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
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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
WR DV503       57          319830222   1   1    0.00    RF502        3     11604102
SO                                                                   1
IFWDV807   4413.3    IF80719850430         1
WR424141   272.63          319850430   1   1    0.00   WRF805        3     11604241
WSWS0806     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
WRWDV803      211          319790129   1   1    0.00                       11603665
WRWDV868      990          319450330   1   1    0.00                       61602092
IFWDV865    724.0           19800121       1
WRWDV865      420          319800121   1   1    0.00   WRF866              11603725
IFWDV862    724.0           19810518       1
IFWDV871      362           19810518       1
**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
SO                             WDV871
** this water right has been modified to allow diversions from the reservoir backed up by diversions
** from CPWDV855
IFWDV853    362.0           19811207       1
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
WRWDV843      550          319810526   1   1    0.00   WRF844                3836_1
WRWDV801     1750          319640731   1   1    0.00                       61602093
IFEDV726   3403.0           19811116       1
WR390941      350          319811116   1   1    0.00   ERF728              11603909
WSWS0727     45.0     1.00    0.727     0.00
SO          148.8      350   EDV726
IFEDV723   2896.0           19800121       1
WREDV723      913          319800121   1   1    0.00   ERF722              11603727
IFEDV721   3620.0           19811116       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
WREDV731      520          319811116   1   1    0.00                         3907_2
WSEOS732      1.5     1.00    0.727     0.00
IFEDV712   1448.0           19811116       1
WREDV712      800          319811116   1   1    0.00   ERF711              11603903
**
** Start Lake Texana (Navidad River)(no assumed return flows for Texana in BR's run1)
** wr for basic texana right.
** IF for B&E from Texana follows.(IF's have to be @ dif CP's, both DS of Texana, to keep from being overwriten)
IFDV221B     3570           19720515       1       1           IF2
IFDV221A   346972   BAYEST19720515         1       2           IF1
** ws for Texana @ 43 ft msl (total is 170300 - 151919 @ 43msl per TWDB 8/2000 revised survey)
** reservoir crippled to impound @ 43 msl with these old priority dates. First divert firm water
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
WSTEXANA   170300
**refill done
**begin inturupt
**
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 entered instream flow requirements meeting SB3 Base Dry B&E prior to subordinate Stage II diversions
**
IF 20955   122408   MEDIAN20170101         1              IFMETESTON
WR 20955     12.0           20170101   1   1     1.0    20955                METEST     OCR
IF 20955        0   MEDIAN20170101         1              IFMETESTOF
**
IF 20955   122408   MEDIAN20170101         1              MEDIAN-REG
```

```
TO     6             LIM     0.1    10.0                                 METEST
**AECOM modifies Stage II project to be subordinate to Lavaca OCR
**Change priority date from 19720515 to 20170102 (two days junior to OCR, one day junior to B&E)
**Bay and Estuary flows (2095_5) subordinate to CCEFN flows. Change PD from 19931006 to 20170102
**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  BAYES120170102   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 add SB3 Base Dry B&E requirements as instream flows for OCR
**
**use dummy water rights to check if diversions can be made under Base Dry B&E requirements.
**Return flows diverted by dummy rights to same control point from which diverted to preserve
**mass balance.
**
IFWQ002A  122408  MEDIAN20161231        1              IFMETESTON
WRWQ002A    12.0        20161231   1   1      1.0  WQ002A                     METEST     OCR
IFWQ002A       0  MEDIAN20161231        1              IFMETESTOF
**
**Utilize diversions made by dummy water rights to set the appropriate instream flow
**requirement for Base Dry B&E requirements.  Since WRAP mdoel protects downstream
**water rights, IF requirement to protect ds senior wr is unnecessary and commented out.
**
**Base Dry IF
IFWQ002D  122408  MEDIAN20161231        1              MEDIAN-REG
TO     6             LIM     0.1    10.0                                 METEST
***************************************************************************
**
**
*********************************************************************************
**AECOM diversion for Lavaca OCR (using storage/pumping recommended in 2011 Lavaca River Water Supply
**Project Feasibility Study for LNRA)
**
WR WQ002       0        120161231   1   1                                       Fill  NEWOCR
** 25,000 ac-ft capacity
WSNEWOCR    25000  0.0024       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
WR WQ002 25000.0        120161231   3   1                                     NewWR1     9991
WSNEWOCR    25000
**end of diversion additions
*****************************************************************************************
**
**
*******************************************************************************************
**AECOM add SB3 Base Dry B&E requirements as instream flows for ASR DIVERSION
**
**use dummy water rights to check if diversions can be made under Base Dry B&E requirements.
**Return flows diverted by dummy rights to same control point from which diverted to preserve
**mass balance.
**
IFWQ001A  122408  MEDIAN20170101        1              IFMETESTON
WRWQ001A    12.0        20170101   1   1      1.0  WQ001                      METEST     ASR
IFWQ001A       0  MEDIAN20161231        1              IFMETESTOF
**
**Utilize diversions made by dummy water rights to set the appropriate instream flow
**requirement for Base Dry B&E requirements.  Since WRAP model protects downstream
**water rights, IF requirement to protect ds senior wr is unnecessary and commented out.
**
**Base Dry IF
IFWQ001D  122408  MEDIAN20170101        1              MEDIAN-REG
TO     6             LIM     0.1    10.0                                 METEST
***************************************************************************
**
**
*********************************************************************************
**AECOM diversion for LNRA ASR
**
**
**WRDVASR1       0        120170101   1   1                                       Fill  NEWASR
WRDVASR1   25000        120170101   1   1                                     NewWR2
** 25,000 ac-ft capacity
```

```
**WSNEWASR   25000  0.0024       1  969.85
**SO                        DVASR1
** 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
**WRDVASR1 25000.0        120170101   3  1                                   NewWR2    9992
**WSNEWASR   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  45      44      43      39      36      30      24      18      13      10       0   -13.3
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
**
*********************************************************************************************************
** 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
** AECOM commented out
**SVSTAGE2   62454   57676   40543   23475   11695    4980    1819     596     152       0
**SA          4887    4679    3888    2940    1774     914     352     138      40       0
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 2/24/03 Input for Run 3
** Run 3: full diversion amounts, authorized area capacity, no term permits, and one-hundred percent reuse
FO    0       0       0       0       0       0       0
JD   57    1940       1      -1      -1               4
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
**
** AECOM entered use coefficients to meet Base Dry B&E requirements
******************use coefficients for OCR*********************************
**
UCMEDIAN     1960   18360   18360   18360   18360    1960
UC           1960   13056   13056   13056    1960    1960
**
********************************************************************************
** 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
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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
CP DV301   GS300          7        GS300     -1
CP GS300   DV214          1
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
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
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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
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
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
CPEDV712  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
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**********************************
**
CP WQ002   20955                              5            GS300       -2
CP 20955  WQ002A                              5            GS300       -2
CPNEWOCR     OUT                              2     NONE   GS300       -3
CPWQ002A  WQ002B                              5             NONE       -2
CPWQ002B  WQ002C                              5             NONE       -2
CPWQ002C  WQ002D                              5             NONE       -2
CPWQ002D   DV212                              5             NONE       -2
**
**
**** AECOM entered control points for BSW diversion
**
**
CPDVBSW1   20956                              7            GS300       -2
CP 20956  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
** 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
**
** Water Right Input
** 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
**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
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
**this water right was modified to reflect diversion from the upstream control point
** to the reservoir with a backup diversion from the downstream control point
WRTDV333      33       319610228   1   1    0.00                           2096_1
WS OS332    12.0    1.00   0.727    0.00
SO                        DV332
IF DV301    8688        19830103        1
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
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
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
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
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
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
WRWDV816     140       319811116   1   1    0.00                         11603906
WSWOS816    20.0    1.00   0.727    0.00
IFWDV815  1269.3   IF81519811116        1
WRWDV815      60       319811116   1   1    0.00                         11603904
IFWDV814   956.1   IF81419811116        1
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
WR DV503       57        319830222   1   1    0.00    RF502        3           11604102
SO                                                                 1
IFWDV807   4413.3    IF80719850430       1
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
WRWDV803      211        319790129   1   1    0.00                             11603665
WRWDV868      990        319450330   1   1    0.00                             61602092
IFWDV865    724.0         19800121       1
WRWDV865      420        319800121   1   1    0.00   WRF866                    11603725
IFWDV862    724.0         19810518       1
IFWDV871      362         19810518       1
**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
SO                          WDV871
** this water right has been modified to allow diversions from the reservoir backed up by diversions
** from CPWDV855
IFWDV853    362.0         19811207       1
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
WRWDV843      550        319810526   1   1    0.00   WRF844                      3836_1
WRWDV801     1750        319640731   1   1    0.00                             61602093
IFEDV726   3403.0         19811116       1
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
WREDV723      913        319800121   1   1    0.00   ERF722                    11603727
IFEDV721   3620.0         19811116       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
WREDV731      520        319811116   1   1    0.00                               3907_2
WSEOS732      1.5     1.00   0.727    0.00
IFEDV712   1448.0         19811116       1
WREDV712      800        319811116   1   1    0.00   ERF711                    11603903
**
** Start Lake Texana (Navidad River)(no assumed return flows for Texana in BR's run1)
** wr for basic texana right.
** IF for B&E from Texana follows.(IF's have to be @ dif CP's, both DS of Texana, to keep from being overwriten)
IFDV221B     3570         19720515       1       1            IF2
IFDV221A   346972   BAYEST19720515       1       2            IF1
** ws for Texana @ 43 ft msl (total is 170300 - 151919 @ 43msl per TWDB 8/2000 revised survey)
** reservoir crippled to impound @ 43 msl with these old priority dates. First divert firm water
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
WSTEXANA   170300
**refill done
**begin inturupt
**
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 entered instream flow requirements meeting SB3 Base Dry B&E prior to subordinate Stage II diversions
**
IF 20955   122408   MEDIAN20170101       1                IFMETESTON
WR 20955     12.0         20170101   1   1     1.0   20955                       METEST      OCR
IF 20955        0   MEDIAN20170101       1                IFMETESTOF
**
IF 20955   122408   MEDIAN20170101       1                MEDIAN-REG
```

```
TO     6              LIM     0.1    10.0                          METEST
**AECOM modifies Stage II project to be subordinate to Lavaca OCR
**Change priority date from 19720515 to 20170102 (two days junior to OCR, one day junior to B&E)
**Bay and Estuary flows (2095_5) subordinate to CCEFN flows. Change PD from 19931006 to 20170102
**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  BAYES120170102   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 add SB3 Base Dry B&E requirements as instream flows for OCR
**
**use dummy water rights to check if diversions can be made under Base Dry B&E requirements.
**Return flows diverted by dummy rights to same control point from which diverted to preserve
**mass balance.
**
IFWQ002A  122408  MEDIAN20161231       1              IFMETESTON
WRWQ002A    12.0        20161231   1   1     1.0  WQ002A                    METEST     OCR
IFWQ002A       0  MEDIAN20161231       1              IFMETESTOF
**
**Utilize diversions made by dummy water rights to set the appropriate instream flow
**requirement for Base Dry B&E requirements.  Since WRAP mdoel protects downstream
**water rights, IF requirement to protect ds senior wr is unnecessary and commented out.
**
**Base Dry IF
IFWQ002D  122408  MEDIAN20161231       1              MEDIAN-REG
TO     6              LIM     0.1    10.0                          METEST
**************************************************************************
**
**
********************************************************************************
**AECOM diversion for Lavaca OCR (using storage/pumping recommended in 2011 Lavaca River Water Supply
**Project Feasibility Study for LNRA)
**
WR WQ002       0        120161231   1   1                                Fill  NEWOCR
** 25,000 ac-ft capacity
WSNEWOCR   25000  0.0024       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
WR WQ002 25000.0        120161231   3   1                              NewWR1     9991
WSNEWOCR   25000
**end of diversion additions
****************************************************************************************
**
**
***************************************************************************************
**AECOM add SB3 Base Dry B&E requirements as instream flows for BSW DIVERSION
**
**use dummy water rights to check if diversions can be made under Base Dry B&E requirements.
**Return flows diverted by dummy rights to same control point from which diverted to preserve
**mass balance.
**
IFWQ001A  122408  MEDIAN20170101       1              IFMETESTON
WRWQ001A    12.0        20170101   1   1     1.0  WQ001                     METEST     BSW
IFWQ001A       0  MEDIAN20161231       1              IFMETESTOF
**
**Utilize diversions made by dummy water rights to set the appropriate instream flow
**requirement for Base Dry B&E requirements.  Since WRAP model protects downstream
**water rights, IF requirement to protect ds senior wr is unnecessary and commented out.
**
**Base Dry IF
IFWQ001D  122408  MEDIAN20170101       1              MEDIAN-REG
TO     6              LIM     0.1    10.0                          METEST
**************************************************************************
**
**
********************************************************************************
**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
** 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  45      44      43      39      36      30      24      18      13      10       0   -13.3
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
**
*****************************************************************************************************
** 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
** AECOM commented out
**SVSTAGE2   62454   57676   40543   23475   11695    4980    1819     596     152       0
**SA          4887    4679    3888    2940    1774     914     352     138      40       0
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
**
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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 LRWPG, representing all of Lavaca and Jackson Counties as well as the Precinct 3 and City of El Campo portions of Wharton County. LRWPG is one of 16 state water supply planning groups defined by TWDB. RWPs prepared by each 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 Regional Water Plan (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 are shown in the following tables. *Table 6-1* shows how often the SB3 environmental flow standards are met without any water management strategies. *Table 6-2* shows how often the SB3 environmental flow standards are met with the water management strategies included.

Table 6-1 SB3 Environmental Flow Standard Frequency Attainment – No Strategies

	Subsistence		Base Dry		Base Avg		Base Wet	
Onset Period	Count	%	Count	%	Count	%	Count	%
Springtime	51	89%	45	79%	38	67%	25	44%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	52	91%	45	79%	39	68%

Table 6-2 SB3 Environmental Flow Standard Frequency Attainment – With Strategies

Onset Period	Subsistence		Base Dry		Base Avg		Base Wet	
	Count	%	Count	%	Count	%	Count	%
Springtime	51	89%	45	79%	36	63%	24	42%
Fall	45	79%	32	56%	19	33%	16	28%
Intervening 6 mo	55	96%	50	88%	45	79%	38	67%

The two tables above show that while the flows continue to meet or exceed the SB3 environmental flow standards, the recommended strategies have some impacts to the volumes of water reaching Lavaca Bay under Base Dry, Base Average, and Base Wet conditions. Subsistence conditions are not impacted.

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 Desalination, and Aquifer Storage and Recovery. The effects of the recommended water management strategies on specific resources are discussed in further detail within this Section.

6.3.1 Agricultural

The LRWPA currently has nearly 97,000 acres of irrigated agricultural land that requires a projected 217,846 ac-ft/yr of water for irrigation under DOR conditions. This demand is expected to remain approximately constant through 2070. The majority of this water is used for growing rice and represents, by far, 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 strategies consisting of the Lane City Off-channel Reservoir and Expanded Use of the Gulf Coast Aquifer would increase the availability of water for irrigation purposes, which would reduce the threat to agriculture. These strategies would be the most favorable for agriculture. However, the Expanded Use of the Gulf Coast Aquifer strategy is currently not recommended due to MAG restrictions, but is included as an Alternative strategy in the RWP.

Although slightly less favorable but recommended by the LRWPG to meet irrigation needs are the water management strategies including Irrigation Conservation (On-farm) and Irrigation Conservation (Tail Water Recovery). On-farm conservation methods such as land leveling, moisture 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, Brackish Groundwater Desalination, and Aquifer Storage and Recovery would have minimal influence given the projects would remove a small portion of land for agricultural production relative to the large quantity of agricultural land in the area.

Drought Management for irrigation would have negative economic impacts to agriculture, and was therefore not recommended by the LRWPG; and Drought Management for municipalities would have very little positive impact to the amount of water available to meet irrigation needs in Wharton County.

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.

Appendix 6A includes a listing of current water right holders within the Region. Although most of these rights are not firm under DOR conditions, they provide an important source for irrigation water without the need for high amounts of lift that are required for pumping groundwater.

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 insufficient to meet the demands of irrigators under DOR conditions. 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 RWP. 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.

The only contracted surface water supply used within the LRWPA is a 1,032 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

As in the Colorado-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 RWP. 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. Approximately 42,000 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 an additional 32,500 ac-ft/yr. The manufacturing contract listed above in the Colorado-Lavaca River Basin is one of these contracts. The remaining water supply is reserved for use in maintaining bay and estuary flows.

The recommended Lavaca Off-Channel Reservoir, Aquifer Storage and Recovery, and LNRA Desalination strategies would all 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.

Aquifer Storage and Recovery is similar to the Lavaca Off-Channel Reservoir in that it would capture a portion of pulse flows that otherwise would have reached the bay.

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 2016 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 94% of the total water used in the Lavaca Region in Year 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 Lavaca Region 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 Lavaca Region, 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.

As noted previously, the impacts of moving water from rural and agricultural areas are primarily economic. *Section 6.6* contains the specific calculations of socio-economic impacts prepared by the TWDB for the Lavaca Region.

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 Region.

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 LRWPG management strategies in place.

For the Lavaca Region, the predominant water use is for agricultural purposes, with 95 percent of the water used for irrigation and livestock watering. The water for municipal and manufacturing use is approximately 4 percent of the total demand. In addition, the Gulf Coast Aquifer in this area currently has a sufficient amount of water in storage, and it is assumed that all of the municipal and manufacturing demands will be met because these users will be better able to drill deeper wells and accommodate the cost of increased pumping lifts to a much greater extent than will agricultural users.

Approximately 87 percent of the irrigation demand is used for growing rice. 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 Lavaca Region, 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. Of the key water parameters identified in the Lavaca Region, the TWDB includes records for pH, TDS, and chloride for groundwater. Irrigation, domestic, municipal, manufacturing, and livestock supplies are the main uses for water in the LRWP.

The most recent TWDB water chemistry results available are from 2005-2006. Some data are available for 2009 but are limited to specific conductance and pH measurements. Data from the TWDB show that the groundwater in the Lavaca Region continues to be of good quality and that the quality has not changed significantly throughout the years. For the constituents examined, recent data indicates average concentrations near or below the historical average. Recent data indicate TDS levels generally range from about 300 to 700 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 200 mg/L in wells sampled in 2005 and 2006. The TDS content of the water generally is in the range of 300 to 750 mg/L, but can be as much as 970 mg/L at a few locations in Jackson County.

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 Lavaca Region during the 1980s to the recent 2005 and 2006 TWDB water quality records do not indicate a change in the water quality. Available data for wells sampled in the 1980s and more recent years have water quality constituents with similar values with only slight differences noted. Samples taken from wells in 2005 or 2006 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 Lavaca Region of Wharton County show TDS that averaged about 495 mg/L in the period of the early 1980s and averaged about 539 mg/L for samples collected in 2005. The data show very little change in the overall mineralization of the water during a period of relatively intense irrigation and water use. The Chicot and Evangeline Aquifers provide a prolific water source within most of the Lavaca Region, and the Jasper Aquifer provides groundwater in the northern and central parts of Lavaca County. The aquifers should continue providing good quality groundwater for the pumping regime that is estimated to occur in future decades as water is utilized for irrigation, public supply, domestic, industrial, and livestock uses.

6.4.2 Conservation Impacts

While conservation strategies are recommended in this RWPG 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 in particular 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 a future option for farmers, by providing low-interest loans for funding conservation measures.

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 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, nearly all 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 (Municipalities Only)
- Irrigation Conservation (On-farm and Tail Water Recovery)
- Municipal Conservation
- Off-Channel Reservoir (Lane City Reservoir in Region K)
- Reuse of Municipal Effluent (El Campo)
- Lavaca Off-Channel Reservoir
- LNRA Desalination
- LNRA Aquifer Storage and Recovery

The following paragraphs discuss the impacts of each management strategy on the chosen water quality parameters.

Drought Management (Municipalities Only), would have little to no impact on other water sources of the State.

Irrigation and Municipal 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.

Lane City Reservoir (Region K) is recommended because it will increase water supplies in the Colorado Basin, and therefore make the supplies allocated for irrigation use in Garwood more reliable during times of drought. Supplies would not come directly from the reservoir, so there are no water quality impacts with this strategy for the Lavaca Region.

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.

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.

LNRA Desalination will provide a usable water supply with a level of dissolved solids low enough to be used for multi-use purposes. A significant side effect of this strategy is the disposal of wastes generated from the desalination process. A discharge permit would be required for disposing the brine in Lavaca Bay. LNRA customers are currently surface water users, so the increased use from groundwater would increase return flows to the streams.

LNRA Aquifer Storage and Recovery (ASR) utilizes surface water that is diverted from the Lavaca River and treated at a surface water treatment facility. The treated water would either be delivered to meet existing demands, or diverted to aquifer storage for later recovery and use. The diversion of surface water could reduce instream flows downstream, which in turn, could negatively impact water quality during certain months of the year when instream flows are already lower. Permitting would be required for ASR and diversion. Treatment of water prior to injection should prevent water quality issues.

6.5 Impacts of Water Management Strategies on Navigation

Due to the nature of the strategies recommended in the 2016 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.

6.6 Summary of Unmet Identified Water Needs

The 2016 Lavaca Regional Water Plan has identified water management strategies to meet all identified water needs. There are no unmet water needs in this plan. The following section provides a summary of an analysis performed by TWDB of the socioeconomic impacts if the water needs are not met.

6.6.1 Socioeconomic Impacts of Unmet Water Needs

For the 2016 Lavaca RWP, TWDB prepared the report *Socioeconomic Impacts of Projected Water Shortages for the 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.

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 DOR 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 2011 data using IMPLAN PRO™ distributed by the IMPLAN Group.

Additionally, methodology for socioeconomic impact analyses for the 2016 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 $9 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 236 agricultural jobs, a population reduction of 43 people, and a decline in school enrollment of 8 students.

APPENDIX 6A

Water Rights

Lavaca Regional Water Planning Area
TCEQ Active Water Rights - March 31, 2015

WRNo	WRType	Permit #	WR Issue Date	Amendment Letter	OwnerName	Owner Type Code	Diversion Amount (AFY)	Priority Date Month	Priority Date Day	Priority Date Year	Expiration	Acreage	Reservoir Name	Reservoir Capacity (AFY)	Site Name	Basin Number	WMCode	Region Code	County
1947	9		12/14/1993		CITY OF CORPUS CHRISTI TEXAS	2	41840				12/14/2035		LAKE TEXANA			16	ST	P	Jackson
2078	6		7/3/1981		M T SIMONS JR ET AL	4	1138	9	30	1903		300				16	ST	P	Jackson
2078	6		7/3/1981		M T SIMONS JR ET AL	4	450	12	10	1938		300				16	ST	P	Jackson
2084	6		7/3/1981		E I ROSE ESTATE	5	400	11	10	1950		200				16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	42518	5	15	1972			LAKE TEXANA	170300	STAGE 1, NAVIDAD RIVER	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	4000	5	24	1982			LAKE TEXANA		STAGE 1, NAVIDAD RIVER	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	32482	5	15	1972			LAKE TEXANA		STAGE 1, NAVIDAD RIVER	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2		5	15	1972			LAKE TEXANA		STAGE 1, NAVIDAD RIVER	16	ST	P	Jackson
2095	6		7/3/1981	D	LAVACA-NAVIDAD RIVER AUTHORITY	2	7500	7	1	2002			LAKE TEXANA			16	ST	P	Jackson
2095	6		7/3/1981	D	LAVACA-NAVIDAD RIVER AUTHORITY	2		7	1	2002			LAKE TEXANA			16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	7150	5	15	1972				93340	STAGE 2	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	22850	5	15	1972					STAGE 2	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2		5	15	1972					STAGE 2	16	ST	P	Jackson
2095	6		7/3/1981	C	LAVACA-NAVIDAD RIVER AUTHORITY	2	18122	10	6	1993					STAGE 2	16	ST	P	Jackson
2097	6		7/3/1981		GEBRUEDER VIEHOF FARMS OHG	2	95	11	17	1939		47.5				16	ST	P	Jackson
2098	6		7/3/1981	A	HARRISON STAFFORD II ET AL	4	452.5	11	17	1939		226.25				16	ST	P	Jackson
2098	6		7/3/1981	A	HARRISON STAFFORD II ET AL	4	747.5	11	22	1982		173.75				16	ST	P	Jackson
2099	6		7/3/1981		HARRISON STAFFORD ET AL	4	226.25	11	17	1939						16	ST	P	Jackson
2100	6		7/3/1981		HARRISON STAFFORD II ET AL	4	226.25	11	17	1939						16	ST	P	Jackson
2101	6		7/3/1981		FRANCIS KOOP	1	1000	11	28	1939		500				16	ST	P	Jackson
2102	6		7/3/1981		JOHNNIE E KOTLAR	1	10	6	30	1967		47				17	ST	P	Jackson
3827	1	4123	8/3/1981		ALBERT W & CLAUDIA SWENSON	1	100	5	11	1981		100				15		P	Jackson
3884	1	4192	6/18/1982	B	FORMOSA PLASTICS CORP	2	9000	3	1	1982		5900		1120		15		P	Jackson
3978	1	4296	5/19/1983		JAVALIN HOLDINGS LLC	2	1200	1	3	1983		266.67		480		16	ST	P	Jackson
3978	1	4296	5/19/1983		OWEN ENTERPRISES LLC1 ET AL	4	600	1	3	1983		133.33				16	ST	P	Jackson
4085	1	4353	3/14/1984	B	JOHN B LAY ET AL	4	500	4	18	1983		350				16	ST	P	Jackson
4791	6		1/20/1987		FORMOSA PLASTICS CORP	2	11035	12	20	1976		4874		900		15		P	Jackson
5120	1	5120	6/10/1987		T J BABB HEIRS REVOCABLE TRUST	5	2500	2	19	1987		500				17	ST	P	Jackson
5120	1	5120	6/10/1987		ROBERT MARTIN ET AL	4		2	19	1987						17	ST	P	Jackson
5487	1	5487	8/8/1994		BRIAN M SWENSON ET AL	4	35	5	20	1994		35	OFF-CHANNEL RESERVOIR	8		15		P	Jackson
5584	1	5584	10/27/1997		JACKSON COUNTY	2	1.52	4	24	1997						16	ST	P	Jackson
5584	1	5584	10/27/1997		JACKSON COUNTY	2		4	24	1997						17	ST	P	Jackson
2077	6		7/3/1981		MATT J BOZKA	1	61	2	28	1949		61		10		16	ST	P	Lavaca
2077	6		7/3/1981		MATT J BOZKA	1	4	12	31	1956		16				16	ST	P	Lavaca
2096	6		7/3/1981		VLASTA MRAZ	1	33	2	28	1961		22	ROCKY CREEK	12		16	ST	P	Lavaca
2096	6		7/3/1981		VLASTA MRAZ	1		2	28	1961			ROCKY CREEK	12		16	ST	P	Lavaca
3912	1	4185	10/14/1982	A	JOHN E LEAVESLEY ET AL	4	340	2	8	1982		460		100		16	ST	P	Lavaca
4102	1	4327	4/19/1984	A	T-BAR-D LLC	2	57	2	22	1983		18				16	ST	P	Lavaca
5130	1	5130	7/15/1987	A	CITY OF MOULTON	2		4	24	1987				6.08		16	ST	P	Lavaca
5370	1	5370	10/15/1991	A	EVA RUTH HANCOCK ET AL	4	900	7	1	1991		500		356		16	ST	P	Lavaca
2082	6		7/3/1981		EL RANCHO DE LOS PATOS INC	2	932	3	31	1929		233				16	ST	P	Wharton
2083	6		7/3/1981		NORRIS RAUN	1	623.2	5	10	1948		312				16	ST	P	Wharton
2083	6		7/3/1981		NORRIS RAUN	1	2400	10	27	1969		1200				16	ST	P	Wharton
2090	6		7/3/1981		WILLIAM J NAISER ET AL	4	527	3	31	1956		174				16	ST	P	Wharton
2091	6		7/3/1981	B	JACK BIRKNER ET UX	3	290	3	31	1953		240.794				16	ST	P	Wharton
2092	6		7/3/1981		MARK & CHARLOTTE DEFRIEND	1	990	3	30	1945		277				16	ST	P	Wharton
2093	6		7/3/1981		EVA REIGH TUCKER	1	1750	7	31	1964		350				16	ST	P	Wharton
2094	6		7/3/1981		J K ALLEN ESTATE & GRADY ALLEN	5	640	4	30	1952		320				16	ST	P	Wharton
3665	1	3958	4/23/1979	A	JACK BIRKNER ET UX	3	211	1	29	1979		100				16	ST	P	Wharton
3725	1	4019	4/22/1980		CARL B BAIN	1	420	1	21	1980		107				16	ST	P	Wharton
3727	1	4021	4/23/1980		GREGORY PAUL SCHMIDT ET AL	4	913	1	21	1980		234				16	ST	P	Wharton
3836	1	4132	10/23/1981		HARRY E VITERA	1	550	5	26	1981		140				16	ST	P	Wharton
3876	1	4129	6/4/1982	A	ALAN WAYNE MEEK	1	47.12	5	18	1981		12.04				16	ST	P	Wharton
3876	1	4129	6/4/1982	A	BRIAN NELSON MEEK	1	208.05	5	18	1981		53.18				16	ST	P	Wharton
3876	1	4129	6/4/1982	A	DALE CHARLES MEEK	1	208.05	5	18	1981		53.18				16	ST	P	Wharton
3876	1	4129	6/4/1982	A	GARY KENNETH MEEK	1	160.93	5	18	1981		41.13				16	ST	P	Wharton
3876	1	4129	6/4/1982	A	ALAN WAYNE MEEK ET AL	4	1.85	5	18	1981		0.47				16	ST	P	Wharton
3903	1	4158	10/14/1982		MUSTANG EXPLORATION CO INC	2	800	11	16	1981		200				16	ST	P	Wharton
3905	1	4161	10/14/1982	A	EL RANCHO DE LOS PATOS INC	2	1332	11	16	1981						16	ST	P	Wharton
3907	1	4163	10/14/1982		J K ALLEN ESTATE	5	640	11	16	1981		375		1		16	ST	P	Wharton
3907	1	4163	10/14/1982		J K ALLEN ESTATE	5	520	11	16	1981				1		16	ST	P	Wharton
3909	1	4165	10/14/1982		KATHLEEN HALAMICEK	1	350	11	16	1981		120		45		16	ST	P	Wharton
3910	1	4166	10/14/1982		WILBERT O DERNEHL JR	1	1000	11	16	1981		290		63		16	ST	P	Wharton
3911	1	4174	10/14/1982		GAYNARD & ELAINE WIGGINTON	1	400	12	7	1981		580		2		16	ST	P	Wharton
4241	1	4560	8/1/1985	B	EDMUND A WEINHEIMER JR	1	272.63	4	30	1985		184.5		25.2		16	ST	P	Wharton
4252	1	4559	10/3/1985	A	TRAVIS NORRIS RAUN ET AL	4	5500	4	16	1985		2250		4.9		16	ST	P	Wharton
5168	1	5168	6/17/1988	A	JOHN L & SUSAN H RICHARDS ET AL	4	1092	2	2	1988		398				16	ST	P	Wharton
5168	1	5168	6/17/1988	A	JOHN L & SUSAN H RICHARDS ET AL	4	651	2	2	1988				336		16	ST	P	Wharton
5263	1	5263	3/8/1990	A	EDMUND A WEINHEIMER JR	1	90	11	21	1989		187				16	ST	P	Wharton

TCEQ Active Water Rights - March 31, 2015

WRNo	WRType	Permit #	WR Issue Date	Amendment Letter	OwnerName	Owner Type Code	Diversion Amount (AFY)	Priority Date Month	Priority Date Day	Priority Date Year	Expiration	Acreage	Reservoir Name	Reservoir Capacity (AFY)	Site Name	Basin Number	WMCode	Region Code	County
5579	1	5579	3/18/2003		WILLIAM R SEIFMAN ET UX	3	200	3	7	1997		336				16	ST	P	Wharton
5595	1	5595	9/27/2000		E G GOFF ET AL	4	1550	9	27	2000		769				16	ST	P	Wharton
5678	1	5678	11/14/2000		PIN OAK FARMS 2	2	120	7	27	2000	SUBJECT TO: LEASE & ONGOING FARMING	80				16	ST	P	Wharton
5706	1	5706	3/27/2002		ANTON BRANDL JR ET UX	3	104.4	10	1	2000						16	ST	P	Wharton
2345	9		12/14/2001		CITY OF CORPUS CHRISTI	2	4500				12/14/2043		LAKE TEXANA			16	ST	PN	Jackson

APPENDIX 6B

Socioeconomic Analysis of Projected Water Shortages in Region P

Socioeconomic Impacts of Projected Water Shortages

for the Region P Regional Water Planning Area

Prepared in Support of the 2016 Region P Regional Water Plan

Texas Water
Development Board

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August, 2015

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Executive Summary

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

Based on projected water demands and existing water supplies, the Region P planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic 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 during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. 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 were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region P would result in an annually combined lost income impact of approximately $9 million (Table ES-1). In 2020, the region would lose approximately 240 jobs.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

Table ES-1: Region P Socioeconomic Impact Summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$9	$9	$9	$9	$9	$9
Job losses	236	236	236	236	236	236
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ 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	43	43	43	43	43	43
School enrollment losses	8	8	8	8	8	8

** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate 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 existing businesses and industry, 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.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region P Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning group's data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 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 meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region P Regional Water Plan.

Table 1-1 Regional Water Needs Summary by Water Use Category

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	Water Needs (acre-feet per year)	50,285	50,285	50,285	50,285	50,285	50,285
	% of the category's total water demand	23%	23%	23%	23%	23%	23%
Livestock	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Manufacturing	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Mining	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Municipal	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Steam-electric power	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Total water needs		**50,285**	**50,285**	**50,285**	**50,285**	**50,285**	**50,285**

2 Economic Impact Assessment Methodology Summary

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 (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables 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 GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes 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.
Financial Transfer Impacts	**Description**
Tax losses on production and imports	Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies.
Water trucking costs	Estimate for 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 less water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

Income Losses - Value Added Losses

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

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

For the purpose of this analysis, it was 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 from the recent drought period in 2011.

Job Losses

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category 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. Many of 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 was used to estimate reduced tax collections associated with the reduced output in the economy.

Water Trucking Costs

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

Utility Revenue Losses

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

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

2.1.3 Social Impacts

Consumer Surplus Losses of 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 the 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. However, consumer's access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer's wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

Population and School Enrollment Losses

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] 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 an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population losses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages 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.

2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key 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 2011 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 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

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[1] 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/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, 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.

2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were 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 deepens, 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 such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)

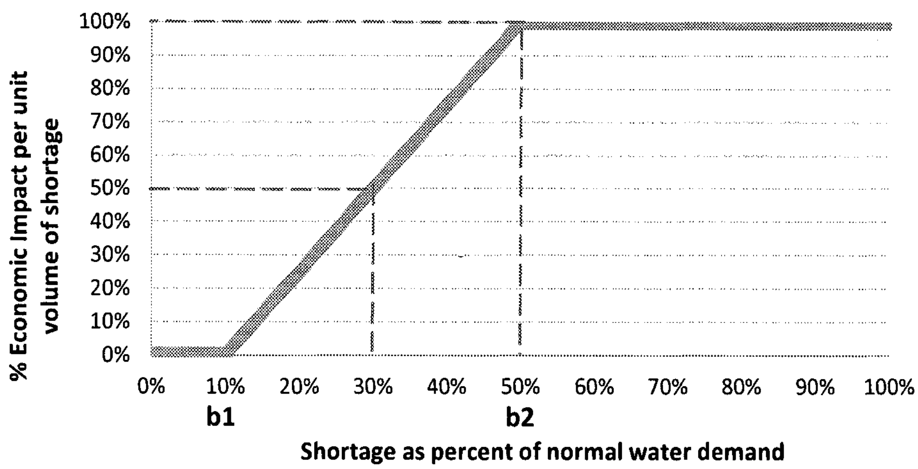

Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds

Water Use Category	Lower Bound (b1)	Upper Bound (b2)
Irrigation	**5%**	**50%**
Livestock	**5%**	**10%**
Manufacturing	**10%**	**50%**
Mining	**10%**	**50%**
Municipal (non-residential water intensive)	**50%**	**80%**
Steam-electric power	**20%**	**70%**

2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts 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 severe drought conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated 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, supplies of limited resources, and other structural changes to the economy that may occur into the future. This 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 analysis is not a 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 procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model 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.

7. 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 categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. 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.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. 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 these types of economic impact modeling efforts, 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, which is one reason why the impact estimates are likely conservative.

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

11. The model did 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 the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item 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 accurately 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.

3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region P. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

3.1 Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region P. In year 2011, Region P generated about $1.2 billion in gross state product associated with 19,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

Table 3-1 Region P Economy

Income ($ millions)*	Jobs	Taxes on production and imports ($ millions)*
$1,215	**18,991**	**$123**

[1] Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.

The remainder of Section 3 presents estimates of potential economic impacts for each water use category 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.

3.2 Impacts for Irrigation Water Shortages

One of the 3 counties in the region is 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 3-2. 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. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

Table 3-2 Impacts of Water Shortages on Irrigation in Region

Impact Measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$9	$9	$9	$9	$9	$9
Job losses	236	236	236	236	236	236

** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.*

3.3 Impacts for Livestock Water Shortages

None of the 3 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigation water use category described above.

Table 3-3 Impacts of Water Shortages on Livestock in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	-	-	-	-	-	-
Job losses	-	-	-	-	-	-

** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000*

3.4 Impacts for Municipal Water Shortages

None of the 3 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	-	-	-	-	-	-
Job losses[1]	-	-	-	-	-	-
Tax losses on production and imports[1] ($ millions)*	-	-	-	-	-	-
Consumer surplus losses ($ 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 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.*

3.5 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in none of the 3 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

Table 3-5 Impacts of Water Shortages on Manufacturing in Region

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

** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.*

3.6 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in none of the 3 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

Table 3-6 Impacts of Water Shortages on Mining in Region

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

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.7 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in none of the 3 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

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

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid 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.
- Does 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 3-7 Impacts of Water Shortages on Steam-Electric Power in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	-	-	-	-	-	-

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.8 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 3-8.

Table 3-8 Region-wide Social Impacts of Water Shortages in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	-	-	-	-	-	-
Population losses	43	43	43	43	43	43
School enrollment losses	8	8	8	8	8	8

***** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate 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 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

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

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
WHARTON	IRRIGATION	$9	$9	$9	$9	$9	$9	236	236	236	236	236	236	-	-	-	-	-	-
WHARTON TOTAL	**IRRIGATION**	**$9**	**$9**	**$9**	**$9**	**$9**	**$9**	**236**	**236**	**236**	**236**	**236**	**236**	-	-	-	-	-	-
REGION Total		**$9**	**$9**	**$9**	**$9**	**$9**	**$9**	**236**	**236**	**236**	**236**	**236**	**236**	-	-	-	-	-	-

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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 Lower Colorado Regional Water Planning Area) regarding drought, including preparations and response throughout the Region.

Drought Definitions

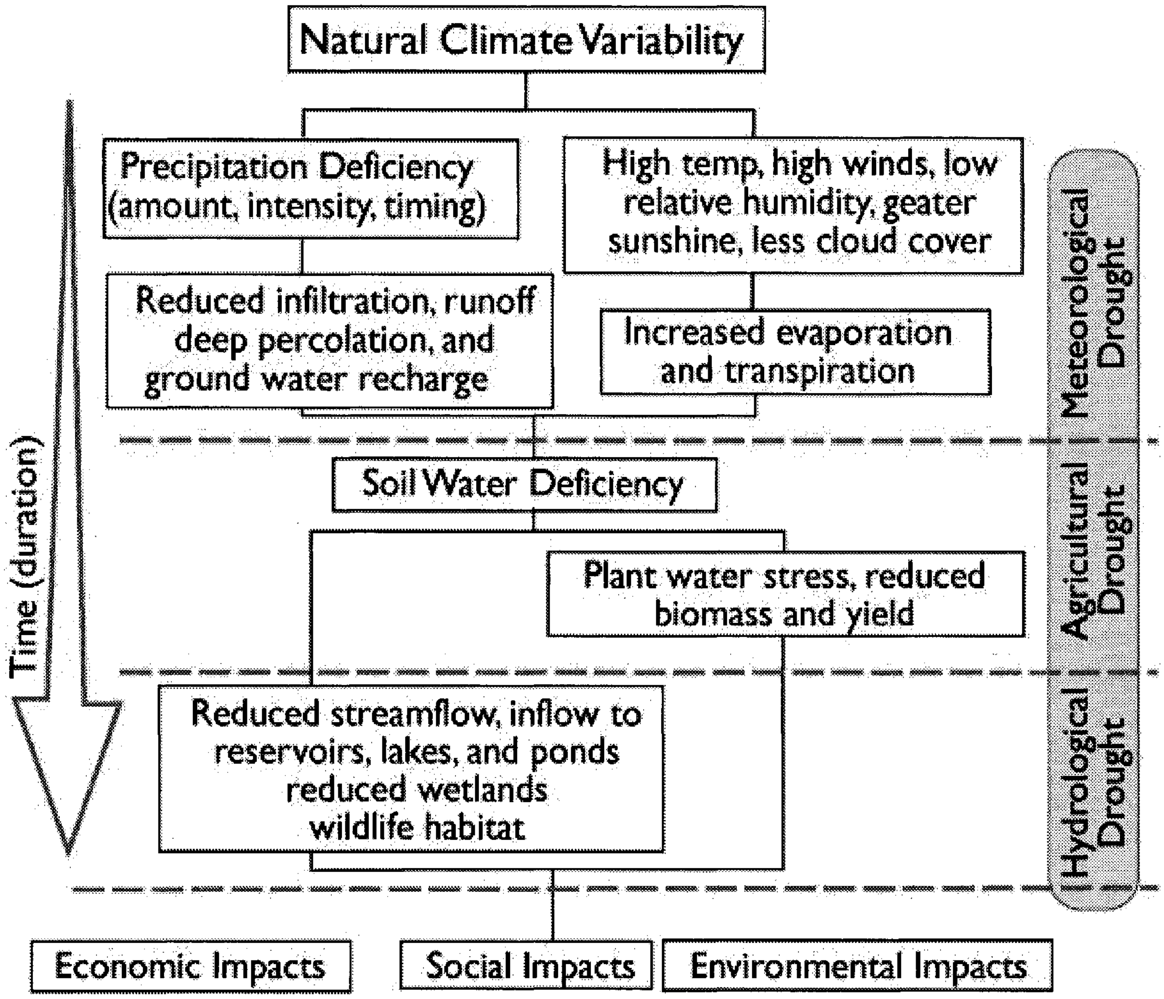
Drought is often referred to as a slow-moving emergency. The impact of droughts can be far-reaching but can be challenging to define due to the gradual and sometimes subtle progression of severity, as well as the tendency for temporal and geographic variations as isolated rain events shift perception 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 natural hydrological conditions 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

Statewide, the period typically considered the Drought of Record occurred in the 1950s and had significant hydrologic and economic consequences throughout the State. 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

The recent year 2011 was an extremely dry year throughout the State and the lake levels in Lake Texana fell dramatically. This caused the Lavaca-Navidad River Authority to enact a 20% water use reduction on their customers. Since then, the region has recovered in such a way as to remove the existing potential for a new drought of record based on current conditions. Other regions in the State continue to suffer through more severe drought conditions that could eventually cause potential negative impacts to the Lavaca Region.

Continuous drought conditions in neighboring regions have begun to have impacts on the groundwater levels in the Lavaca Region. Should the ongoing drought continue and surface water users in neighboring regions continue their use of groundwater in place of unavailable surface water, aquifer levels in the Lavaca Region will likely continue to fall during periods of high use.

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 all seven of the municipal water providers in LRWPA to serve as a summary of existing drought planning within LRWPA. The drought contingency plan for the only WWP in the region, LNRA, was also compiled into this regional summary. In addition, 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 were 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.

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.

Table 7-1 provides the drought triggers for a Severe 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. Manufacturing water users 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 35.00 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.

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
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%
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

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
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
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

WUG Name	County	Basin	Source Name	Severe Water Shortage		Critical/Emergency Water Shortage	
				Trigger	Goal	Trigger	Goal
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
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

7.3 Existing and Potential Emergency Interconnects

The guidance provided by the Texas Water Development Board states that "RWPGs shall collect and summarize information on existing major water infrastructure facilities that may be used for emergency interconnects and provide this information to the Executive Administrator confidentially and separately from the RWP document. This information may be collected in a tabular format that shows the potential user(s) of the interconnect, the potential supplier(s), the estimated potential volume of supply that could be provided via the interconnect (including the source name), and a general description of the facility/infrastructure and its location."

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. 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 (30 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 with a 2010 population of less than 7,500 and with a sole-source of water, as well as all county-other water user groups.

A list of identified single-source Water User Groups with population of less than 7,500 and all county is included in *Table 7-2*, with potential emergency supply options and implementation requirements identified as applicable. Due to limited water sources 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	5,707	885			X					X	well				
GANADO	**JACKSON**	2,003	2,079	252			X					X	well				
COUNTY-OTHER	**JACKSON**	6,573	6,820	700			X					X	well				
HALLETTSVILLE	**LAVACA**	2,550	2,550	606			X					X	well				
MOULTON	**LAVACA**	886	886	121			X					X	well				
SHINER	**LAVACA**	2,069	2,070	485			X					X	well				
YOAKUM	**LAVACA**	3,677	3,678	646			X					X	well				
COUNTY-OTHER	**LAVACA**	10,081	10,079	1,241			X					X	well				
COUNTY-OTHER	**WHARTON**	4,085	4,536	588			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 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 assuming only a first rice crop was grown, instead of a first and second crop. See Chapter 5 for additional details.

7.6.1 Recommended Drought Management Strategies

Drought Management is recommended as a strategy for the municipalities in the region. While no water needs exist, the LRWPG supports municipalities following their Drought Contingency Plans.

7.6.2 Potential Drought Management Strategies Considered

Drought Management was considered and evaluated as a potentially feasible water management strategy for those entities with a Drought Contingency Plan and for Irrigation in Wharton County, as it had a water need. The entities with a Drought Contingency Plan included: El Campo, Edna, Ganado, Hallettsville, Moulton, Shiner, Yoakum, and Manufacturing in Jackson County. 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 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, and evaluating the drought preparedness impacts of unanticipated population growth or industrial growth within the region over the planning horizon. The LRWPG recommended conservation and drought management as water management strategies for municipalities, which will aid in buffering any unanticipated population growth. With respect to industrial growth, the LRWPG has recommended several water management strategies for the Lavaca-Navidad River Authority to enhance supplies that may be needed to meet future growth not accounted for in the 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 DCP

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APPENDIX 7A

Region-Specific Model Drought Contingency Plans

Model Lavaca Region Drought Contingency Plan Template
Utility/Water Supplier

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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:

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, 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 any time 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 parent's 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

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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

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Model Lavaca Region Drought Contingency Plan Template
Wholesale Water Providers

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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

Requirements for initiation: 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.***

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., 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

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 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

8

Contents

List of Appendices

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Chapter 8 – Unique Stream Segments, Reservoir Sites, and Legislative Recommendations

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.

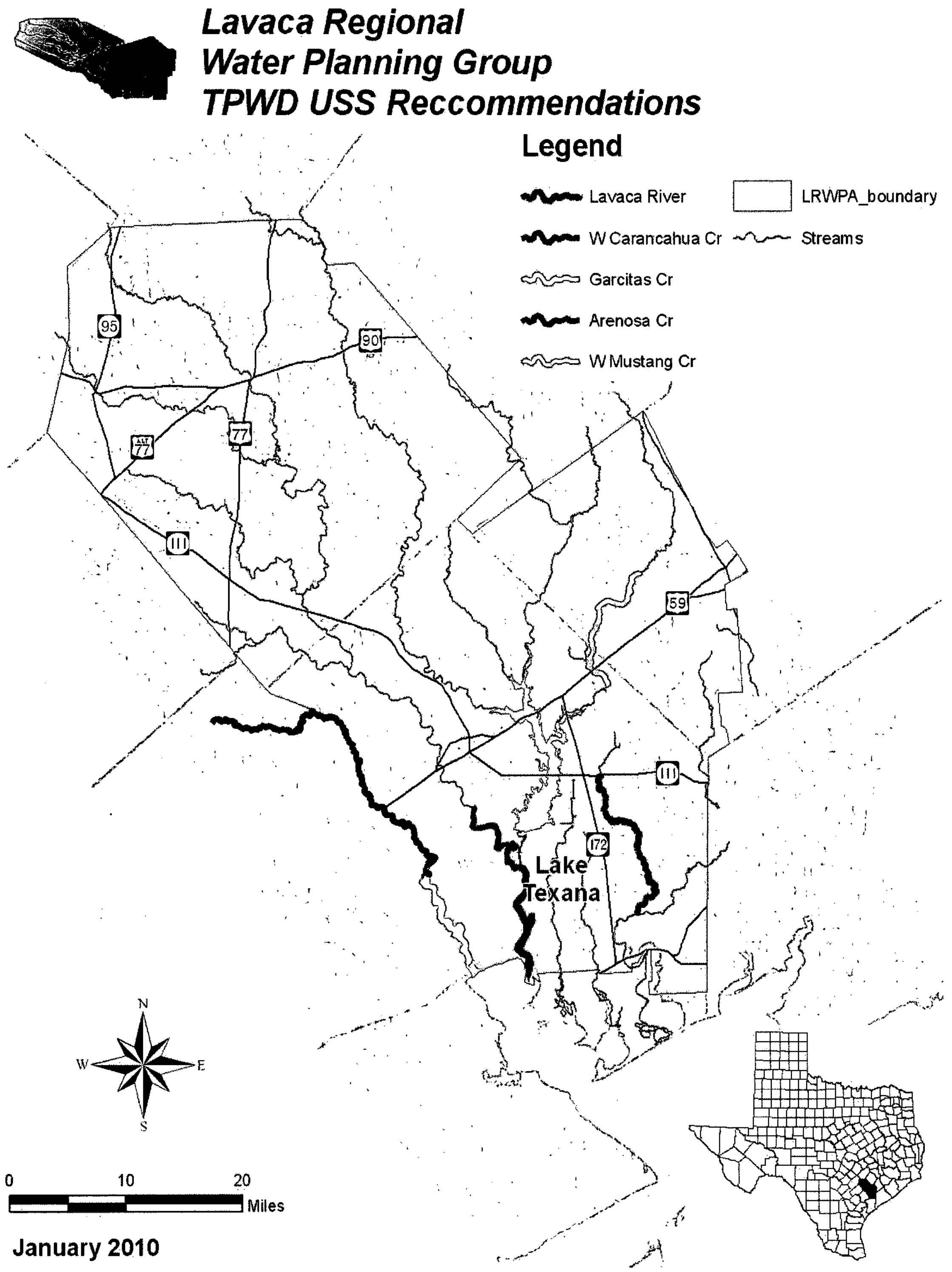
8.1 Unique Stream Segments and Reservoir Sites

The proposed Palmetto Bend Stage II Reservoir has been designated as a unique reservoir site (URS). It is 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. Since the original design and permitting of the reservoir, a number of changes have been made to the proposed Stage II project. The most significant of these changes is the relocation of the reservoir from its originally-proposed location to a point 1.4 miles upstream along the Lavaca River. Subsequent studies indicated that separation of the storage pools and moving Stage II upstream would be more cost effective. Due to this change and a resultant alteration of yield, the Certificate of Adjudication for Stage II would need to be revised if the off-channel impoundment is to be constructed.

LNRA has designated an off-channel option in its Management Plans as the desired future treatment of the Lavaca River. In 2010, the owner LNRA, studied the planned reservoir development and identified alternative strategies to the on-channel impoundment which included two off-channel reservoir sites. 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 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 LRWPA may have changed. Since the TPWD study, much of West Carancahua Creek has been channelized for drainage improvement. The LRWPG 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 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, LRWPG considered and approved several policy resolutions as presented in the 2006 RWP. These policy recommendations and rationales for the proposals are detailed below. No additional policy recommendations have been made for the current planning round. 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 Group recommends that the State recognize the importance of these multi-regional issues and support a greater role for inter-regional coordination in future planning rounds.

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 on August 20, 2009 and most recently on November 10, 2014, and the Texana GCD management plan was updated on February 25, 2011. 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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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

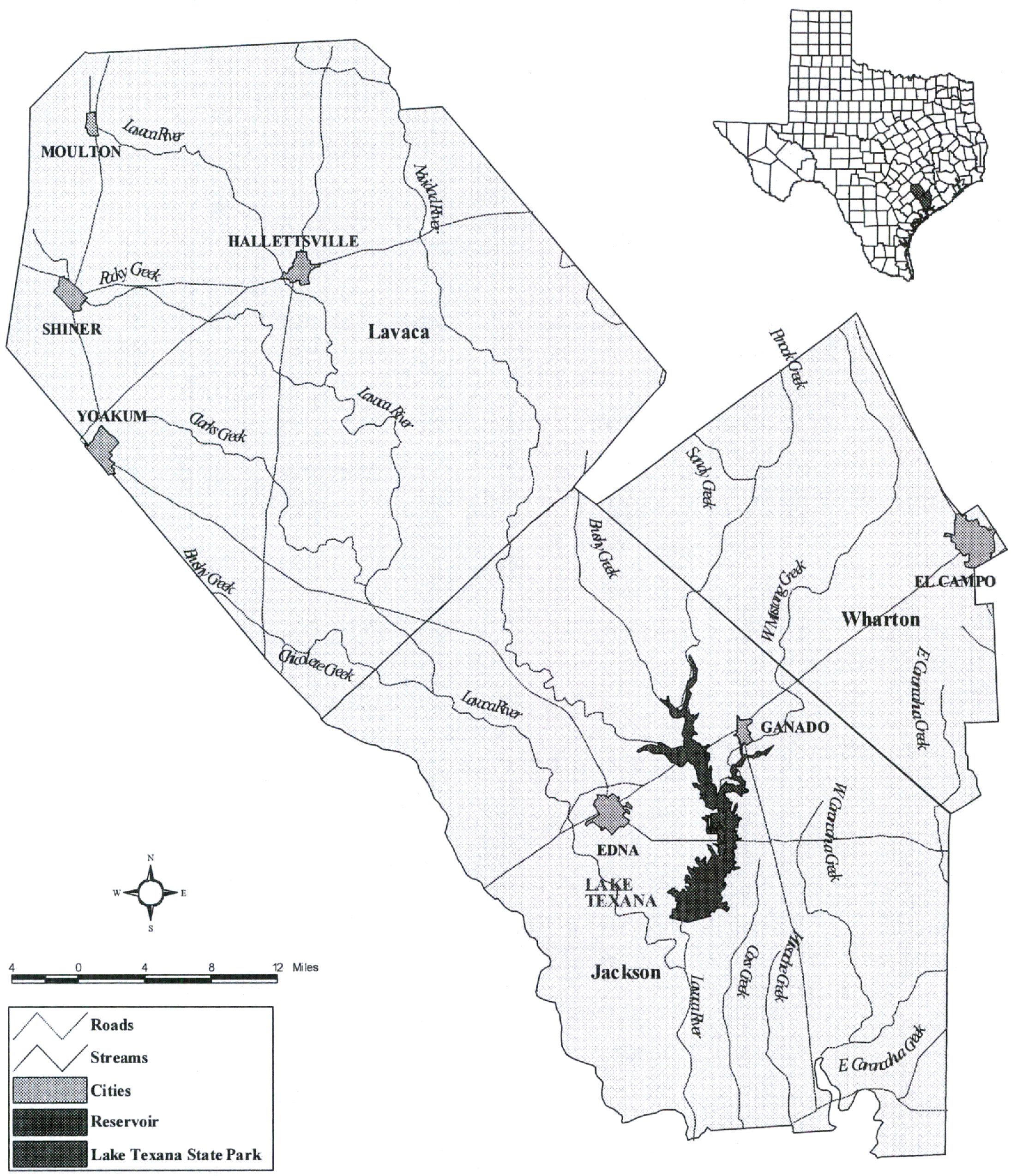
The 1990 census estimated the population of the study area to be 45,039 (Table 1, TWDB 1998). TWDB (1998) predicted a 2050 population of 58,958. Moderate increase in population is projected for all three counties, Jackson, Lavaca, and Wharton.

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

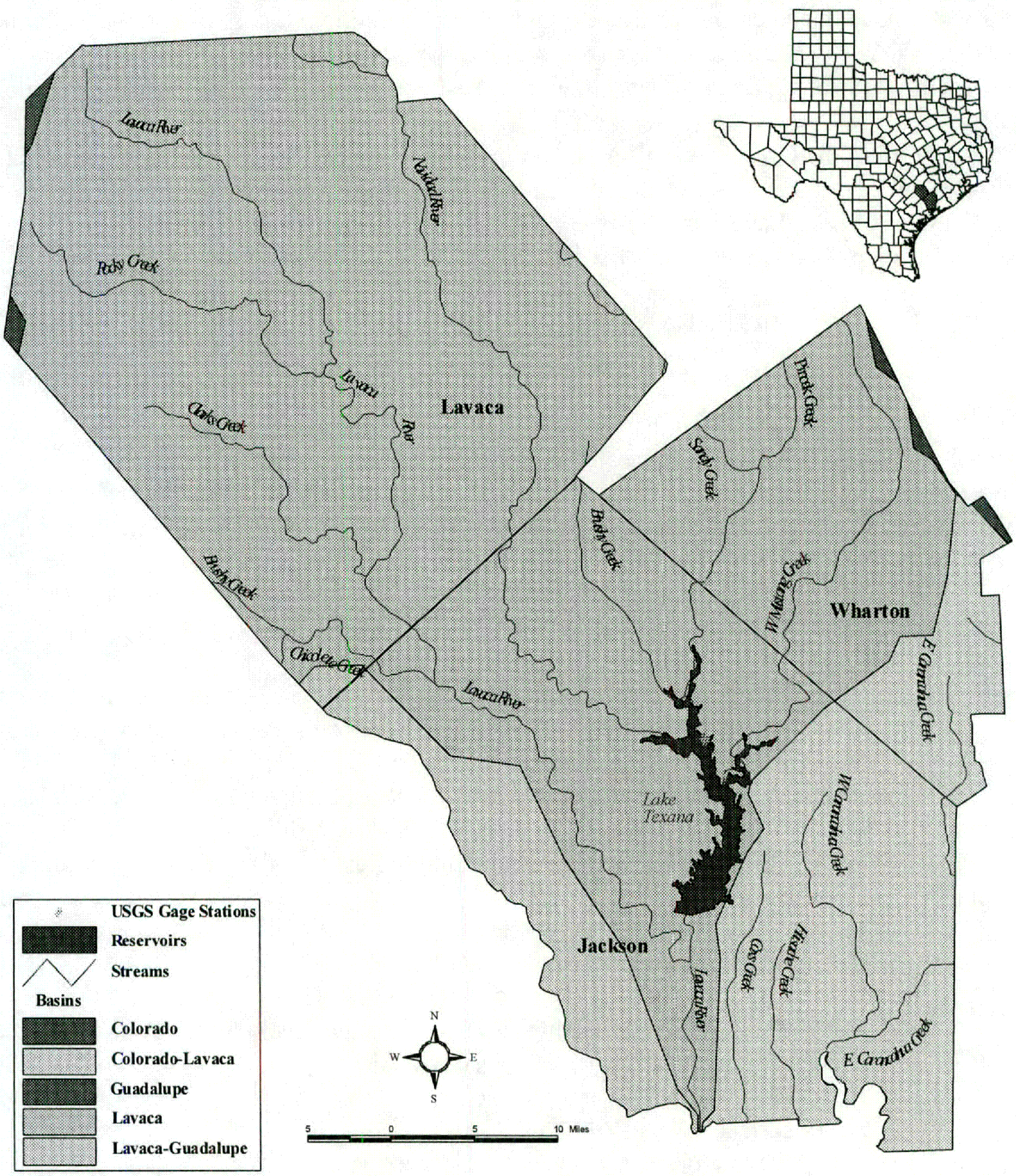


TEXAS PARKS & WILDLIFE

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



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 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.

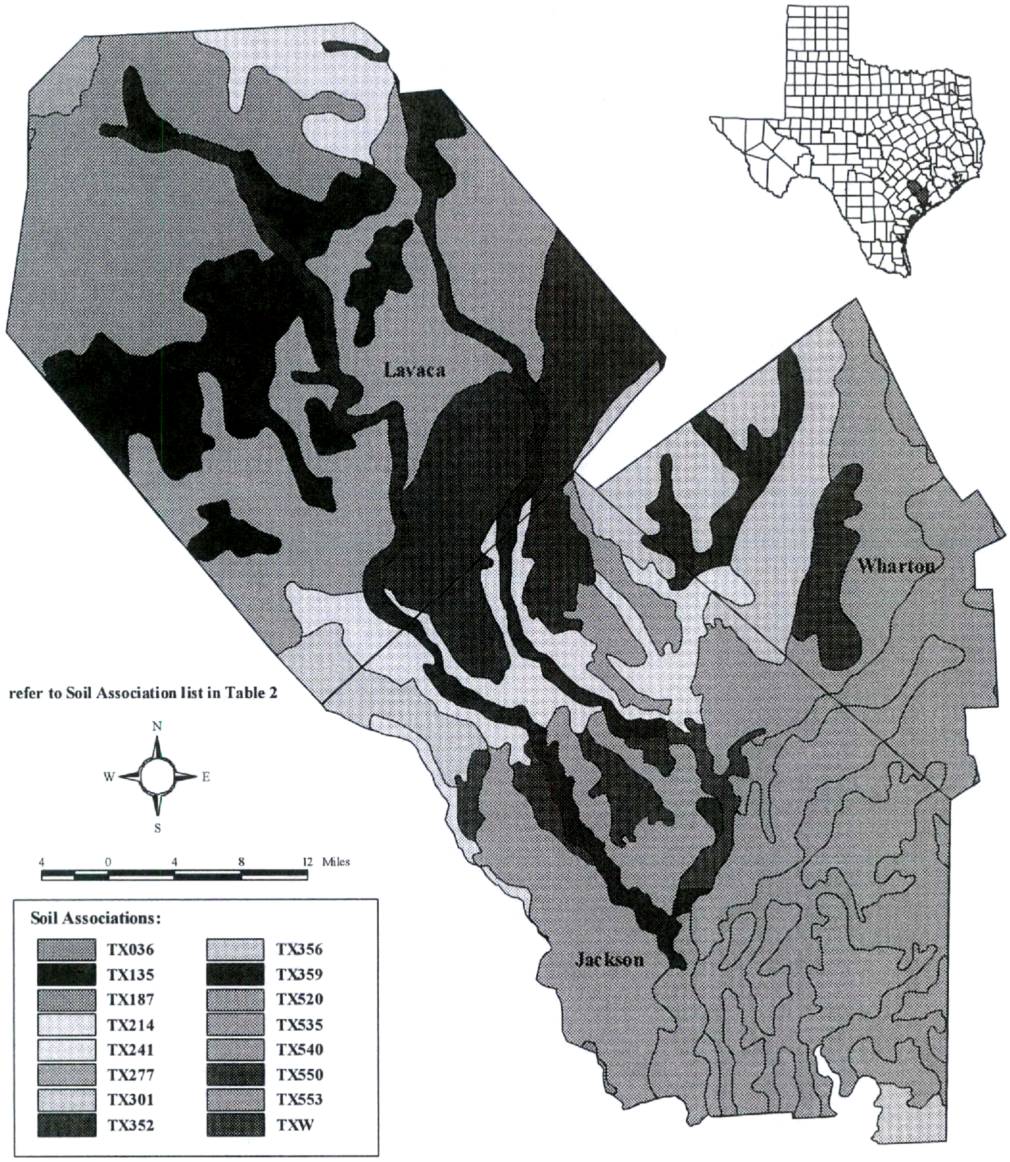
2. Undulating alkaline to slightly acid soils of the Blackland Prairie

   (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.

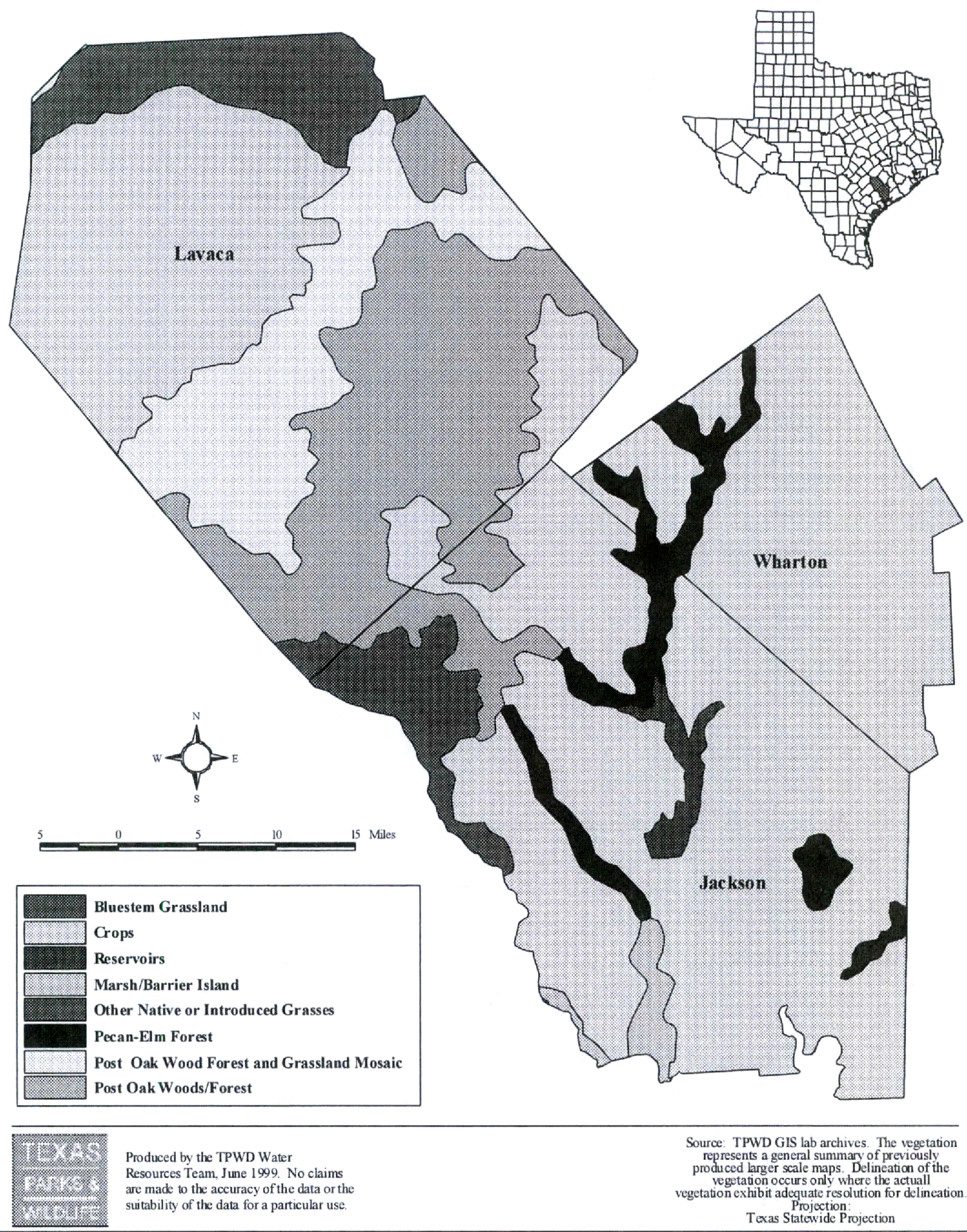
Pecan-Elm Forest includes: Pecan, American elm, cedar elm, cottonwood, sycamore, black willow, live oak, green ash, bald cypress, water oak, hackberry, virgin's bower, yaupon, greenbrair, mustang grape, poison oak, Johnsongrass, Virginia wildrye, Canada wildrye, rescuegrass, frostweed, and western ragweed.

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



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.

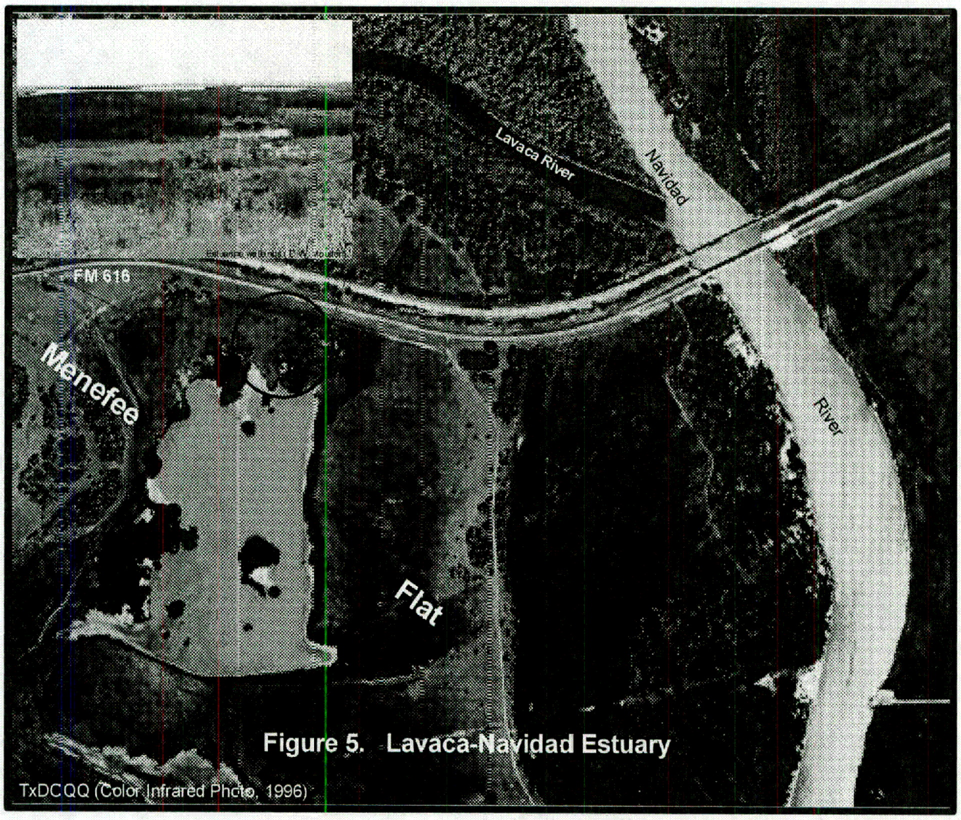


Figure 5. Lavaca-Navidad Estuary

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.

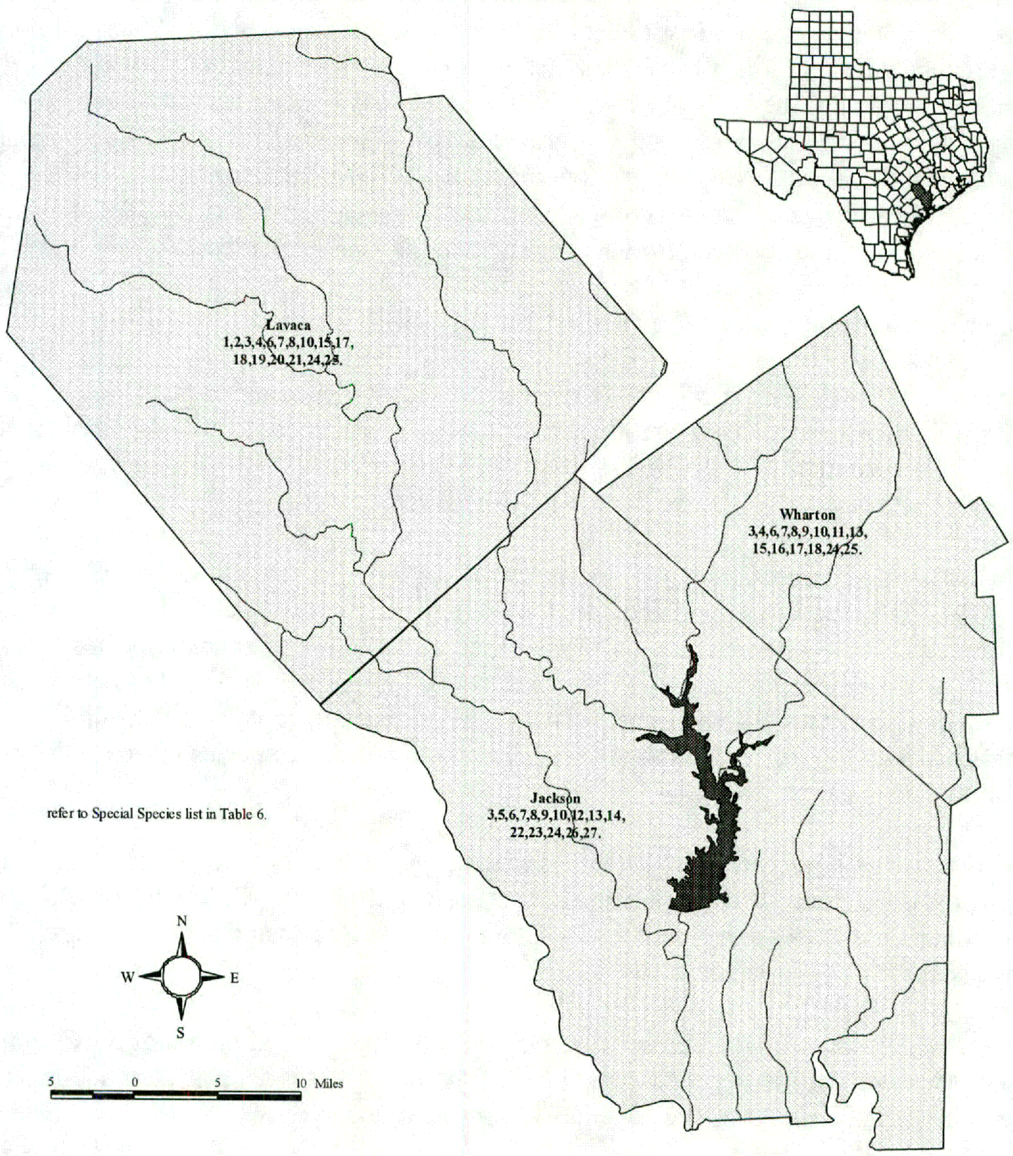
Lepisosteus osseus	Longnose gar
Lepisosteus spatula	Alligator gar
Lepomis auritus	Redbreast sunfish
Lepomis cyanellus	Green sunfish
Lepomis gulosus	Warmouth
Lepomis humilis	Orangespotted sunfish
Lepomis macrochirus	Bluegill
Lepomis megalotis	Longear sunfish
Lepomis microlophus	Redear sunfish
Lepomis 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

ACTUAL 1997 VISITATION (Fiscal Year):
Day Visitors = 556,092
Overnight Visitors = 58,659

AVERAGE DISTANCE TRAVELED TO SITE:
Day Visitors = 72.6 Miles
Overnight Visitors = 100.6 Miles

PERCENT OF OUT-OF-COUNTY VISITORS:
Day Visitors = 80.95
Overnight Visitors = 94.43

PER PERSON PER DAY EXPENDITURES

Sector	Day Visitors* Adjacent	Day Visitors* Enroute	Day Visitors* Total	Overnight Visitors Adjacent	Overnight Visitors Enroute	Overnight Visitors Total	Visitor 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* Expenditures	Day Visitors* Direct Impact	Day Visitors* Total Impact	Overnight Visitors Expenditures	Overnight Visitors Direct Impact	Overnight Visitors Total Impact	Visitor 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* Expenditures	Day Visitors* Direct Impact	Day Visitors* Total Impact	Overnight Visitors Expenditures	Overnight Visitors Direct Impact	Overnight Visitors Total Impact	Visitor 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* Expenditures	Day Visitors* Direct Impact	Day Visitors* Total Impact	Overnight Visitors Expenditures	Overnight Visitors Direct Impact	Overnight Visitors Total Impact	Visitor 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

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[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.

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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 2016 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 and/or non-municipal water user groups 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

This chapter includes a list of projects and their costs that were included in surveys sent to sponsoring entities. These surveys were sent to assess the timeline and level of funding anticipated to be needed by the State in order to implement the recommended water management strategies in the 2016 Lavaca Regional Water Plan. This chapter also summarizes the received responses to the surveys.

In addition, policy recommendations by the LRWPG related to financing are included in this chapter.

9.2 Summary of Survey Responses

Infrastructure Financing Recommendation (IFR) surveys were generated by the Texas Water Development Board, using data provided by the individual regions. The surveys were provided to the regions for distribution, and state the following:

"As part of the state water planning process, regional water planning groups recommend water supply projects for each of their respective regions. The Texas Water Development Board (TWDB) has several funding programs for water projects that support the planning, design, and construction of water supply projects with several financing options including low-interest loans and deferral of principal and interest. Texas Water Code (TAC 16.053 (q)) requires the regional water planning groups to examine the financing needed to implement the water management strategies and projects recommended in their regional plan."

The IFR surveys were sent to the following list of project sponsors, to gather information on how the project sponsor anticipates financing the projects recommended in the 2016 Lavaca RWP to meet current and future water demands.

Table 9-1 Summary of Recommended Projects in 2016 Lavaca RWP

Region	Sponsor	Recommended Water Management Strategy	Total Capital Costs ($)
P	Hallettsville	Municipal Conservation	$62,313
P	Moulton	Municipal Conservation	$20,750
P	Shiner	Municipal Conservation	$50,357
P	Yoakum	Municipal Conservation	$85,984
P	El Campo	Municipal Conservation	$243,652
P	El Campo	Reuse of Municipal Effluent	$4,664,000
P	Irrigation, Wharton County	Irrigation Conservation - On-farm Conservation	$23,719,000
P	Irrigation, Wharton County	Irrigation Conservation - Tail water Recovery	$25,760,000
P	LNRA	Lavaca River Off-Channel Reservoir	$177,485,000
P	LNRA	LNRA Desalination	$44,252,000
P	LNRA	LNRA Aquifer Storage and Recovery	$181,906,000

As of November 17, 2015, three survey responses were received. The City of Yoakum responded stating they would require financing for the full $85,984 in the year 2016. The City of El Campo responded, stating they would require financing of $240,000 for municipal conservation, starting in the year 2015, and $2,960,000 for Reuse, starting in 2017. The Lavaca-Navidad River Authority (LNRA) responded, stating that they would require financing of $177,485,000 for the Lavaca Off-Channel Reservoir project, starting in 2017; financing of $44,252,000 for the LNRA Desalination project, starting in 2020; and financing of $181,906,000 for the LNRA Aquifer Storage and Recovery project, starting in 2030.

A spreadsheet containing a summary of the responses is provided in Appendix 9A.

9.3 Policy Recommendations

The RWPG is directed by the TWDB to propose roles for the State to take in financing the recommended water supply projects. In the *2006 Lavaca RWP*, recommendations were made regarding policies and programs that directly or indirectly funded water projects and water infrastructure. Those recommendations are discussed below.

In addition to the recommendations continued from the *2006 Lavaca RWP*, 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. **Another recommendation would be to have the Legislature review private activity bonds to expand the authority beyond the current $50 million cap**.

9.3.1 Summary

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. LRWPG recommendations are summarized below and detailed discussions of each program or policy are provided in the following sections.

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.

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.

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.

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.

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.

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.

APPENDIX 9A

Summary of IFR Survey Responses

Appendix 9A - Summary of Infrastructure Financing Survey Responses

SponsorEntityName	SponsorEntityPrimaryRegion	ProjectName	WMSProjectSponsorRegion	IFRElementName	IFRElementValue	YearOfNeed	IFRProjectDataId	EntityRwpId	WMSProjectId	IFRProjectElementsId
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	60000	2017		690	1161	1
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	P	CONSTRUCTION FUNDING	180000	2018		690	1161	2
EL CAMPO	P	MUNICIPAL CONSERVATION - EL CAMPO	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			690	1161	3
EL CAMPO	P	REUSE	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	150000	2015		690	1277	1
EL CAMPO	P	REUSE	P	CONSTRUCTION FUNDING	2810000	2017		690	1277	2
EL CAMPO	P	REUSE	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			690	1277	3
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				793	1264	1
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	P	CONSTRUCTION FUNDING				793	1264	2
HALLETTSVILLE	P	MUNICIPAL CONSERVATION - HALLETTSVILLE	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				793	1264	3
LAVACA NAVIDAD RIVER AUTHORITY	P	AQUIFER STORAGE AND RECOVERY	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	18190600	2030		83	1667	1
LAVACA NAVIDAD RIVER AUTHORITY	P	AQUIFER STORAGE AND RECOVERY	P	CONSTRUCTION FUNDING	163715400	2035		83	1667	2
LAVACA NAVIDAD RIVER AUTHORITY	P	AQUIFER STORAGE AND RECOVERY	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	49			83	1667	3
LAVACA NAVIDAD RIVER AUTHORITY	P	LAVACA OFF-CHANNEL RESERVOIR	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	15968835	2017		83	1162	1
LAVACA NAVIDAD RIVER AUTHORITY	P	LAVACA OFF-CHANNEL RESERVOIR	P	CONSTRUCTION FUNDING	161716165	2020		83	1162	2
LAVACA NAVIDAD RIVER AUTHORITY	P	LAVACA OFF-CHANNEL RESERVOIR	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	49			83	1162	3
LAVACA NAVIDAD RIVER AUTHORITY	P	LNRA DESALINATION	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	4425200	2020		83	1276	1
LAVACA NAVIDAD RIVER AUTHORITY	P	LNRA DESALINATION	P	CONSTRUCTION FUNDING	39826800	2025		83	1276	2
LAVACA NAVIDAD RIVER AUTHORITY	P	LNRA DESALINATION	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			83	1276	3
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1967	1267	1
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	P	CONSTRUCTION FUNDING				1967	1267	2
MOULTON	P	MUNICIPAL CONSERVATION - MOULTON	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1967	1267	3
SHINER	P	MUNICIPAL CONSERVATION - SHINER	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2211	1269	1
SHINER	P	MUNICIPAL CONSERVATION - SHINER	P	CONSTRUCTION FUNDING				2211	1269	2
SHINER	P	MUNICIPAL CONSERVATION - SHINER	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2211	1269	3
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	P	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	85,984	2016		2482	1270	1
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	P	CONSTRUCTION FUNDING	0			2482	1270	2
YOAKUM	P	MUNICIPAL CONSERVATION - YOAKUM	P	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			2482	1270	3

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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 2016 Lavaca Regional Water Plan was developed in accordance with the public participation requirements of the Texas Open Meetings Act.

Following the development of the 2016 Initially Prepared Lavaca Regional Water Plan, a public hearing was held to present the draft plan to the public and receive comments. A copy of the public notice and the public hearing presentation are included in *Appendix 10A*. No public comments were received at the public hearing. Written comments from TWDB and Texas Parks and Wildlife (TPWD) were received and are included in *Appendix 10B*. The written comments from TWDB include a cover letter that addresses what needs to be included in the final adopted plan. No written public comments were received during the public comment period, held for 60 days after the public hearing. Formal responses to the written TWDB and TPWD comments are included in *Appendix 10C*.

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 2016 Planning Cycle in May of 2011. 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 May 16, 2011, Meeting

Replacements are needed for voting members Calvin Bonzer and Larry Waits. Copies of the Grant Application for Funding to TWDB were distributed. The agreement between LNRA and TWDB for funding related to the Fourth Cycle of Regional Water Planning was authorized. AECOM was approved to provide professional services related to regional water management planning for the LRWPA Planning Area – 2016 RWP. The group was updated on the TWDB 2011-2016 planning cycle.

10.2.2 January 23, 2012, Meeting

The formation of an Appointment Committee to fill the two vacated positions (Bonzer and Waits) on the LRWPG Board was approved. The formation of an LRWPG committee to define proposed changes and updates to the current by-laws was approved. Patrick Brzozowski, L.G. Raun, and Harrison Stafford II were re-elected. The consultant presented to the Group a Regional Water Planning overview, summary of the 2011 RWP, information on the 2016 Planning Cycle, the draft non-municipal demand projections from TWDB, and an update on desired future condition and groundwater availability. The formation of an Agricultural Demand Committee was approved. A summary of the TWDB 2016 Planning Cycle was presented.

10.2.3 May 14, 2012, Meeting

A change to the LRWPG By-Laws was approved. Rodney Jahn was approved as a new member of the LRWPG to replace Calvin Bonzer. A TWDB status report on drought conditions and prognosis was presented. The LRWPG Agriculture Committee will review the draft non-municipal water demand projections and present a plan of action at their next meeting. TWDB plans to revise the 2016 planning schedule contingent on when data is received from the State's demographer's office. TWDB groundwater availability data was presented to the group. The Water Management Strategy screening process was approved. A summary of the TWDB 2016 Planning Cycle was presented.

10.2.4 February 28, 2013, Meeting

The Group approved Phillip Spenrath to replace Philip Miller as a voting member, and Edward Pustka to be reassigned. Stafford, Raun, and Brzozowski were re-elected to their current LRWPG positions. The Revised Regional Water Planning Requirements were presented to the Group. The 2016 planning activities, revised schedule, non-municipal demand projections, and a draft letter to the WUG with draft population projections was presented. The draft letter was approved with a minor change. The water management strategies task was discussed. The status of neighboring regional water planning group activities was presented, and the Group requested to be kept updated on these activities for Region K, L, and N.

10.2.5 May 14, 2013, Meeting

David Wagner was approved as a new voting member. The timeline including revision submission and scope amendment was reviewed. Multiple topics including the potential legislative impacts to prioritizing projects, drought contingency plans, the definition of the Drought of Record, draft population and municipal demand projections, draft manufacturing demands, potentially feasibly water management strategies, and zebra mussels, were presented and discussed.

10.2.6 July 23, 2013, Meeting

TWDB updates were presented, including project prioritization, house bills, and the State Water Implementation Fund for Texas (SWIFT). The consultant presented the draft population and municipal demand projections, and the draft manufacturing demand projects, both of which were approved.

10.2.7 December 2, 1013 Meeting

TWDB updated the group on water plan project prioritization, and SWIFT and state revolving fund financial assistance workshops. The consultant presented information regarding population and demand approval and the draft Water Needs Analysis. The Group approved the scope of work for potential water management strategy evaluation and authorized consultants and LNRA to submit it to TWDB.

10.2.8 May 5, 2014 Meeting

Replacement is needed for voting member Tommy Brandenberger. Stafford, Raun, and Brzozowski were re-elected to their current LRWPG positions, and Griffin and Weinheimer were re-elected to the Executive Committee. TWDB updated the Group on their new project Manager Sarah Backhouse and on upcoming deadlines and deliverables. The consultant briefed the Group on Garwood surface water availability and the reduction of the Garwood supply was approved. The consultant was approved to prepare and submit the required technical memorandum. A strategy for reuse from the City of El Campo WWTP was presented. LRWPG was approved to send a letter supporting this strategy. The strategy was approved to be included in the scope of work and submitted to TWDB for approval. The draft prioritization of projects was approved for submittal to TWDB. The consultant and LRWPG were approved to address comments and finalize the prioritization.

10.2.9 August 18, 2014 Meeting

Replacements are needed for voting members Tommy Brandenberger and Rodney Jahn. Final prioritization of water management strategies was presented and approved for submittal to TWDB. The Lavaca Region Technical Memorandum was ratified. The consultant briefed the Group on the requirements for the drought-related Chapter 7 for 2016. A Drought Committee was established and approved. The Policy and Legislative Chapter was discussed.

10.2.10 January 19, 2015 Meeting

LNRA was approved as the contracting entity for the fifth round of regional water planning. Replacements are needed for voting members Tommy Brandenberger and Rodney Jahn, and a new member is needed to represent water utilities. Stafford, Raun, and Brzozowski were re-elected to their current LRWPG positions, and Griffin and Weinheimer were re-elected to the Executive Committee. LNRA was approved to submit a grant application for funding the fifth round of water planning. The LRWPG Chair was approved to request performing a socio-economic impact analysis after LRWPG water needs are satisfied. The TWDB Contract Amendment #6 was approved. TWDB briefed the Group on the 5th Regional Water Planning Cycle, the current Contract Amendment, timeline, the IPP process, and SWIFT. The consultant discussed Chapters 1, 2, 3, 4, and 7 of the report, and informed the Group of the schedule for the Plan.

10.2.11 February 23, 2015 Meeting

Clay Schultz, Regional Water Planning & Development Team 5 Manager, presented information on TWDB Financial Assistance Programs. The LRWPG took action to authorize LNRA to post public notice and hold a public hearing on the Initially Prepared Plan. The consultant presented draft Chapter 8 for discussion and requested comments prior to the next meeting. The consultant also presented details on several of the potential water management strategies for discussion. Wharton County Judge Spenrath addressed the LRWPG regarding the City of Wharton water availability and potential water use and sale. Brooke Duever, Watermaster Specialist for the South Texas Watermaster Program, responsible for the Lavaca Basin, was introduced to the LRWPG.

10.2.12 March 23, 2015 Meeting

TWDB Board Member Kathleen Jackson attended and was introduced to the LRWPG. The LRWPG took action to authorize the LNRA to execute a contract with the TWDB on behalf of the LRWPG for the fifth cycle of regional water planning. The consultant presented RWPG edits to Chapters 1-4, and 8 for discussion. The consultant presented the details for the list of potential water management strategies, and the LRWPG selected recommended and alternative strategies for the 2016 Plan from the list.

10.2.13 April 20, 2015 Meeting

The LRWPG discussed and took action to approve the amendment of the Task 4D Scope of Work to revise the LNRA Desalination strategy to include brackish surface water as well as brackish groundwater, and to submit the amendment request to the TWDB. The consultant presented the RWPG edits for the remaining draft chapters for discussion and approval. The LRWPG took action to approve the Lavaca Region Initially Prepared Plan and authorized submittal of the IPP to the TWDB by the May 1, 2015 deadline.

10.2.14 June 23, 2015 Public Hearing

A presentation discussing the components of the 2016 Lavaca Regional Water Plan was made to meeting attendees. No public comments were received.

10.2.15 October 26, 2015 Meeting

The LRWPG received a briefing on the regional water planning boundaries. The LRWPG reviewed comments and proposed responses to TWDB and TPWD comments received on the Initially Prepared plan. The LRWPG discussed the Socioeconomic Impact Analysis of Projected Water Shortages, prepared by TWDB. The LRWPG discussed the Infrastructure Financing surveys for projects listed in the 2016 Lavaca RWP. The LRWPG reviewed and discussed the draft prioritization of the projects listed in the 2016 Lavaca RWP.

10.2.16 November 17, 2015 Meeting

The LRWPG discussed and took action to adopt the 2016 Lavaca Regional Water Plan. The LRWPG also took action to approve the Prioritization of the 2016 Lavaca RWP projects. In addition, a motion passed for the Consultant to be allowed to make necessary non-substantive changes to the RWP after its adoption without requiring the RWPG to reconvene.

APPENDIX 10A

Meeting Minutes

Minutes of Lavaca Regional Water Planning Group
May 16, 2011
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 16, 2011 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Tommy Brandenberger, John Butschek, Gerald Clark, Roy Griffin, Lester Little, Jack Maloney, Richard Ottis, Edward Pustka, L. G. Raun, Robert Shoemate, Harrison Stafford II, David Wagner, and Ed Weinheimer.

Absent Voting Group Members were: Philip Miller, and Michael Skalicky.

Also present was: Lann Bookout of Texas Water Development Board, Sam Hoerster of Texana Groundwater Conservation District, Philip Taucer and Mike Voinis of AECOM, Josh Harper, Texas Parks and Wildlife Department, Ronald Kubecka, Jerry Adelman, and Jon Bradford, LNRA Board members, Doug Anders and Karen Gregory, LNRA staff and Lindsey Lee Bradford and Shelley Lee Srp, public.

Chairman Stafford called the meeting to order.

Public Comments
There were no public comments.

Minutes
The minutes of the February 28, 2011 meeting were reviewed. Clark moved to approve the minutes as presented. Wagner seconded the motion. Motion passed.

Appointments for New Voting Members
Brzozowski informed the Group that new voting members are needed to replace Calvin Bonzer, Small Business, Lavaca County, Small Business and Larry Waits, Agricultural, Jackson County. Wagner and Brzozowski will continue to find replacements for Bonzer and Waits.

Grant Application for Funding
Brzozowski and Bookout briefed the Group on the Grant Application for Funding including funding opportunities. The Group received a copy of the grant application as submitted to the Texas Water Development Board.

Funding Agreement with the Texas Water Development Board
Brzozowski informed the Board that the Lavaca-Navidad River Authority, as the contracting entity for the Lavaca Regional Water Planning Group, would need to execute an agreement with

the Texas Water Development Board for funding related to the Fourth Cycle of Regional Water Planning.

Raun moved to authorize the Lavaca-Navidad River Authority to execute an agreement with the Texas Water Development Board for funding related to the Fourth Cycle of Regional Water Planning. Maloney seconded the motion. Motion passed.

Receive Public Input

Public meeting was opened at 1:44 p.m. There were no public comments. Public meeting closed at 1:45 p.m.

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 – 2016 Regional Water Plan.

Clark moved to approve AECOM to provide professional services related to regional water management planning for the Lavaca Regional Water Planning Area – 2016 Regional Water Plan. Griffin seconded the motion. Motion passed.

Texas Water Development Board Update

Bookout updated the Group on the 2011-2016 planning cycle including the timeline and planning and funding process.

Schedule Future Meetings

The Group agreed to schedule a meeting in August or September.

Public Comments

There were no public comments.

The meeting adjourned at 2:04 p.m.

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Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
January 23, 2012
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 23, 2012 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, John Butschek, Gerald Clark, Roy Griffin, Lester Little, Jack Maloney, Richard Ottis, L. G. Raun, Robert Shoemate, Michael Skalicky, Harrison Stafford II, David Wagner, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Philip Miller, and Edward Pustka.

Also present was: Lann Bookout of Texas Water Development Board, Sam Hoerster and James Revel of Texana Groundwater Conservation District, David Parkhill and Jaime Burke of AECOM, Neil Hudgins of Coastal Bend Groundwater Conservation District, Tim Andruss of Victoria County Groundwater Conservation District, Ronald Kubecka, LNRA Board member, and Doug Anders and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments
There were no public comments.

Minutes
The minutes of the May 16, 2011 meeting were reviewed. Ottis moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Appointments for New Voting Members

Brzozowski informed the Group that new voting members are needed to replace Calvin Bonzer, Small Business, Lavaca County, and Larry Waits, Agricultural, Jackson County.

Brzozowski moved to form an Appointment Committee to work together to fill the two vacated positions on the LRWPG Board. The Committee will be comprised of the following members: Brzozowski, Butschek, Skalicky, Wagner, Maloney, Clark, Shoemate and Ottis.

Weinheimer seconded the motion. Motion passed.

It was noted that Neil Hudgins was elected by the Groundwater Management Area 15 members as a GMA 15 representative to the Lavaca Regional Water Planning Group as required by Senate Bill 660.

Discuss Current By-laws

The Group was presented a copy of the current LRWPG By-laws and discussed proposed changes. Parkhill recommended that a Committee work with AECOM to define proposed changes and updates to the current by-laws.

Butschek moved to form a LRWPG Committee to discuss and recommend proposed changes and updates to the current by-laws. The Committee will be comprised of the following members: Brzozowski, Raun, and Hudgins. Clark 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. Ottis seconded the motion. Motion passed.

Regional Water Planning 101

Parkhill and Burke presented the Group with a Regional Water Planning overview and summary of the 2011 Regional Water Plan. The Group also discussed the draft rule revisions -357 RWP Guidelines from Texas Water Development Board. Skalicky moved to approve the LRWPG Executive Committee to review the State's report and submit comments. Butschek seconded the motion. Motion passed.

2016 Planning Cycle

Burke presented the Group with information regarding the 2016 Planning Cycle including the planning cycle process and a summary of the scope of work and project budget and schedule.

Discuss Draft Non-Municipal Water Demand Projections

Parkhill and Burke discussed with the Group the draft non-municipal demand projections from Texas Water Development Board.

Clark moved to form an Ag Demand Committee to develop a methodology and set of irrigation demands for a revision request. Raun seconded the motion. Motion passed.

The Committee will be comprised of members as follows: Raun, Hudgins, Ottis, Skalicky, Little, and Shoemate.

Desired Future Conditions

Parkhill presented the Group with an update on desired future condition and groundwater availability.

TWDB Update

Bookout summarized the 2016 Planning Cycle schedule.

Future Meetings

The Group scheduled their next LRWPG meeting for April 23, 2012 at 1:30 p.m.

There were no public comments.

The meeting adjourned at 4:22 p.m.

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Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
May 14, 2012
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 14, 2012 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, John Butschek, Roy Griffin, Neil Hudgins, Jack Maloney, Richard Ottis, Michael Skalicky, Harrison Stafford II, David Wagner, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Gerald Clark, Lester Little, Philip Miller, Edward Pustka, L.G. Raun, and Robert Shoemate.

Also present was: Lann Bookout and Mark Wentzel of Texas Water Development Board, David Parkhill and Virginia Wilkinson of AECOM, Ronald Kubecka and Jerry Adelman, LNRA Board members, and Doug Anders and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments
There were no public comments.

Minutes
The minutes of the January 23, 2012 meeting were reviewed. Weinheimer moved to approve the minutes as presented. Butschek seconded the motion. Motion passed.

LRWPG By-Laws

Brzozowski briefed the Group on the LRWPG Committee's review and proposed changes to the LRWPG By-laws.

Stafford moved to change the word "shall" to "may" in the first sentence of Article VII. Designated Alternates, to read as follows: *Each member may designate an alternate to represent him/her when he/she is unable to attend a meeting or hearing.* Brzozowski seconded the motion. Motion passed.

Appointment for new Voting Members

Maloney recommended to the Group to appoint Rodney Jahn, Lavaca County, small business, as a voting member of the Lavaca Regional Water Planning Group to replace Calvin Bonzer. He presented the Group with a written bio of Jahn.

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Ottis moved to appoint Jahn as a voting member of the LRWPG. Brzozowski seconded the motion. Motion passed.

Drought Monitoring by TWDB

Wentzel presented to the Group a Texas Water Development Board status report on the drought conditions and prognosis.

Draft Non-Municipal Water Demand Projections

Parkhill and Wentzel presented the Group with the draft non-municipal water demand projections received from Texas Water Development Board. It was the consensus of the Group for the LRWPG Agriculture Committee to review the projections and present a plan of action to the Group at their next scheduled meeting.

Status of Draft Municipal Demands

Parkhill informed the Group that the State's demographer's office had not released date to Texas Water Development Board. TWDB plans to formally revise the schedule for remaining 2016 regional water planning process once the actual date is determined for data availability.

Draft Groundwater Availability

Parkhill and Wentzel presented the Group TWDB groundwater availability data which was snet to Groundwater Conservation Districts within Region P.

Open Public Meeting

Stafford declared the meeting to be a public meeting and requested public comments regarding the water management strategy development. There were none. Brzozowski moved to approve the Water Management Strategy screening process as presented. Weinheimer seconded the motion. Motion passed.

2016 Planning Cycle

Bookout summarized the 2016 Planning Cycle schedule. He presented the Group a potential schedule and work task revisions.

Committee Updates

No further Committee updates were available.

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Future Meeting Dates

The Group's next scheduled meeting will be Monday, September 24, 2012. Butschek moved to approve the Executive Committee take any necessary action prior to the next scheduled meeting. Brzozowski seconded the motion. Motion passed.

There were no public comments.

The meeting adjourned at 3:50 p.m.

Harrison Stafford II
Chairman

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Minutes of Lavaca Regional Water Planning Group
February 28, 2013
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Navidad Room of the Harry Hafernick Recreation Center located approximately seven (7) miles southeast of Edna, Jackson County, Texas, off Highway 111 in Brackenridge Plantation Park and Campground on Thursday, February 28, 2013 at 1:30 p.m.

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Roy Griffin, Rodney Jahn, Jack Maloney, Richard Ottis, L.G. Raun, Robert Shoemate, Michael Skalicky, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Neil Hudgins, Lester Little, Robert Martin, Edward Pustka, and Harrison Stafford II.

Also present was: Lann Bookout of Texas Water Development Board, Jaime Burke and Virginia Wilkinson of AECOM, Josh Harper of Texas Parks and Wildlife Department, Phillip Spenrath, Wharton County Judge, Ronald Kubecka, LNRA Board President and Karen Gregory, LNRA staff.

Vice-Chair Raun called the meeting to order.

Public Comments
There were no public comments.

Minutes
The minutes of the August 20, 2012 meeting were reviewed. Skalicky moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Appointments for New Voting Members

Brzozowski informed the Group that new voting members are needed to replace Philip Miller, Counties, Wharton County, and David Wagner, Counties, Lavaca County.

Ottis moved to appoint Phillip Spenrath, Wharton County Judge, to replace Philip Miller and reassign Edward Pustka, Public, Lavaca County, to Counties, Lavaca County. Weinheimer seconded the motion. Motion passed.

The Appointment Committee will work together to fill the vacant position, Public, Lavaca County.

Election of Officers

Ottis moved to re-elect Stafford, Chairman, Raun, Vice-Chairman, and Brzozowski, Secretary of the Lavaca Regional Water Planning Group. Brzozowski seconded the motion. Motion passed.

Revised Regional Water Planning Requirements and Update from TWDB

Bookout reviewed with the Group the Revised Regional Water Planning Requirements. A power point with background information on planning requirements, purpose and nature of rule changes, and a summary of specific rule changes was presented to the Group.

Consultant Update

Burke gave the Group an overview of 2016 planning activities and revised schedule including activities to date, work progress highlights since the last meeting and scheduling and upcoming work. Burke and Wilkinson also gave an update on non-municipal demand projections including mining demand updates. The Group was presented a draft letter prepared by Burke to the Water User Groups (WUG) with draft population projections. Butschek recommended changing the word "expected" in the third paragraph to "potential".

Weinheimer moved to approve the draft letter as prepared by Burke with recommended change by Butschek, to the WUGs for comments. Griffin seconded the motion. Motion passed.

Burke and Wilkinson discussed with the Group the scope of work development for Task 4D – Evaluation and recommendation of Water Management Strategies (WMS). The Region needs to submit and receive approval on a Scope of Work prior to evaluating strategies. Conjunctive Use was a recommended WMS in the 2011 Plan, but is not allowed per TWDB in 2016 Plan. The Group discussed how to identify potentially feasible Water Management Strategies within the TWDB Regional Water Planning Guidelines.

Burke presented the Group with a brief status of neighboring regional water planning group activities. The Group requested to be kept updated on activities for Region K, L, and N. Burke agreed to provide monthly Region K updates with the monthly Lavaca Region progress reports, and will provide updates on the other regions at the quarterly meetings.

LRWPG Committee Updates

Updates from Committees were discussed when applicable in previous discussions. No Committee meeting dates were scheduled.

Future Meeting Dates

The Group tentatively scheduled their next meeting for Tuesday, May 14, 2013 at 1:30 p.m.

The meeting adjourned at 4:25 p.m.

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Harrison Stafford II
Chairman

Minutes of Lavaca Regional Water Planning Group
May 14, 2013
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Navidad Room of the Harry Hafernick Recreation Center located approximately seven (7) miles southeast of Edna, Jackson County, Texas, off Highway 111 in Brackenridge Plantation Park and Campground on Tuesday, May 14, 2013 at 1:30 p.m.

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Neil Hudgins, Rodney Jahn, Lester Little, Jack Maloney, Robert Martin, Phillip Spenrath, Edward Pustka, L.G. Raun, Robert Shoemate, Michael Skalicky, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Roy Griffin, Richard Ottis, and Harrison Stafford II.

Also present was: Lann Bookout of Texas Water Development Board, Jaime Burke and Virginia Wilkinson of AECOM, Josh Harper of Texas Parks and Wildlife Department, Ronald Kubecka, LNRA Board President and Jerry Adelman, LNRA Board member and Karen Gregory, LNRA staff.

Vice-Chair Raun called the meeting to order.

Public Comments
There were no public comments.

Minutes
The minutes of the February 28, 2013 meeting were reviewed. Weinheimer moved to approve the minutes as presented. Clark seconded the motion. Motion passed.

Appointments for New Voting Members

Brzozowski informed the Group that a voting member is needed for Public, Lavaca County replacing Edward Pustka, who replaced David Wagner, Counties, Lavaca County. Maloney moved to appoint David Wagner, Public, Lavaca County. Pustka seconded the motion. Motion passed.

TWDB Project Manager Update

Bookout reviewed with the Group the timeline including revision submission and amending Scope – Task 4D.

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Consultant Update

Burke and Wilkinson briefed the Group (via Power Point presentation).

Burke summarized agenda items previously discussed at the February 28, 2013 LRWPG meeting.

Wilkinson summarized task work since February 28, 2013, including attendance of TWDB training sessions, conference calls, and preparation of Chapters 1 and 7. Raun raised questions about pending legislative impacts on requirements to prioritized projects in both the regional and state water plans. The consultants and TWDB staff noted that should legislation be passed it would result in new rule development which would provide guidance as to how prioritization would occur.

Wilkinson asked planning group members to be aware of changed conditions that should be considered when developing the plan. Lann Bookout, TWDB staff, pointed out the recent decision in Aransas Project v. Shaw as an example of such changed conditions.

The planning group members discussed drought contingency plans and the need for GCDs to provide plans to the GMA. Brzozowski suggested that could be a source of coordination for non-municipal uses and county-other.

The planning group extensively discussed the definition of Drought of Record and requested the consultants follow up with suggestions of how to proceed, including seeking clarification from the TWDB, providing any easily attainable data, etc. The group noted that 2011 was Lake Texana's single driest year but may not be the new drought of record.

Wilkinson presented draft population and municipal demand projections from TWDB and comment responses from Water User Groups. It was noted that the City of Edna may have building permit and school enrollment data to support higher population growth. El Campo may not have revisions and the consultants were asked to follow up directly with the City. The planning group authorized consultants to submit initial revisions to TWDB in July per the Chairman's approval. The initial revisions will be sent to the planning group members prior to submittal to TWDB. The planning group will meet again on July 23 to seek final adoption as necessary.

Burke reviewed draft manufacturing demands. It was confirmed that the LNRA contract with Inteplast should be 1,000 ac-ft (down from 1,832 in previous plan.) Brzozowski raised the question about the 10,000 ac-feet currently going to Corpus Christi being reserved to meet industrial demands within Region P. Raun requested clarification about what is included in manufacturing and how aquaculture is categorized. Bookout confirmed he would check with TWDB.

Burke led a discussion of a list to date of potentially feasible water management strategies, as well as new ideas. At this time the planning group opted not to direct consultants to develop Scope of Work items. This matter will be revisited at the July planning group meeting.

An extensive discussion of Zebra Mussels indicated that this may become a threat in Region P in the near future, constituting the need for emergency measures in case of single-supply being impacted

LRWPG Committee Updates

Updates from Committees were discussed when applicable in previous discussions. No Committee meeting dates were scheduled.

Future Meeting Dates

The Group tentatively scheduled their next meeting for Tuesday, July 23, 2013 at 9:30 a.m.

The meeting adjourned at 4:25 p.m.

Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
July 23, 2013
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Navidad Room of the Harry Hafernick Recreation Center located approximately seven (7) miles southeast of Edna, Jackson County, Texas, off Highway 111 in Brackenridge Plantation Park and Campground on Tuesday, July 23, 2013 at 9:30 a.m.

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Roy Griffin, Neil Hudgins, Jack Maloney, Robert Martin, Richard Ottis, Edward Pustka, L.G. Raun, Robert Shoemate, Michael Skalicky, Phillip Spenrath, Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Rodney Jahn, Lester Little, and David Wagner.

Also present was: Lann Bookout of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Ronald Kubecka, LNRA Board President, Charles Taylor, LNRA Board member and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the May 14, 2013 meeting were reviewed. Griffin stated that the minutes incorrectly list him as an absentee group member.

Weinheimer moved to approve the minutes as presented with recommended correction. Butschek seconded the motion. Motion passed.

Texas Water Development Board Update

Bookout presented the Group with Texas Water Development Board prioritization of Regional and State Water Plan projects. He also presented information regarding House Bill 4, Senate Joint Resolution 1 and House Bill 1025 implementation deadlines. Bookout also presented the Group with information regarding the State Water Implementation Fund for Texas (SWIFT).

Consultant Update

Burke briefed the Group (via Power Point presentation).

DRAFT

Burke summarized agenda items previously discussed at the May 14, 2013 meeting.

Burke also summarized task work since May 14, 2013, including preparation of monthly progress reports for May and June 2013, communication activities with Texas Water Development Board (TWDB), efforts to finalize population and municipal demands, preparation of possible non-municipal demand revisions, continued efforts for drought and conservation, including initial development of survey to water user groups (WUGs) concerning sources, supplies, conservation and drought and the Regional Water Planning Group Chairs' conference call on July 2, 2013.

Burke presented the Group with information regarding the population and municipal demand projections and manufacturing demand projections for their review.

Brzozowski moved to approve the draft population and municipal demand projections as provided by Texas Water Development Board with no changes. Shoemate seconded the motion. Motion passed with 14 ayes and 1 nay by Griffin.

Griffin moved to approve the draft manufacturing demand projections as provided by Texas Water Development Board, except for Jackson County, where revisions were recommended to increase the demand back to those in the 2012 State Water Plan with an extrapolation to 2070. Weinheimer seconded the motion. Motion passed.

Updates from Committees were discussed when applicable in previous discussions. No Committee meeting dates were scheduled.

The Group tentatively scheduled their next meeting for Monday, October 7, 2013 at 9:30 a.m.

The meeting adjourned at 10:45 a.m.

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Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
December 2, 2013
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Navidad Room of the Harry Hafernick Recreation Center located approximately seven (7) miles southeast of Edna, Jackson County, Texas, off Highway 111 in Brackenridge Plantation Park and Campground on Monday, December 2, 2013 at 1:30 p.m.

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Roy Griffin, Neil Hudgins, Jack Maloney, L.G. Raun, Robert Shoemate, Harrison Stafford II, David Wagner, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Rodney Jahn, Lester Little, Robert Martin, Phillip Spenrath, Richard Ottis, Edward Pustka, and Michael Skalicky.

Also present was: Lann Bookout of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Rodney Tegeler of Rice Belt Warehouse, Ronald Kubecka, LNRA Board President, Jerry Adelman, LNRA Board member and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the July 23, 2013 meeting were reviewed.

Weinheimer moved to approve the minutes as presented. Butschek seconded the motion. Motion passed.

Texas Water Development Board Update

Bookout updated the Group with Texas Water Development Board prioritization of Regional and State Water Plan projects. He also presented information regarding the State Water Implementation Fund for Texas (SWIFT) and the State revolving fund financial assistance workshops being conducted by the TWDB.

Consultant Update

Burke briefed the Group (via Power Point presentation).

DRAFT

Burke summarized agenda items previously discussed at the July 23, 2013 meeting.

Burke also summarized task work since July 23, 2013, including preparation of monthly progress reports.

Burke presented the Group with information regarding the final TWDB population and demand approval.

Burke also presented the Group the draft Water Needs Analysis. She also presented the requirements to receive a "Notice to Proceed" to evaluate potential water management strategies under Task 4D.

Discuss and Consider Draft Scope of Work

The Group discussed the draft Scope of Work for potential water management strategy evaluation (Task 4D). Each potential strategy was presented to the Group for their review and discussion.

There were no public comments regarding the potential water management strategies as presented and discussed.

Approval of Task 4D Scope of Work

The Group discussed the draft Scope of Work for Task 4D.

Brzozowski moved to approve the Task 4D Scope of Work and authorize consultants and LNRA to submit Scope of Work to Texas Water Development Board. Weinheimer seconded the motion. Motion passed.

The meeting adjourned at 3:25 p.m.

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Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
May 5, 2014
Edna, Texas

A meeting of the Lavaca Regional Water Planning Group was held in the Navidad Room of the Harry Hafernick Recreation Center located approximately seven (7) miles southeast of Edna, Jackson County, Texas, off Highway 111 in Brackenridge Plantation Park and Campground on Monday, May 5, 2014 at 1:30 p.m.

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Roy Griffin, Neil Hudgins, Jack Maloney, Robert Martin, Phillip Spenrath, Richard Ottis, and Ed Weinheimer.

Absent Voting Group Members were: Tommy Brandenberger, Rodney Jahn, Lester Little, Edward Pustka, L.G. Raun, Robert Shoemate, Michael Skalicky, Harrison Stafford, and David Wagner.

Also present was: Lann Bookout and Sarah Backhouse of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Clay Harris, City of El Campo, Lawrence Brown, Texas State Soil Water Conservation Board, Paul Bizier and Luke Burris of Barge Waggoner Summer & Cannon, Inc., Ronald Kubecka, LNRA Board President, Leonard Steffek, LNRA Board member, and Heather Tobola, LNRA staff.

Secretary Brzozowski called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the December 2, 2013 meeting were reviewed.

Weinheimer moved to approve the minutes as presented. Clark seconded the motion. Motion passed.

Appointments for New Voting Members

Brzozowski informed the Group that a new voting member is needed to replace Tommy Brandenberger, Industries, Lavaca County, who has submitted his resignation. The Appointment Committee will work together to fill the vacant position.

Brzozowski also informed the Board that Jack Maloney, Municipalities, City of Yoakum, has retired from the City of Yoakum. Maloney informed the Board that he would like to continue to serve on the Lavaca Regional Water Planning Group. The Group agreed and was appreciative of Maloney's willingness to serve.

Election of Officers

Clark moved to re-elect Stafford, Chairman, Raun, Vice-Chairman, Brzozowski, Secretary of the Lavaca Regional Water Planning Group and re-elect Griffin and Weinheimer to the Executive Committee. Weinheimer seconded the motion. Motion passed.

Update from TWDB Project Manager

Bookout introduced Sarah Backhouse, as the Texas Water Development Board new Project Manager. Backhouse and Bookout updated the group on upcoming deadlines and deliverables.

Consultant Update

Burke briefed the Group (via Power Point presentation).

Burke summarized agenda items previously discussed at the December 2, 2013 meeting.

Burke also summarized task work since December 2, 2013.

Burke briefed the Group on the discussion with Region K Modeling Committee on the topic of Garwood surface water availability. Drought of record indicated that 100,000 AFY is available for Garwood Irrigation. The Region K/Region P split is currently 84%/16%. The available volume has been somewhat reduced in recent years attributable to the emergency drought relief. Region K is assuming that the full amount is available for supply. Region P could assume a reduced supply that would firm up under the LCRA off-channel reservoir strategy.

Griffin moved to reduce the Garwood supply from 16,000 acre feet to 4,000 acre-feet. Spenrath seconded the motion. Motion passed.

Weinheimer moved to approve the consultant team to prepare and submit the required technical memorandum prior to August 1, 2014 to be ratified by the Regional Water Planning Group following submittal. Spenrath seconded the motion. Motion passed.

LRWPG Committee Updates

The LRWPG By-laws Committee will schedule a meeting to prepare policy statements before next legislative session.

DRAFT

El Campo Reuse Project

Bizier of Barge Waggoner Sumner & Cannon, Inc. gave a presentation to the Group regarding the City of El Campo's State Revolving Fund (SRF) application. The City of El Campo is applying for a SRF loan for wastewater planning and design. The reuse of treated effluent is not currently included in the Region P Regional Water Plan. TWDB requires that the Plan to be amended or to request a waiver from the TWDB. To complete the loan application, the City needs a letter from the Lavaca Regional Water Planning Group to Texas Water Development Board indicating the Group's response to the City's planning/feasibility study on the potential for reuse of treated effluent from the City's wastewater treatment plant.

Spenrath moved to approve the LRWPG to send a letter in support of reuse of treated effluent from the City of El Campo's wastewater treatment plant. Griffin seconded the motion. Motion passed.

Griffin moved to amend the Task 4D Scope of Work to include Reuse as a strategy for inclusion in the 2016 Plan and to delete Corpus Christi Surface Water Purchase as a strategy and authorize the consultants and LNRA to submit the amended Scope of Work to TWDB for approval. Maloney seconded the motion. Motion passed.

There were no public comments regarding the addition of Reuse strategy to the Scope of Work and deleting Corpus Christi Surface Water Purchase as a strategy.

Draft Prioritization of Water Management Strategies

Burke informed the Group that TWDB finalized and approved the uniform standards and project scoring spreadsheet that LRWPG used to prioritize projects in the 2011 LRWP. Each Region is to use the provided template to score each project in the Plan. The scoring results will determine the priority position of each project. LRWPG has two (2) projects from the 2011 LRWP.

Spenrath moved to approve draft prioritization for submittal to TWDB by May 30, 2014. Weinheimer seconded the motion. Motion passed.

Weinheimer moved to authorize the consultant and the LRWPG Executive Committee to work to address any comments received relative to the draft prioritization list submitted and develop the final prioritization for RWPG consideration and approval. Clark seconded the motion. Motion passed.

The Group tentatively scheduled a LRWPG meeting for August 18, 2014 at 1:30 p.m.

There were no public comments.

DRAFT

The meeting adjourned at 3:23 p.m.

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Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
August 18, 2014
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 18, 2014 at 1:30 p.m..

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Jack Maloney, Phillip Spenrath, Richard Ottis, Edward Pustka, L.G. Raun, Robert Shoemate, and Harrison Stafford II.

Absent Voting Group Members were: Roy Griffin, Neil Hudgins, Lester Little, Robert Martin, Michael Skalicky, David Wagner, and Ed Weinheimer.

Also present was: Bech Brunn, Lauren Graber, and Lann Bookout of Texas Water Development Board, Jaime Burke of AECOM, Josh Harper of Texas Parks and Wildlife Department, Lawrence Brown, Texas State Soil Water Conservation Board, Ronald Kubecka, LNRA Board President and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

Stafford introduced Bech Brunn and Lauren Graber from the Texas Water Development Board (TWDB). Brunn serves as a director of TWDB. He addressed the Group with information regarding TWDB's support for planning, financial assistance, and outreach for conservation and development of water for Texas.

Minutes

The minutes of the May 5, 2014 meeting were reviewed.

Ottis moved to approve the minutes as presented. Spenrath seconded the motion. Motion passed.

Appointments for New Voting Members

Brzozowski informed the Group that new voting members were needed to replace Tommy Brandenberger, Industries, Lavaca County and Rodney Jahn, Small Business, Lavaca County, who have submitted their resignations. The Appointment Committee will work together to fill the vacant positions.

Update from TWDB Project Manager

Bookout updated the group on upcoming deadlines and deliverables.

Consultant Update

Burke briefed the Group (via Power Point presentation).

Burke summarized agenda items previously discussed at the May 5, 2014 meeting.

Burke also summarized task work since May 5, 2014 LRWPG meeting.

Burke presented the Group with final Prioritization of Water Management Strategies from the 2011 Lavaca Regional Water Plan. The Group was previously emailed final prioritization documents for their review. The submittal to TWDB is September 1, 2014.

Raun moved to approve the final prioritization of the 2011 Lavaca Regional Water Plan Water Management Strategies for submittal to the TWDB by September 1, 2014. Brzozowski seconded the motion. Motion passed.

The Group approved the completion and submittal of the Technical Memorandum at the May 5th meeting. The consultants completed data entry, reviewed reports and submitted the Technical memorandum on July 31, 2014. Burke presented the Group the Technical Memorandum. TWDB requires the Group to ratify the Technical Memorandum.

Spenrath moved to ratify the Lavaca Region Technical memorandum which was submitted to TWDB on July 31, 2014 as presented. Ottis seconded the motion. Motion passed.

Burke briefed the Group on the new drought-related Chapter 7 for 2016. TWDB has provided a template for Chapter 7. Requirements include:

Define Drought of Record (regional and local)
Summarize regional drought preparations and responses
Emergency interconnects
Region-specific drought response and contingency plans
Drought Management WMS
Other regional drought recommendations

The Group needs to establish a Drought Committee to address portions of TWDB requirements:

Closed meeting to collect emergency interconnect data
Other items as Committee deems appropriate

Raun moved to establish a Drought Committee to included members: Hudgins, Skalicky, Weinheimer, Maloney, and Brzozowski. Ottis seconded the motion. Motion passed.

The Group discussed the Policy and Legislative Chapter which included Unique Designations in 2011 RWP and proposed regulatory changes and resolutions. Burke informed the Group to consider updates to policy recommendations, unique stream and reservoir designations.

The Group tentatively scheduled a LRWPG meeting for December 1, 2014 at 1:30 p.m.

There were no public comments.

The meeting adjourned at 3:20 p.m.

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Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
January 19, 2015
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 19, 2015 at 1:30 p.m..

Voting Group Members present were: John Butschek, Patrick Brzozowski, Gerald Clark, Roy Griffin, Neil Hudgins, Jack Maloney, Robert Martin, Richard Ottis, Robert Shoemate, Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: Lester Little, Phillip Spenrath, Edward Pustka, L. G. Raun, Michael Skalicky, and David Wagner.

Also present was: Sarah Backhouse of Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Michael W, Rivet of Formosa Plastics, Tony Franklin of TSSWCB, Kristin Lambrecht of the Texas Department of Agriculture, Ronald Kubecka, LNRA Board President and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the August 18, 2014 meeting were reviewed.

Butschek moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

LRWPG Contracting Entity

Backhouse informed the Group that as part of the regional water planning process, it is necessary to approve a contracting entity for the fifth round of planning.

Weinheimer moved to approve the Lavaca-Navidad River Authority as the Lavaca Regional Water Planning Group political subdivision and contracting entity for the fifth round of regional water planning. Clark seconded the motion. Motion passed.

DRAFT

Voting Member Nominations

Brzozowski informed the Group that new voting members were needed to replace Tommy Brandenberger, Industries, Lavaca County, and Rodney Jahn, Small Business, Lavaca County, who have submitted their resignations. A new voting member is also needed to represent water utilities. The Appointment Committee will work together to fill the vacant positions.

Election of Officers

Clark moved to re-elect Stafford, Chairman, Raun, Vice-Chairman, and Brzozowski, Secretary of the Lavaca Regional Water Planning Group and Griffin and Weinheimer to the Executive Committee. Ottis seconded the motion. Motion passed.

LRWPG Political Subdivision Approval to Act

Maloney moved to approve for Lavaca-Navidad River Authority (LRWPG Political Subdivision) to provide public notice and submit a grant application to Texas Water Development Board (TWDB on behalf of LRWPG for funding the fifth round of region water planning. Shoemate seconded the motion. Motion passed.

Authorization of LRWPG Chair

Shoemate moved to authorize the Lavaca Regional Water Planning Group (LRWPG) Chair to submit a request to the Texas Water Development Board (TWDB) to perform a socio-economic impact analysis after LRWPG's water needs are finalized. Brzozowski seconded the motion. Motion passed.

Ratification LNRA's Execution of Amendment #6

Brzozowski moved to ratify Lavaca-Navidad River Authority's execution of Texas Water Development Board Contract Amendment #6 for contract 1148301327. Weinheimer seconded the motion. Motion passed.

TWDB Update

Backhouse briefed the Group on the following:

- 5th Regional Water Planning Cycle
  - 5th cycle contracts must be executed by August 31
  - Applications for funding due to TWDB March 3
  - Initial funding for Tasks 2A, 2B, and partial funding of Task 10
  - Large public notice associated with applying for funds
- Current Contract Amendment

- Timeline
  - Water Management Strategy data module released early April
  - IPP due to TWDB May 1
  - RWPGs to hold public hearings on IPP
  - Water Management Strategy data completed by July 1
  - Final Plan due to TWDB December 1
  - Final 2016 project prioritization list due to TWDB December 1

Backhouse also provided information regarding the IPP process which included a schematic indicating process. Information was also made available for the Group on SWIFT: State Water Implementation Fund for Texas.

Consultant Update

Burke briefed the Group (via Power Point presentation).

Burke summarized agenda items previously discussed at the August 18, 2014 meeting.

Burke also summarized recent task work since August 18th LRWPG meeting which included strategy evaluation efforts and draft chapter work.

Burke and the Group discussed Draft Chapter 1 (Regional Planning Area Description) which will be sent to the Group for their review next week. Draft Chapter 2 (Population and Water Demands) and Draft Chapter 3 (Analysis of Current Water Supplies) were sent to the Group for their review on January 7th. Draft Chapter 4 (Water Needs) will also be sent to the Group next for their review. Comments are due by the end of February for all draft Chapters.

Burke also presented information for the Group to discuss regarding draft water management strategies.

Burke presented information on the Drought Chapter 7 including requirements. The Drought Committee will be meet 30 minutes prior to the next scheduled LRWPG meeting.

Burke also informed the Group of the following schedule:

- Initially Prepared Plan due May 1st. (RWPG needs to approve the plan prior to submittal).
- TWDB Database entry due July 1st.
- Public hearing to receive public comments in June or July.
- Final Adopted 2016 Plan and Prioritization of 2016 Plan WMS due December 1st.

The Group scheduled LRWPG meetings for February 23 and March 23 at 1:30 p.m.

There were no public comments.

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The meeting adjourned at 3:42 p.m.

Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
February 23, 2015
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, February 23, 2015 at 2:00 p.m..

Voting Group Members present were: Patrick Brzozowski, Gerald Clark, Neil Hudgins, Jack Maloney, Richard Ottis, Robert Shoemate, Michael Skalicky, Phillip Spenrath, Harrison Stafford II, David Wagner, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Roy Griffin, Lester Little, Robert Martin, Edward Pustka, and L. G. Raun.

Also present was: Sarah Backhouse and Clay Schultz of Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Brooke Duever, Watermaster Specialist, Ronald Kubecka, LNRA Board President and Karen Gregory, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the January 19, 2015 meeting were reviewed.

Weinheimer moved to approve the minutes as presented. Clark seconded the motion. Motion passed.

Voting Member Nominations

Brzozowski briefed the Group on his efforts to fill the vacant member positions. Contacts have been made to several candidates. Brzozowski will inform the Group at the next scheduled meeting of the progress.

Texas Water Development Board Update

Backhouse briefed the Group as follows:

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- Applications for 5th Regional Water Planning Cycle funding due to TWDB March 3rd
- Initially Prepared Plan (IPP) due to TWDB – May 1
- Regional Water Planning Groups will hold public hearings on IPP
- Final Plan due to TWDB December 1
- Final 2016 project prioritization list due to TWDB December 1
- Regional Water Planning Group Chairs conference call with TWDB to be held March 9th

Backhouse introduced Clay Schultz, Regional Water Planning & Development Team 5 Manager, Texas Water Development Board. Schultz presented the Group with information on TWDB Financial Assistance Programs. Information was provided pertaining to the State Revolving Fund Programs and State Programs including Texas Water Development Fund (Dfund), Rural Water Assistance Fund (RWAF), and State Water Implementation Fund for Texas (SWIFT).

Authorization for Public Notice and Public Hearing

Backhouse informed the Group that authorization from the Planning Group was necessary for the political subdivision to post public notice and to hold a public hearing on the Initially Prepared Plan (IPP) which is due to the Texas Water Development Board May 1, 2015.

Spenrath moved to approve to authorize the Lavaca Regional Water Planning Group political subdivision (LNRA) to post public notice and hold a public hearing on the Initially Prepared Plan. Skalicky seconded the motion. Motion passed.

Consultant Update

Burke briefed the Group.

Burke summarized agenda items previously discussed at the January 19, 2015 meeting.

Burke also summarized recent task work since January 19th LRWPG meeting which included strategy evaluation efforts and draft chapter work.

Burke requested that all comments/recommendations on the draft Chapters 1-4 be submitted by March 2nd. The Group discussed draft Chapter 8 – Unique Stream Segments, Reservoir Sites, and Legislative Recommendations. Comments regarding draft Chapter 8 should be submitted by the next meeting date of March 23rd.

Burke also presented information for the Group to discuss regarding draft water management strategies. Draft information regarding water management strategies will be sent to the Group prior to the March 23rd meeting for their review.

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Discuss and Schedule Future Meeting Dates

The Group's next scheduled meeting is March 23, 2015 at 1:30 p.m.

Public Comments

Wharton County Judge Spenrath addressed the Group regarding the City of Wharton water availability and potential water use and sale.

South Texas Watermaster Program

Brzozowski introduced Brooke Duever, Watermaster Specialist for the South Texas Watermaster Program. Duever is responsible for the Lavaca Basin. Duever informed the Group that the Watermaster Program informs individuals and groups as needed concerning water rights and other matters related to availability of surface water. The program also responds to complaints and may follow up with enforcement actions if necessary.

Watermaster deputies also provide services such as measuring reservoirs to insure compliance with state law requirements. They perform Doppler measurements on diversion water pipes and may set stream-flow markers to help water-right holders comply with guidelines. Databases are kept to document amounts of water authorized and used.

The Watermaster Program will also update and maintain water-right ownerships and assessments due on each water-right account.

The meeting adjourned at 4:15 p.m.

Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
March 23, 2015
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 23, 2015 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Gerald Clark, Roy Griffin, Neil Hudgins, Jack Maloney, Robert Martin, Richard Ottis, L. G. Raun, Robert Shoemate, Michael Skalicky, Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Lester Little, Edward Pustka, Phillip Spenrath, and David Wagner.

Also present was: Sarah Backhouse, Jennifer White, and Kathleen Jackson of Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Stefan Schuster of MWH, Mike Rivet of Formosa, Ronald Kubecka, LNRA Board President, and Jennifer Dierlam, LNRA staff.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the February 23, 2015 meeting were reviewed.

Gerald Clark moved to approve the minutes as presented. Weinheimer seconded the motion. Motion passed.

Voting Member Nominations

Brzozowski informed the Group that he made several contacts regarding potential nominees but had not received responses as of this date.

Texas Water Development Board Update

Chairman Stafford introduced Kathleen Jackson, Board Member with the Texas Water Development Board. Jackson was appointed to the TWDB Board by Governor Rick Perry in 2014. Jackson addressed the Group and stated that one of her goals is to see TWDB more efficient in developing water for Texas.

DRAFT

Authorize LNRA to Execute a Contract with TWDB

Backhouse informed the Group authorization was needed from LRWPG for LNRA (LRWPG political subdivision) to execute a contract with Texas Development Board (TWDB) for the fifth cycle of regional water planning.

Raun moved to approve to authorize Lavaca-Navidad River Authority (LNRA) to execute a contract with Texas Water Development Board (TWDB) on behalf of the Lavaca Regional Water Planning Group (LRWPG) for the fifth cycle of regional water planning. Skalicky seconded the motion. Motion passed.

Consultant Update

Burke briefed the Group.

Burke presented information to the Group regarding Chapters 1-4, 8. Edits were discussed. Burke will send the Group edited Chapters 1-4, based on the discussion for their review. The Group requested more time to review Chapter 8. Chapters 9, 10 and 7 have been presented to the Group for their review. The remaining Chapters will be presented to the Group for their review and edits. At the April meeting, the Group will be asked to recommend final edits to all Chapters.

Burke presented the Group a summary of Potential Management Strategies for their consideration. The Group discussed in depth the potential strategies. The Group will select and consider approval of potential water management strategies at the April meeting.

Burke also presented the Group with a schedule indicating the following:

- Initially Prepared Plan due May 1st.
  - ✓ LRWPG needs to approve the plan prior to submittal
- Public hearing to receive public comments in June or July.
- Final adopted 2016 Plan and Prioritization of 2016 Plan WMS due December 1st.

Discuss and Schedule Future Meeting Dates

The Group's next scheduled meeting is April 20, 2015 at 1:30 p.m.

DRAFT

Public Comments

There were no public comments.

The meeting adjourned at 5:00 p.m.

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Harrison Stafford II
Chairman

DRAFT

Minutes of Lavaca Regional Water Planning Group
April 20, 2015
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 20, 2015 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Gerald Clark, Neil Hudgins, Lester Little, Jack Maloney, Richard Ottis, Phillip Spenrath, L.G. Raun, Robert Shoemate, Michael Skalicky, Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Roy Griffin, Robert Martin, Edward Pustka, and David Wagner.

Also present was: David Meesey of Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Kristin Lambrecht, Texas Department of Agriculture, Ronald Kubecka, LNRA Board President, and Karen Gregory, LNRA Deputy General Manager.

Chairman Stafford called the meeting to order.

Public Comments

There were no public comments.

Minutes

The minutes of the March 23, 2015 meeting were reviewed.

Weinheimer moved to approve the minutes as presented. Ottis seconded the motion. Motion passed.

Voting Member Nominations

There were no voting member nominations.

Texas Water Development Board Update

Meesey briefed the Group on the Initially Prepared Plan TWDB submission requirements.

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Consultant Update

Burke briefed the Group on amending Task 4D Scope of Work to revise *LNRA Groundwater Desalination* strategy name to *LNRA Desalination* and to revise strategy scope to include brackish ground water and brackish surface water sources. The Group discussed the Amendment of Task 4D Scope of Work and were presented a draft copy of the proposed amendment.

There were no public comments.

Brzozowski moved to approve the amendment of Task 4D Scope of Work to incorporate revision and submit amended Task 4D Scope of Work to the Texas Water Development Board as discussed and presented. Weinheimer seconded the motion. Motion passed.

The Group discussed and reviewed RWPG edits on Draft Chapters 5, 6, 7, 9, 10, and 11 of the Initially Prepared Plan.

LRWPG Initially Prepared Plan

Skalicky moved to adopt the Lavaca Regional Water Planning Group Initially Prepared Plan and authorize submittal of the IPP to the Texas Water Development Board by May 1, 2015. Weinheimer seconded the motion. Motion passed.

Discuss and Schedule Future Meeting Dates

The Group scheduled a Public Hearing on June 23, 2015 at 6:30 p.m.

Public Comments

There were no public comments.

The meeting adjourned at 2:40 p.m.

DRAFT

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Harrison Stafford II
Chairman

LAVACA REGIONAL WATER PLANNING GROUP

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

EXECUTIVE COMMITTEE
Judge Harrison Stafford II
Chairman
Counties

L. G. Raun
Vice-Chairman
Agricultural

Patrick Brzozowski
Secretary
River Authorities

Roy D. Griffin
Electric Service

Ed Weinheimer
Small Businesses

MEMBERS

John Butschek
Municipalities

Gerald Clark
Agricultural

Neil Hudgins
GCDs

Lester Little
Agricultural

Jack Maloney
Municipalities

Robert Martin
Agricultural

Commissioner Edward Pustka
Counties

Judge Phillip Spenrath
Counties

Richard J. Ottis
Industries

Robert Shoemate
Environmental

Michael Skalicky
Water Districts

David Wagner
Public

Notice of Public Hearing

The Lavaca-Navidad River Authority (LNRA), on behalf of the Lavaca Regional Water Planning Group (LRWPG) for the Senate Bill 1 Regional Water Planning Program, is providing notice that a public hearing will be held on Tuesday, June 23, 2015 at 6:30 p.m. to accept public comment on the 2016 Initially Prepared Plan (IPP) for the Lavaca Regional Water Planning area. The hearing will be 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.

The Lavaca Regional Water Planning Group was established to develop a regional water plan for the Lavaca Regional Water Planning Area (TWDB Region "P"), which includes Jackson County, Lavaca County, and a portion of Wharton County. A record of the hearing will be kept and comments will be responded to in considering the final plan.

Copies of the Initially Prepared Plan (IPP) are available for review at the following Public Libraries and County Clerk's Offices:

Jackson County Library
411 N. Wells Street
Edna, TX 77947

Wharton County Library - El Campo Branch
200 W. Church Street
El Campo, TX 77437

Hallettsville Library
705 E. 4th Street
Hallettsville, TX 77964

Wharton County Library – Louise Branch
803 3rd Street, P. O. Box 36
Louise, TX 77455

Shiner Public Library
115 E. Wolters At 2nd Street
Shiner, TX 77984

Carl & Mary Welhausen Library
810 Front Street
Yoakum, TX 77995

Jackson County Clerk's Office
Barbara Williams, County Clerk
115 W. Main Street, Room 101
Edna, TX 77957

Wharton County Clerk's Office
Sandra K. Sanders, County Clerk
309 E. Milam Street
Wharton, TX 77488

Lavaca County Clerk's Office
Elizabeth A. Kouba, County Clerk
412 N. Texana Street
Hallettsville, TX 77964

The IPP is also available for review on the LNRA website at www.lnra.org and at the LNRA office at 4631 FM 3131, Edna, Texas 77957.

Questions about the arrangements for the hearing can be directed to Karen Gregory at (361) 782-5229 or kgregory@lnra.org. Questions about the content of the IPP can be directed to Patrick Brzozowski, Secretary, Lavaca Regional Water Planning Group, P.O. Box 429, Edna, Texas 77957, (361)782-5229 or pbrzozowski@lnra.org.

Comments may be submitted orally at the public hearing. Comments in written form can be presented at the hearing or mailed to the Lavaca Regional Water Planning Group address listed above. Comments received by August 24, 2015 will be included in the written summary of comments from the public hearing and will be brought to the attention of the Lavaca Regional Water Planning Group for consideration at a regular meeting of the Group.

Witness my hand this 13th day of May 2015

Patrick Brzozowski, P. E., Secretary

Lavaca Regional Water Planning Group
Public Hearing
Edna, Texas
June 23, 2015

A Public Hearing of the Lavaca Regional Water Planning Group was held in the Meeting Room of the Lavaca Navidad River Authority Office Complex, 4631 FM3131, located approximately seven (7) miles east of Edna, Jackson County, Texas to accept public comment on the 2016 Initially Prepared Plan (IPP) for the Lavaca Regional Water Planning area. Approximately 15 people were present. A sign-in sheet is attached to the minutes.

Voting Group Members present were: Chairman Harrison Stafford II, Vice-Chairman L.G. Raun, Patrick Brzozowski, Neil Hudgins, Jack Maloney, Robert Shoemate, and Michael Skalicky.

Absent Voting Group Members were: Butschek, Clark, Griffin, Little, Martin, Ottis, Pustka, Spenrath, and Wagner, and Weinheimer.

Also present were: Tom Barnett of the Texas Water Development Board, Jaime Burke of AECOM, Joshua Harper of Texas Parks and Wildlife Department, Kristin Lambrecht of Texas Department of Agriculture, LNRA Board President Ronald Kubecka, and Doug Anders and Karen Gregory of Lavaca-Navidad River Authority.

Chairman Stafford called the hearing to order.

Burke presented the group with a power point presentation giving a general overview of the State's Regional Water Planning Process and the 2016 Region P Initially Prepared Regional Water Plan. A copy of Burke's presentation to the group is attached to the minutes.

Chairman Stafford opened the public comment period.

There were no public comments.

The meeting adjourned at 6:59 p.m.

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Harrison Stafford II
Chairman

DRAFT

2016 Lavaca Regional Water Plan

Public Hearing – June 23, 2015

Discussion Items

- Regional Water Planning in Texas
- Lavaca Regional Water Planning Area
- Overview of 2016 Initially Prepared Regional Water Plan for LRWPA
- Public Comment

Regional Water Planning in Texas

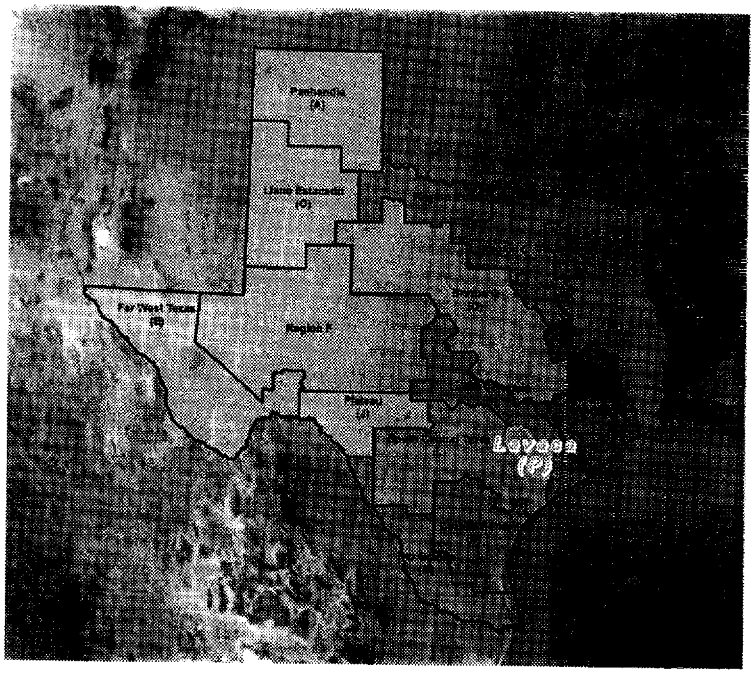
History

- First initiated under Senate Bill 1 of 75th Legislature in 1997
- In response to:
  - Drought
  - Population growth
  - Limits of existing water supplies
- "Bottom Up" approach to water planning
- Administered by Texas Water Development Board
- First Regional Water Plan submitted in 2001, with updates every five years following.

Regional Water Planning in Texas

About the Regions…

- 16 Regions identified in the state, designated A though P
- Designated with consideration for:
  - Watershed and aquifer delineations
  - Water utility development patterns
  - Socioeconomic characteristics
  - Existing regional water planning areas
  - Political subdivision boundaries
  - Public comment
- Routinely up for review



LAVACA

Regional Water Planning in Texas

LAVACA

About the Planning Groups...

- Volunteers with various levels of experience n the water industry
- Diverse backgrounds:
  - Public
  - Counties
  - Municipalities
  - Industries
  - Agriculture
  - Environment
  - Small Business
  - Power Generation
  - River Authorities
  - Water Districts
  - Water Utilities
  - Groundwate- Managemert Area
- Assisted by teams of consultants

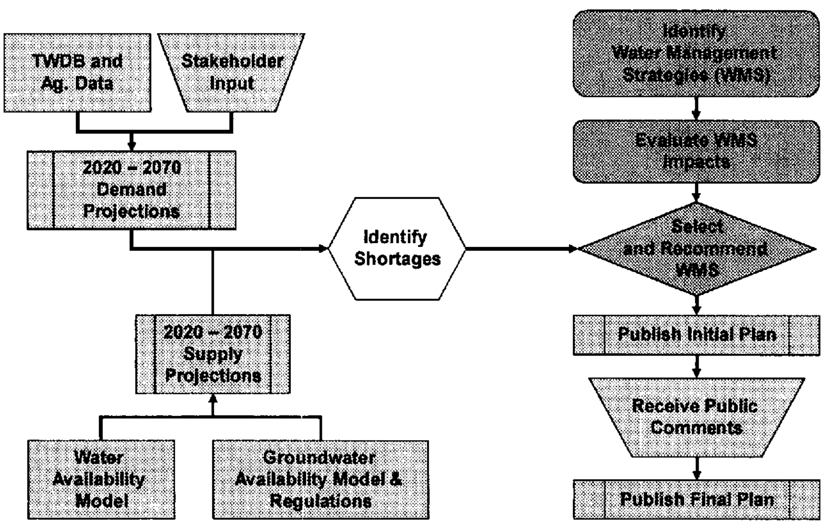
Regional Water Planning in Texas

About the Plans…

- *"The regional water plan shall provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions…"*
  -Texas Administrative Code
- Encourage public and stakeholder input throughout the process
- Study and consider:
  - Population and demand growth
  - Drought-of-Record water supply projections
  - Impacts of water management strategies
    - Financial cost
    - Environmental, agricultural, and socioeconomic impacts
- New Chapters for 2016 Plan – Drought Response (Ch 7) and Comparison to Previous RWP (Ch 11)

Regional Water Planning in Texas

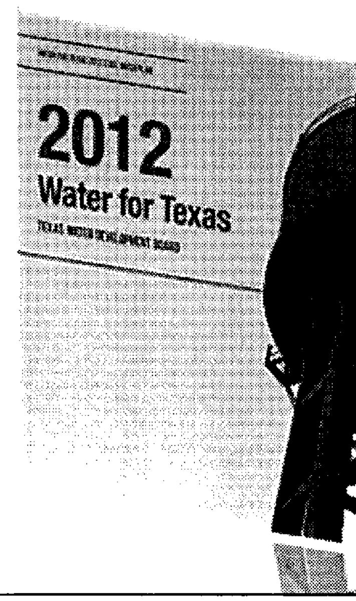
Regional Planning Process



Regional Water Planning in Texas

State Water Plan

- Developed as a compilation of Regional Water Plans
- Published in year following conclusion of regional planning
  - 2012 SWP followed 2011 RWPs

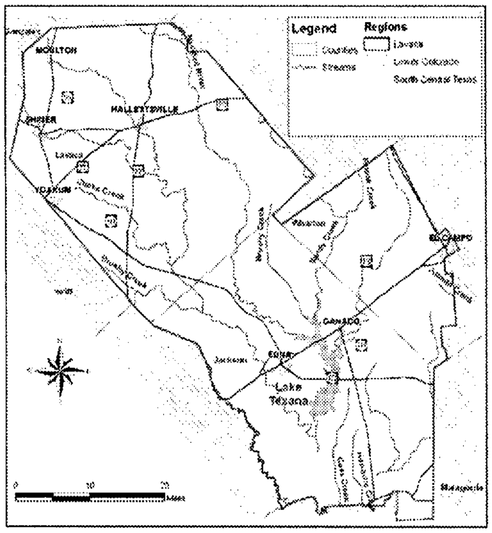


Regional Water Planning in Texas

- Regional Planning <u>does</u> <u>not</u> replace the need for planning at the local level
- Regional Planning <u>does</u> build upon local planning efforts to provide long-term, regional direction
- Communication and feedback are essential to the process
- No mandate to adopt strategies in the plans
- Consistency with the State Water Plan is required to:
  - Obtain TWDB funding for infrastructure
  - Obtain a water right permit

Lavaca Regional Water Planning Area

- Jackson and Lavaca Counties, portion of Wharton County
- One river basin
  - Lavaca
- Two coastal basins
- One major aquifer
  - Gulf Coast Aquifer
- One minor aquifer
- Seven cities



Lavaca Regional Water Planning Area

- Very distinctive characteristics
  - Major surface water provider to other Regions
  - Low population and municipal demand
  - High agricultural groundwater demand
  - Major rice-producing region
- Designation as separate region helps protect local interests

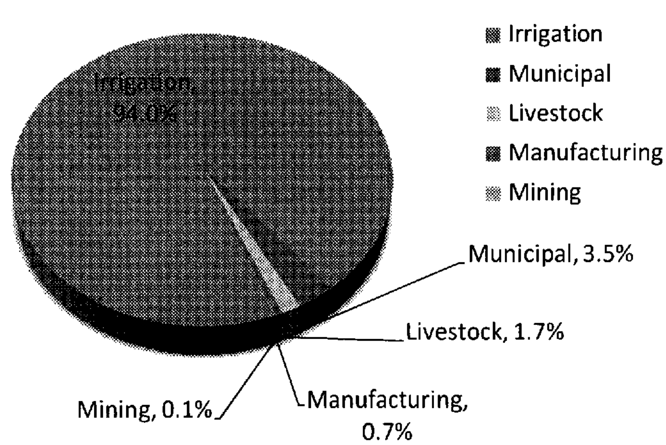
Population and Water Demands

- TWDB projections
  - Municipalities were sent correspondence regarding the TWDB draft population and municipal demand projections
  - No municipality population changes were requested based on TWDB required documentation
  - LRWPG requested changes to the TWDB draft agricultural demand projections to equal those in the 2012 State Water Plan
  - LRWPG requested changes to the TWDB draft manufacturing demand projections for Jackson County, but the 2016 RWP may not include all currently anticipated future MFG demands
- Regional population increasing to 55,522 by 2070
- Total regional demand 231,778 to 233,596 ac-ft/yr
  - Approximately 207 MGD

Population and Water Demands

Water Demand by Type

2070



WWP Requests for Service

- LNRA is sole WWP in the Region
- Current requests for additional surface water supply
  - Existing and potential future customers
  - Within region and outside region
- Not all requests included in RWP demands, but needs are addressed in WMS chapter

- Existing Agreements

Customer	Volume (ac-ft/yr)
Calhoun CND	594
Corpus Christi	41,840
Corpus Christi Interruptible	12,000
Point Comfort	178
Formosa Plastics	30,800
Inteplast Corporation	1,032
Held in Reserve	56
Total	**86,500**

Existing Supply and Allocations

- Supplies allocated by county and river basin
- Total groundwater availability 196,524 ac-ft/yr
- Allocated 179,331 ac-ft per year
- Availability and demands not always in same location

Identification of Needs

- Shortages to irrigated agriculture – groundwater source
- Maximum production under dry conditions

WUG Name	County	Basin	Shortage (Ac-Ft/Yr)					
			2020	2030	2040	2050	2060	2070
IRRIGATION	WHARTON	COLORADO -LAVACA	12,779	12,779	12,779	12,779	12,779	12,779
IRRIGATION	WHARTON	LAVACA	37,506	37,506	37,506	37,506	37,506	37,506
		Wharton County Total	*50,285*	*50,285*	*50,285*	*50,285*	*50,285*	*50,285*
		Regional Total	**50,285**	**50,285**	**50,285**	**50,285**	**50,285**	**50,285**

WMS Evaluation and Selection

- Potential Water Management Strategies Considered
  - Drought Management
  - Municipal Conservation
  - Irrigation Conservation
  - Reuse – El Campo
  - Lavaca Off-Channel Reservoir (LNRA)
  - Aquifer Storage and Recovery (LNRA)
  - Desalination (LNRA)
  - Expand Use of Groundwater
  - Lane City Reservoir (Region K strategy)

WMS Evaluation and Selection

- Recommended Water Management Strategies
  - To meet Irrigation Needs:
    - Irrigation Conservation
    - Lane City Reservoir (Region K strategy)
  - Strategies requested by entities:
    - Reuse – El Campo
    - Lavaca Off-Channel Reservoir (LNRA)
    - Aquifer Storage and Recovery (LNRA)
    - Desalination (LNRA)
  - To encourage mindful water use and allow for State funding options:
    - Drought Management (Municipal)
    - Municipal Conservation

WMS Evaluation & Selection

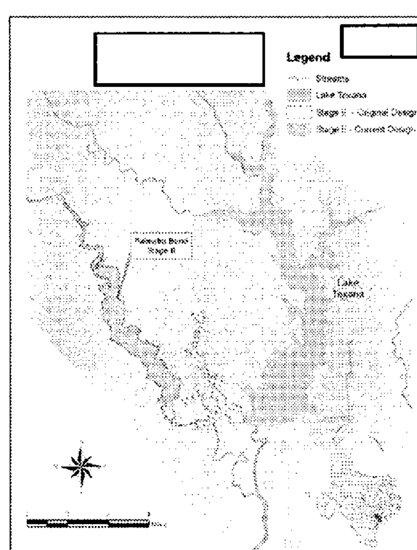
Region	ID	Recommended Water Management Strategy	Total Capital Costs ($)	Estimated Annual Average Unit Cost ($/ac-ft/yr)	Water Supply Volume (ac-ft/yr) 2020	2030	2040	2050	2060	2070
P	P1	Local Wharton County Off-Channel Reservoir(s) - Lane City Reservoir	$0	$33	12,000	12,000	12,000	12,000	12,000	12,000
P	P2	Municipal Conservation	$463,056	$350	209	323	444	507	590	674
P	P3	Reuse of Municipal Effluent - El Campo	$3,272,000	$896	560	560	560	560	560	560
P	P4	Irrigation Conservation - On-farm Conservation	$20,833,000	$76	41,338	41,338	41,338	41,338	41,338	41,338
P	P5	Irrigation Conservation - Tail water Recovery	$22,561,000	$423	8,429	8,429	8,429	8,429	8,429	8,429
P	P6	Lavaca River Off-Channel Reservoir	$123,213,000	$867	16,963	16,963	16,963	16,963	16,963	16,963
P	P7	Drought Management - Municipalities	$0	$100	324	321	316	320	318	321
P	P8	LNRA Desalination	$31,393,000	$1,369	6,452	6,452	6,452	6,452	6,452	6,452
P	P9	LNRA Aquifer Storage and Recovery	$130,169,000	$1,641	14,163	14,163	14,163	14,163	14,163	14,163

Drought Response

- Current Drought Preparations and Response
  - Drought Triggers
  - Emergency Interconnects
  - Emergency Responses to Drought or Loss of Supply
  - Drought Management Strategies
- Regional Drought Response Recommendations

Unique Stream Segments and Reservoir Sites

- Planning Group can only recommend USS, URS; Legislature designates
- No USS recommended for 2011 RWP
- Palmetto Bend Stage II has been designated as a unique reservoir site from the 2007 State Water Plan
- LNRA currently looking at an off-channel option instead



Policy Recommendations

LAVACA

Groundwater
- Sustainable yield of the Gulf Coast Aquifer
- Rule of capture
- Support GCDs
- Fees for groundwater export

Environment
- Consideration of environmental issues

Regional Planning
- Continued Funding of RWPGs
- Support for inter-regional coordination

Conservation
- Program funding
- Good stewardship

Public Comment on the IPP

LAVACA

- Initially Prepared Plan Available:
  - http://www.lnra.org/water/lavaca-regional-water-planning-group
  - County Clerk's Offices
  - Libraries
- Taking written comments through:
  - 5:00 PM August 24, 2015
- Please submit comments to:
  - Patrick Brzozowski
    Secretary, Lavaca Regional Water Planning Group
    P.O. Box 429
    Edna, TX 77957

Minutes of Lavaca Regional Water Planning Group
October 26, 2015
Edna, Texas

DRAFT

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 26, 2015 at 1:30 p.m.

Voting Group Members present were: Patrick Brzozowski, Gerald Clark, Neil Hudgins, Jack Maloney, Robert Martin, Richard Ottis, Edward Pustka, Phillip Spenrath, L.G. Raun, Robert Shoemate, Harrison Stafford II, and Ed Weinheimer.

Absent Voting Group Members were: John Butschek, Lester Little, Roy Griffin, Michael Skalicky, and David Wagner.

Also present was: Sarah Backhouse 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, 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 April 20, 2015 and June 23, 2015 meetings were reviewed.

Weinheimer moved to approve the minutes as presented. Raun seconded the motion. Motion passed.

Voting Member Nominations

Brzozowski informed the Board that Roy Griffin, Electric Service, had retired from Jackson Electric Cooperative, Inc. Brzozowski has contacted Jim Coleman, General Manager of Jackson Electric Cooperative, Inc. for a potential new member. Brzozowski will report to the Group when more information is available.

Briefing on Regional Water Planning Area Boundaries

Brzozowski informed the Board that the Texas Water Development Board voted at their October meeting to make no changes at this time to the regional water planning area boundaries.

Texas Water Development Board Update

Backhouse reminded the Group of the December 1st deadline for submitting the 2016 Final Plan. She also informed the Group that the procurement of consultants for the 2020 Plan should be a public hearing process.

Backhouse also presented information on the SWIFT funding available through Texas Water Development Board.

Consultant Update

Burke discussed with the Group the following:

1. Reviewed comments from TWDB and TPWD on Initially Prepared Plan (IPP) and discussed proposed responses to comments and applicable modifications to the IPP.

2. Presented and discussed the TWDB Socioeconomic Impact Analysis of Not Meeting Water Needs for the 2016 Lavaca Regional Water Plan and discussed the inclusion of the analysis in Chapter 6 of the Final Plan.

3. Discussed TWDB Infrastructure Financing Surveys for projects with capital costs in the 2016 LRWP and addressed the inclusion the surveys in Chapter 9 of the Final Plan.

4. Presented and discuss addition of public comment material to Chapter 10 of the 2016 LRWP.

5. Presented and discussed draft prioritization of 2016 LRWP projects.

6. Discussed required final efforts to complete 2016 LRWP and schedule to complete

Burke informed the Group that based on the discussion, comments, and recommended edits from the Group today, she would send to them, prior to the next scheduled meeting, red-lined plan chapters for the group's final review. She will also include the Chapter text, plus any appendices that are either new or updated.

The Group was asked to contact her with any additional comments or edits.

DRAFT

Discuss and Schedule Future Meeting Dates

The Group's next scheduled meeting will be November 17, 2015 to finalize the 2016 Lavaca Regional Water Plan.

Public Comments

There were no public comments.

The meeting adjourned at 3:30 p.m.

____
Harrison Stafford II
Chairman

DRAFT

APPENDIX 10B

Written Public and Agency Comments

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

August 6, 2015

Mr. Harrison Stafford, III, Chair
Lavaca Regional Water Planning Group
115 W. Main
Edna, Texas 77957

Ms. Karen Gregory
Lavaca-Navidad River Authority
P.O. Box 429
Edna, Texas 77957

Re: Texas Water Development Board Comments on the Lavaca (Region P) Regional Water Planning Group Initially Prepared Plan, Contract No. 1148301327

Dear Mr. Stafford and Ms. Gregory:

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted by May 1, 2015 on behalf of the Region P Regional Water Planning Group. The attached comments follow this format:

- **Level 1:** Comments, questions, and online regional water planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and,

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

The TWDB's statutory requirement for review of potential interregional conflicts under Title 31 Texas Administrative Code (TAC) §357.62 will not be completed until submittal and review of adopted regional water plans. However, as previously requested by our Executive Administrator, please inform TWDB in advance of your final plan if your planning group believes that an interregional conflict exists. Additionally, subsequent review will be performed as the planning group completes its data entry into the regional water planning database (DB17). If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve.

Our Mission

To provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas

Board Members

Bech Bruun, Chairman | Carlos Rubinstein, Member | Kathleen Jackson, Member

Kevin Patteson, Executive Administrator

Title 31 TAC§357.50(d) requires the regional water planning group to consider timely agency and public comment. Section 357.50(e) requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan. While the comments included in this letter represent TWDB's review to date, please anticipate the need to respond to additional comments regarding data integrity, including any water source overallocations, in the regional water planning database (DB17) once data entry is completed by the region.

Standard to all planning groups is the need to include certain content in the final regional water plans that was not yet available at the time that IPPs were prepared and submitted. In your final regional water plan, however please be sure to also incorporate the following:

a) Completed results from the regional planning group's infrastructure financing survey (IFR) for sponsors of recommended projects with capital costs *[31 TAC §357.44]*;
b) Completed results from the implementation survey *[31 TAC §357.45(a)]*;
c) The socioeconomic impact evaluation provided by TWDB at the request of the planning group *[31 TAC §357.33(c)]*;
d) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC §357.50(d)]*;
e) Evidence, such as a certification, that the final, adopted regional water plan is complete and adopted by the planning group *[31 TAC §357.50(j)(1)]*; and,
f) The required DB17 reports, as made available by TWDB, in the executive summary or elsewhere in the plan as specified in the Contract *[31 TAC §357.50(e)(2)(B), Contract Scope of Work Task 4D(p), Contract Exhibit 'C', Table 2]*. Please ensure that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB17. For the purpose of development of the 2017 State Water Plan, water management strategy and other data entered by the regional water group in DB17 (and as presented in the regional plan) shall take precedence over any conflicting data presented in the final regional water plan. *[Contract Exhibit 'C', Sections 12.1.3. and 12.2.2]*

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

- The prioritized list of all recommended projects in the regional water plan *[Texas Water Code 15.436(a), Contract Scope of Work Task 13]*; and,
- Any remaining hydrologic modeling files or GIS files that may not have been provided at the time of the submission of the IPP but that were used in developing the final plan. *[31 TAC §357.50(e)(2)(C), Contract Exhibit 'C', Section 12.2.1; Contract Scope of Work Task 3-III-13]*

Note that provision of certain content in an electronic-only form is permissible as follows: Internet links are permissible as a method for including model conservation and drought contingency plans within the final regional water plan; hydrologic modeling files may be submitted as electronic appendices, however all other regional water plan appendices should be incorporated in hard copy format within each plan. *[31 TAC §357.50(e)(2)(C), Contract Scope of Work Task 5e, Contract Exhibit 'C', Section 12.2.1]*

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

- Regional water plans must not include any strategies or costs that are associated with simply maintaining existing water supplies or replacing existing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.2, Section 5.1.2.3]*; and,
- Regional water plans must not include any retail distribution-level infrastructure costs (other than those costs related to conservation strategies such as water loss reduction). *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.3]*

To facilitate efficient and timely completion, and Board approval, of your final regional water plan, please provide your TWDB project manager with early drafts of your responses to these IPP comments for preliminary review and feedback.

If you have any questions regarding these comments or would like to discuss your approach to addressing any of these comments, please do not hesitate to contact Sarah Backhouse at (512) 936-2387. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Jeff Walker
Deputy Executive Administrator
Water Supply and Infrastructure

Attachments

cc w/att: Ms. Jaime Burke, AECOM, Inc.

TWDB Comments on the Initially Prepared 2016 Lavaca (Region P) Regional Water Plan

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

1. Please include a summary of the the municipal demand savings due to plumbing fixture requirements (as previously provided by TWDB) in the final, adopted regional water plan. *[31 TAC §357.31(d)]*

2. Chapter 3: The plan is not clear as to whether the existing supplies determined for water user groups (WUGs) and wholesale water providers (WWPs) are legally and physically available under drought of record conditions. Please clarify in the final, adopted regional water plan. *[31 Texas Administrative Code (TAC) §357.32(a)(2)]*

3. Section 3.4.1, page 3-10: The plan is not clear as to whether the calculated surface water run-of-river diversions used for irrigation purposes are based upon water available under drought of record conditions. Please clarify in the final, adopted regional water plan. *[31 TAC §357.32(a)(1)]*

4. Page 4-1: The plan does not appear to include projected needs associated with each WWP, by category of use and county and river basin splits. Please include WWP needs for Lavaca-Navidad River Authority (LNRA) in the final, adopted regional water plan. *[31 TAC §357.33(b),(d)]*

5. Section 5.1.3.1, page 5-4 and Section 5.1.3.2, page 5-7: The plan is not clear as to whether the evaluations of water management strategies for the Lavaca Off-Channel Reservoir and Aquifer Storage and Recovery are based on an unmodified Texas Commission on Environmental Quality (TCEQ) WAM Run 3. Additionally, page 5-5 includes a statement that "Additions and changes to the Base Lavaca WAM to create the strategy analysis are in the attached Appendix," however this information does not appear to be included in an appendix. Please include this information and clarify that the water management strategy evaluations were based upon the most current TCEQ WAM Run 3 in the final, adopted regional water plan. If not, please evaluate these strategies using an unmodified TCEQ WAM Run 3 for the final, adopted regional water plan. *[31 TAC §357.34 (d)(1); Contract Exhibit 'C', Section 3.4.2]*

6. Section 5.1.3.3, page 5-10: The plan states that surface water yield for the LNRA Desalination Strategy was "estimated to be equivalent to the proposed groundwater yield for the strategy." It is not clear as to whether the surface water evaluation is based on an unmodified TCEQ WAM Run 3. Please clarify that the water management strategy evaluation was based upon the most current TCEQ WAM Run 3 in the final, adopted regional water plan. If not, please evaluate this strategy using an unmodified TCEQ WAM Run 3 for the final, adopted regional water plan. *[31 TAC §357.34(d)(1)]*

7. Section 5.1.3.1, page 5-7, Section 5.1.3.3, page 5-11, Appendix 5B, page 5B-1: The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, strategy evaluations 5.1.3.1 (Lavaca Off-Channel Reservoir) states that there is a "marginal impact" to agriculture, but does not appear to include quantification

of the non-zero impact. Additionally, the table on page 5B-1 presents qualitative numeric scores but it is unclear if the scale is based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(C)]*

8. Section 5.1.4.2, page 5-12, 5-17, 5-18, 5B-4, Section 5.1.2.1, page 5-3, 5B-9 and 5B-10: For the municipal and irrigation conservation strategies, please specify the volume of water associated with the share of these strategies that have a capital cost in the final, adopted regional water plan. *[Contract Exhibit 'D', Section 5.4]*

9. Section 5.1.4.3, page 5-14: The City of El Campo reuse strategy appears to indicate retail distribution-level infrastructure was included in the strategy evaluation by the 8-inch line. Please remove all distribution-level infrastructure and costs from the plan and confirm water management strategy evaluations throughout the plan. *[31 TAC §357.34(d)(3)(A), Contract Exhibit 'C', Section 5.1.2.3]*

10. Section 5.2.2, page 5-18, Appendix 5B, page 5B-1: The plan in some instances, does not appear to include a quantitative reporting of environmental factors. For example, strategy evaluation 5.2.2. (Irrigation Conservation) acknowledges impacts, references a 2006 quantification analysis, but acknowledges changed conditions and does not appear to actually include quantified environmental factors for the current plan and changed conditions. Additionally, the table on page 5B-1 presents qualitative numeric scores but it is unclear if the scoring is based upon quantitative data included elsewhere in the plan. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(b)]*

11. Table 7-1 and Section 7.5: The plan does not appear to present recommended triggers and actions for 'severe' and 'critical/emergency' drought conditions. Please include this information in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 7.4]*

12. Please indicate how the planning group considered relevant recommendations from the Drought Preparedness Council (a letter was provided to planning groups with relevant recommendations in November 2014) in the final, adopted regional water plan. *[31 TAC §357.42(h)]*

13. Chapter 10, Page 10-1: While the plan summarizes the planning group meetings held during development of the regional water plan, it does not state that public participation requirements were met. Please clarify in the plan whether the regional water plan was developed in accordance with the public participation requirements of the Texas Open Meetings Act in the final, adopted regional water plan. *[31 TAC §357.21, §357.50(d)]*

14. Section 11.2: The plan does not include a summary of how identified water needs for WUGs and WWPs differ from the 2011 regional water plan. Please include in the final, adopted regional water plan. *[31 TAC §357.45(b)(3)]*

15. Appendix ES-A and Table 2-1, Page 2-7: The values presented in Table 2-1 for Wharton Total and LRWPA Total do not match the DB17 Population Table in Appendix ES-A for the 2060 and 2070 decades. Please reconcile in the final, adopted regional water plan.

16. Appendix 2B: The plan does not include the DB17 WUG Demand report which is referenced throughout the report. For example, on page i, list of appendices; page 2-4, Section 2.2.3 and 2.2.4; page 2-5, Section 2.2.6 and 2.2.7; page 2-6, Section 2.2.8. Please include the DB17 WUG Demand report in Appendix 2B in the final, adopted regional water plan.

17. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example as an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

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

1. Section ES1.1, ES-1: The figure reference shows the following text: "Error! Reference source not found." Suggest including the correct figure reference in the final, adopted regional water plan.
2. Section 1.7.1, page 1-14: The text references Appendix 76C, however there appears to be no Appendix 76C. Suggest adding Appendix 76C or referencing the correct Appendix in the final, adopted regional water plan.
3. Page 3-11, Section 3.7: Please consider including a description of the methodology for allocating existing water supplies to WUGs in the final, adopted regional water plan.
4. Chapter 4: Please consider revising the Chapter 4 header 'Identification of Water Management Strategies Based on Needs' to match the chapter name in the Table of Contents in the final, adopted regional water plan.
5. Page 11-2, Section 11.2.2: The reference to Appendix 2B2 appears to be incorrect. Suggest confirming reference in the final, adopted regional water plan.
6. Appendix 7A, 7A-15: Please consider incorporating 'severe' and 'critical/emergency' trigger and response stages in the 'Irrigation Uses' model drought contingency template in the final, adopted regional water plan.

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Fort Worth

Carter P. Smith
Executive Director

RECEIVED
AUG 17 2015
LAVACA NAVIDAD RIVER AUTHORITY

August 14, 2015

Mr. Patrick Brzozowski
Region P Water Planning Group
c/o Lavaca-Navidad River Authority
P.O. Box 429
Edna, Texas 77957

Re: 2016 Lavaca Regional Water Planning Area Initially Prepared Regional Water Plan

Dear Mr. Brzozowski:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2016 Initially Prepared Regional Water Plan for the Lavaca Regional Water Planning Area (LRWPA) Region P (IPP). As you know, water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. As the agency charged with primary responsibility for protecting the state's fish and wildlife resources, TPWD is positioned to provide technical assistance during the water planning process. Although TPWD has limited regulatory authority over the use of state waters, TPWD is committed to working with stakeholders and others to provide science-based information during the water planning process intended to avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

- Does the IPP recommend any stream segments be nominated as ecologically unique?
- If the IPP includes strategies identified in the 2010 regional water plan, does it address concerns raised by TPWD in connection with the 2010 Water Plan.

The population of Region P was just over 49,000 in 2010 and is expected to be over 55,000 by 2070. Total regional water demands in the LRWPA are projected to be 233,596 ac-ft/yr in the year 2020, decreasing to 231,820 ac-ft/yr and 231,778 ac-ft/yr in years 2060 and 2070, respectively. TWDB total irrigation water demand for the region is projected to be 217,846 acre-feet per year for all decades from 2020 through 2070.

Approximately 90 percent of the current water use in the LRWPA is for irrigated agriculture while municipal water use accounts for five percent. Rice irrigation accounts for a majority of the projected irrigation demands in the Lavaca Region, making up 87 percent of total irrigation demands.

The expected total water savings for municipalities that have a per capita water use greater than 140 gpcd and have a demonstrated need are projected to be just over 200 acre-feet in 2020, increasing to over 600 acre-feet by 2070. Total water savings from irrigation conservation is projected to be 41,338 acre-feet/year. TPWD commends the LRWPA for progress made toward implementing municipal and irrigation water conservation strategies since water conservation is the most environmentally protective water management strategy (WMS).

Other proposed WMS include reuse, drought management for municipalities, off channel reservoirs (Wharton County, Lane City and Lavaca River Off-Channel Reservoirs), brackish groundwater desalination, an aquifer storage and recovery project and expanded use of groundwater.

Environmental impacts associated with the development of a new reservoir can be significant. TPWD appreciates that the LRWPG has recommended an off-channel reservoir option rather than an on-channel reservoir in the 2016 IPP. Construction of off-channel reservoirs can help to minimize wildlife impacts if reservoirs are located to minimize inundation of habitats and diversions are modified to avoid impacts to environmental flows. TPWD concurs with the statement "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".

Disposal of brine concentrate from brackish water desalination discharged to surface water may have unacceptable environmental impacts. Disposal of concentrate by deep well injection is one preferred approach to minimize impacts to fish and wildlife resources. From the perspective of environmental impacts, ASR projects are generally preferred over surface reservoirs since habitat impacts can be minimized.

Chapter 1.6 provides a brief description of natural resources in the LRWPA. Additional detail is provided in Appendix 1A. Table 1-5 lists threatened, rare and endangered species within the LRWPA. Existing water sources include the Gulf Coast Aquifer as well as the Navidad and

Lavaca Rivers and Lake Texana. According to the IPP, there are no significant springs in the region. The delta of the Lavaca-Navidad River Basin is important nursery habitat for estuarine and marine vertebrates and invertebrates. These habitats require freshwater inflows to maintain salinities adequate to support these species which include several important recreational and commercial fisheries. 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.

The LRWPA IPP includes limited quantitative reporting of the impacts to natural resources that may result from proposed water supply strategies. In cases where this information is available it should be included. For example, WMS that include development of surface water requiring TCEQ water right permits were evaluated using recently adopted TCEQ environmental flow standards. Those results are presented in Chapter 5.

The LRWPA IPP does not recommend nomination of any stream segments as ecologically unique but does include as Appendix 8A the 2006 TPWD report that documents stream segments in the region that meet at least one of the criteria for classification as ecologically unique. TPWD continues to see importance in recommending and designating significant stream segments and will support the LRWPA in this regard if requested in the next planning cycle.

We appreciate the opportunity to provide these comments. While TPWD values and appreciates the need to meet future water supply demands, we must do so in a thoughtful and sound manner that ensures the ecological health of our state's aquatic and natural resources. If you have any questions, or if we can be of any assistance, please feel to contact Cindy Loeffler at 512-389-8715. Thank you.

Sincerely,

Ross Melinchuk
Deputy Executive Director, Natural Resources

RM:CL:ms

cc: Robin Riechers, Division Director, Coastal Fisheries Division, TPWD
Joshua Harper, Coastal Fisheries Division, TPWD

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APPENDIX 10C

Response to Public and Agency Comments

Response to TWDB Comments on the Initially Prepared 2016 Lavaca (Region P) Regional Water Plan

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

1. Please include a summary of the the municipal demand savings due to plumbing fixture requirements (as previously provided by TWDB) in the final, adopted regional water plan. *[31 TAC §357.31(d)]*

   Response: A description of the municipal demand savings due to plumbing fixture requirements is included at the end of Section 2.2.3, and a copy of the savings is provided in Appendix 2C.

2. Chapter 3: The plan is not clear as to whether the existing supplies determined for water user groups (WUGs) and wholesale water providers (WWPs) are legally and physically available under drought of record conditions. Please clarify in the final, adopted regional water plan. *[31 Texas Administrative Code (TAC) §357.32(a)(2)]*

   Response: A sentence was added to Section 3.7 of Chapter 3 stating that the existing supplies determined for water user groups (WUGs) and wholesale water providers (WWPs) are legally and physically available under drought of record conditions.

3. Section 3.4.1, page 3-10: The plan is not clear as to whether the calculated surface water run-of-river diversions used for irrigation purposes are based upon water available under drought of record conditions. Please clarify in the final, adopted regional water plan. *[31 TAC §357.32(a)(1)]*

   Response: Clarification statements were provided on page 3-10, related to Table 3-3 and the Garwood water supplies.

4. Page 4-1: The plan does not appear to include projected needs associated with each WWP, by category of use and county and river basin splits. Please include WWP needs for Lavaca-Navidad River Authority (LNRA) in the final, adopted regional water plan. *[31 TAC §357.33(b),(d)]*

   Response: A sentence has been added to Page 4-1 stating the LNRA (the WWP in Region P) has 0 ac-ft of projected water needs in the 2016 Lavaca RWP. In addition, data provided by TWDB has been included in an appendix in Chapter 4.

5. Section 5.1.3.1, page 5-4 and Section 5.1.3.2, page 5-7: The plan is not clear as to whether the evaluations of water management strategies for the Lavaca Off-Channel Reservoir and Aquifer Storage and Recovery are based on an unmodified Texas Commission on Environmental Quality (TCEQ) WAM Run 3. Additionally, page 5-5 includes a statement that "Additions and changes to the Base Lavaca WAM to create the strategy analysis are in the attached Appendix," however this information does not appear to be included in an appendix. Please include this information and clarify that the water management strategy evaluations were based upon the most current TCEQ WAM Run 3 in the final, adopted regional water plan. If not, please evaluate these strategies using an unmodified TCEQ WAM

Run 3 for the final, adopted regional water plan. *[31 TAC §357.34 (d)(1); Contract Exhibit 'C', Section 3.4.2]*

Response: Clarifications have been made in the appropriate sections that the unmodified TCEQ Lavaca WAM Run 3 was used to evaluate the strategies. In addition, the WAM coding changes have been included in a new Appendix 5F.

6. Section 5.1.3.3, page 5-10: The plan states that surface water yield for the LNRA Desalination Strategy was "estimated to be equivalent to the proposed groundwater yield for the strategy." It is not clear as to whether the surface water evaluation is based on an unmodified TCEQ WAM Run 3. Please clarify that the water management strategy evaluation was based upon the most current TCEQ WAM Run 3 in the final, adopted regional water plan. If not, please evaluate this strategy using an unmodified TCEQ WAM Run 3 for the final, adopted regional water plan. *[31 TAC §357.34(d)(1)]*

   Response: An unmodified TCEQ WAM Run 3 model was run to determine an available firm yield for this strategy. Additional language has been added to the water management strategy evaluation to support this.

7. Section 5.1.3.1, page 5-7, Section 5.1.3.3, page 5-11, Appendix 5B, page 5B-1: The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, strategy evaluations 5.1.3.1 (Lavaca Off-Channel Reservoir) states that there is a "marginal impact" to agriculture, but does not appear to include quantification of the non-zero impact. Additionally, the table on page 5B-1 presents qualitative numeric scores but it is unclear if the scale is based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(C)]*

   Response: Quantitative reporting of impacts to agricultural resources have been included in the main text of Chapter 5 for all recommended and alternative strategies, in some cases using the term "negligible" as a quantification of zero or near zero. Additionally, the rating criteria guidance sheet has been included following the table on page 5B-1, but is not intended to provide clear, quantifiable values. The main text of Chapter 5 provides the required quantified reporting.

8. Section 5.1.4.2, page 5-12, 5-17, 5-18, 5B-4, Section 5.1.2.1, page 5-3, 5B-9 and 5B-10: For the municipal and irrigation conservation strategies, please specify the volume of water associated with the share of these strategies that have a capital cost in the final, adopted regional water plan. *[Contract Exhibit 'D', Section 5.4]*

   Response: Text has been added to the respective sections/pages explaining that the capital costs shown for irrigation conservation are associated with the full demand reduction volumes listed, and that the capital costs shown for municipal conservation can provide the full demand reduction volumes listed.

9. Section 5.1.4.3, page 5-14: The City of El Campo reuse strategy appears to indicate retail distribution-level infrastructure was included in the strategy evaluation by the 8-inch line. Please remove all distribution-level infrastructure and costs from the plan and confirm water management strategy evaluations throughout the plan. *[31 TAC §357.34(d)(3)(A), Contract Exhibit 'C', Section 5.1.2.3]*

Response: The size of the 8-inch line was determined using the TWDB Costing Tool, based on the amount of water supply the RWPG was comfortable recommending in the Plan, and is intended to represent a transmission pipeline. As the City of El Campo is still looking for potential customers and may require a transmission pipeline, the RWPG requests to keep the conveyance line costs in the Plan.

10. Section 5.2.2, page 5-18, Appendix 5B, page 5B-1: The plan in some instances, does not appear to include a quantitative reporting of environmental factors. For example, strategy evaluation 5.2.2. (Irrigation Conservation) acknowledges impacts, references a 2006 quantification analysis, but acknowledges changed conditions and does not appear to actually include quantified environmental factors for the current plan and changed conditions. Additionally, the table on page 5B-1 presents qualitative numeric scores but it is unclear if the scoring is based upon quantitative data included elsewhere in the plan. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC §357.34(d)(3)(b)]*

    Response: Quantitative reporting of impacts to environmental resources have been included in the main text of Chapter 5 for all recommended and alternative strategies, in some cases using the term "negligible" as a quantification of zero or near zero. With respect to the Irrigation Conservation strategy, a detailed discussion of streamflow impacts was/is provided in Sections 5.2.2.3 and 5.2.2.4, with the following text providing a quantified impact at the end of Section 5.2.2.3: "Overall, conservation would reduce the volume of return flows by half that contribute to the health of streams in LRWPA during dry conditions, following the assumptions presented here."

11. Table 7-1 and Section 7.5: The plan does not appear to present recommended triggers and actions for 'severe' and 'critical/emergency' drought conditions. Please include this information in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 7.4]*

    Response: Severe and critical/emergency drought condition triggers have been included in Table 7-1. In Section 7.5, the Lavaca Regional Water Planning Group recommends that each water user follow their drought contingency plans, and reference is now made back to Table 7-1.

12. Please indicate how the planning group considered relevant recommendations from the Drought Preparedness Council (a letter was provided to planning groups with relevant recommendations in November 2014) in the final, adopted regional water plan. *[31 TAC §357.42(h)]*

    Response: A paragraph has been added to Section 7.7 describing the recommendations from the Drought Preparedness Council, and how the planning group considered them.

13. Chapter 10, Page 10-1: While the plan summarizes the planning group meetings held during development of the regional water plan, it does not state that public participation requirements were met. Please clarify in the plan whether the regional water plan was developed in accordance with the public participation requirements of the Texas Open Meetings Act in the final, adopted regional water plan. *[31 TAC §357.21, §357.50(d)]*

    Response: A sentence has been added in Section 10.1 of Chapter 10 stating that the regional water plan was developed in accordance with the public participation requirements of the Texas Open Meetings Act.

14. Section 11.2: The plan does not include a summary of how identified water needs for WUGs and WWPs differ from the 2011 regional water plan. Please include in the final, adopted regional water plan. *[31 TAC §357.45(b)(3)]*

    Response: A section in Chapter 11 has been added that summarizes a comparison of the identified water needs for WUGs and WWPs.

15. Appendix ES-A and Table 2-1, Page 2-7: The values presented in Table 2-1 for Wharton Total and LRWPA Total do not match the DB17 Population Table in Appendix ES-A for the 2060 and 2070 decades. Please reconcile in the final, adopted regional water plan.

    Response: The values have been reconciled.

16. Appendix 2B: The plan does not include the DB17 WUG Demand report which is referenced throughout the report. For example, on page i, list of appendices; page 2-4, Section 2.2.3 and 2.2.4; page 2-5, Section 2.2.6 and 2.2.7; page 2-6, Section 2.2.8. Please include the DB17 WUG Demand report in Appendix 2B in the final, adopted regional water plan.

    Response: The DB17 WUG Demand report has been included in Appendix 2B.

17. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example as an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

    Response: Water loss estimates have been identified in the water management strategy descriptions in Chapter 5.

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

1. Section ES1.1, ES-1: The figure reference shows the following text: "Error! Reference source not found." Suggest including the correct figure reference in the final, adopted regional water plan.

   Response: Figure reference has been corrected.

2. Section 1.7.1, page 1-14: The text references Appendix 76C, however there appears to be no Appendix 76C. Suggest adding Appendix 76C or referencing the correct Appendix in the final, adopted regional water plan.

   Response: Reference was not valid and has been removed from text.

3. Page 3-11, Section 3.7: Please consider including a description of the methodology for allocating existing water supplies to WUGs in the final, adopted regional water plan.

   Response: A sentence was added to Section 3.7 of Chapter 3 describing the methodology used to allocate the existing water supplies.

4. Chapter 4: Please consider revising the Chapter 4 header 'Identification of Water Management Strategies Based on Needs' to match the chapter name in the Table of Contents in the final, adopted regional water plan.

   Response: The requested revision has been made.

5. Page 11-2, Section 11.2.2: The reference to Appendix 2B2 appears to be incorrect. Suggest confirming reference in the final, adopted regional water plan.

   Response: Reference has been corrected.

6. Appendix 7A, 7A-15: Please consider incorporating 'severe' and 'critical/emergency' trigger and response stages in the 'Irrigation Uses' model drought contingency template in the final, adopted regional water plan

   Response: The template has been slightly modified to reference severe and critical/emergency conditions for triggers and responses, but the Lavaca RWPG would prefer to keep the template essentially as-is.

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LAVACA REGIONAL WATER PLANNING GROUP

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Public

October 26, 2015

Mr. Ross Melinchuk
Deputy Executive Director, Natural Resources
Texas Parks & Wildlife
4200 Smith School Road
Austin, TX 78744

Dear Mr. Melinchuk,

The Lavaca Regional Water Planning Group (LRWPG) appreciates the Texas Parks and Wildlife Department's review and comments on the Initially Prepared 2016 Lavaca Regional Water Plan.

Per your comment regarding quantitative reporting of impacts to natural resources, the final adopted 2016 Lavaca Regional Water Plan contains additional quantification of potential impacts to natural resources that may result from the recommended water management strategies.

Thank you for your assistance in the regional water planning process. We look forward to working with you in future planning cycles.

Sincerely,

Hon. Harrison Stafford, II
Chairman, Lavaca Regional Water Planning Group

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Contents

List of Tables

List of Appendices

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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 2011 Regional Water Plan and have since been implemented, as well as providing a summary comparison of the 2016 Regional Water Plan to the 2011 Regional Water Plan with respect to population, demands, water availability and supplies, and water management strategies.

11.1 Implementation

In the 2011 Lavaca Regional Water Plan, the only identified water needs were for Irrigation in Jackson County and Wharton County. Several water management strategies were considered in the 2011 Lavaca Regional Water Plan, but only one strategy was recommended to meet identified water needs. This strategy was Conjunctive Use of Groundwater in Jackson and Wharton (partial) Counties.

Conjunctive Use of Groundwater involves pumping additional groundwater during dry periods and pumping less groundwater during wet periods. The strategy attempts to find a sustainable long-term balance while acknowledging that groundwater over and above the availability yield of the aquifer is used on a temporary basis.

The last several years have been very dry in the region. As such, it is very likely that this strategy has been implemented. There are no capital costs associated with this strategy, simply the energy cost to pump the additional groundwater.

The TWDB had developed an implementation survey template. This survey template has been filled out and is included as *Appendix 11A*.

11.2 Comparison to the Previous Regional Water Plan

This section discusses how the 2016 Regional Water Plan compares to the 2011 Regional Water Plan, with respect to population, water demands, water supplies, and water management strategies.

11.2.1 Population Projections

Overall for Region P, there is a population decrease of approximately 930 for Year 2020 between the 2011 RWP and the 2016 RWP. The difference in population between the two plans eventually ends up being an increase of approximately 5,183 by Year 2060. The year 2070 was not used for comparison purposes because the 2011 RWP did not include the 2070 decade. However, the rate of population growth by planning decade is approximately 2.9% greater than estimated in the 2011 RWP. Tabular data and bar graphs comparing the two plans can be found in *Appendix 11B*.

Population estimates for each county have changed between the 2011 RWP and the 2016 RWP. The following counties have a higher population predicted by Year 2060 in the 2016 RWP: Lavaca and Wharton (partial).

The following counties have a smaller population predicted by Year 2060 in the 2016 RWP: Jackson.

Population growth rates have also changed between the 2011 RWP and the 2016 RWP. The following counties had a slower population growth rate in the 2016 RWP: Jackson.

The following counties had a faster population growth rate in the 2016 RWP: Lavaca and Wharton (partial).

These changes by county are summarized in *Table 11-1*.

Table 11-1 Population Change by County in Year 2060 since 2011 RWP

County	Population in Year 2060 (2016 RWP)	Population Growth Rate (2016 RWP)
Jackson	Decrease	Decrease
Lavaca	Increase	Increase
Wharton (partial)	Increase	Increase
Total (Region P)	**Increase**	**Increase**

11.2.2 Water Demand Projections

Overall for Region P, there is an increase in water demand of approximately 3,600 acre-feet/year for Year 2020 between the 2011 RWP and the 2016 RWP. The difference in water demand between the two plans eventually ends up being approximately 2,000 acre-feet/year by Year 2060. However, the water demand rate of growth by planning decade is approximately 0.2% less than estimated in the 2011 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 2011 RWP and the 2016 RWP. The following water usage categories have a higher water demand predicted by Year 2060 in the 2016 RWP: Municipal, Livestock, Manufacturing, and Mining.

The following water usage categories have no change in water demand predicted by Year 2060 in the 2016 RWP: Irrigation and Steam-Electric Power Generation.

Water demand growth rates for each usage category have also changed between the 2011 RWP and the 2016 RWP. The following water usage categories had a slower water demand growth rate in the 2016 RWP: Mining. Water demand for Livestock, Irrigation, and Steam-Electric Power Generation had a zero water demand growth rate in both plans.

The following water usage categories had a faster water demand growth rate in the 2016 RWP: Municipal and Manufacturing.

These changes are summarized in *Table 11-2*.

Table 11-2 Water Demand Change by Water Usage Category in Year 2060 since 2011 RWP

Water Usage Category	Water Demand in Year 2060 (2016 RWP)	Water Demand Growth Rate (2016 RWP)
Municipal	Increase	Increase
Livestock	Increase	No Change
Irrigation	No Change	No Change
Manufacturing	Increase	Increase
Mining	Increase	Decrease
Steam-Electric Power Generation	No Change	No Change
Total Water Demand	**Increase**	**Decrease**

Table 11-3 identifies counties that have a higher water demand by Year 2060 than was shown in the 2011 RWP. In addition, the usage category that has the greatest growth is shown in *Table 11-3*.

Table 11-3 Counties with Year 2060 Water Demand Increase from 2011 RWP

County	Total Water Demand Increase in Year 2060 (acre-feet/year)	Greatest Water Usage Increase
Lavaca	1,002	Mining
Wharton (partial)	1,043	Municipal

Table 11-4 identifies Counties that have a lower water demand by Year 2060 than was shown in the 2011 RWP. In addition, the usage category that has the greatest decrease is shown in *Table 11-4*.

Table 11-4 Counties with Year 2060 Water Demand Decrease from 2011 RWP

County	Total Water Demand Decrease in Year 2060 (acre-feet/year)	Greatest Water Usage Decrease
Jackson	-79	Municipal

11.2.3 Drought of Record and Hydrologic Assumptions

There are no changes to the Drought of Record for the Lavaca Region or the hydrologic assumptions used for determining water availability since the 2011 RWP.

11.2.4 Groundwater and Surface Water Availability and Water Supplies

Overall for Region P, the total water source availability is 290,642 acre-feet/year in the 2016 RWP. This represents a decrease in water source availability of approximately 19,600 acre-feet/year (approximately 7 percent) for all planning decades when comparing the 2011 RWP and the 2016 RWP. This loss occurs from the Gulf Coast aquifer availability in Jackson and Lavaca Counties of 13 and 46 percent respectively. Wharton (partial) County has a 10 percent increase in Gulf Coast aquifer availability as compared to the 2011 RWP. *Table 11-5* shows a comparison of the current Modeled Available Groundwater (MAG) numbers to the availability in the 2011 RWP. There is no change in the surface water source availability in Lavaca County between the 2011 RWP and the 2016 RWP.

Table 11-5 Gulf Coast Aquifer Availability Comparison to 2011 RWP

Region	County	Basin	2011 Region P Plan	Current MAG	Change
			2010 Availability	2010 Availability	
P	Jackson	Colorado-Lavaca	17,618	23,615	5,997
		Lavaca	51,395	41,927	-9,468
		Lavaca-Guadalupe	18,863	10,844	-8,019
		County Total	*87,876*	*76,386*	*-11,490*
P	Lavaca	Guadalupe	38,025	41	-37,984
		Lavaca	52	19,944	19,892
		Lavaca-Guadalupe	46	400	354
		County Total	*38,123*	*20,385*	*-17,738*
P	Wharton	Colorado	0	441	441
		Colorado-Lavaca	21,949	11,549	-10,400
		Lavaca	67,904	87,763	19,859
		County Total	*89,853*	*99,753*	*9,900*

The current water supplies available to Region P total 184,331 acre-feet/year in the 2016 RWP. This represents an increase in existing water supply of approximately 20,200 acre-feet/year (approximately 12 percent) for all planning decades between the 2011 RWP and the 2016 RWP.

Distributed between water usage categories, all categories had a growth in water supply since the 2011 RWP except Manufacturing. The largest growth was in Irrigation and Mining with approximately 17,500 acre-feet/year and 2,500 acre-feet/year respectively.

11.2.5 Water Needs

Water needs in the 2016 RWP are a total of 50,285 acre-feet/year for the Irrigation WUG in Wharton County only. Water needs in the 2011 RWP were a total of 67,739 acre-feet/year for Irrigation WUGs, with 5,053 acre-feet/year in Jackson County and 62,686 acre-feet/year in Wharton County. There were no needs for any other water use category or the region's wholesale water provider in both the 2011 RWP and the 2016 RWP.

11.2.6 Recommended Water Management Strategies

As mentioned earlier in the chapter, only one water management strategy was recommended in the 2011 RWP. This strategy was Conjunctive Use of Groundwater in Jackson and Wharton (partial) Counties. Due to the nature of the strategy using groundwater over and above the MAG value, the Region was not allowed to recommend this strategy for this planning cycle.

Along with strategies recommended 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. The following strategies were recommended by the LRWPG in the 2016 RWP:

- Drought Management (Municipalities Only)
- Irrigation Conservation – On-farm Conservation
- Irrigation Conservation – Tail water Recovery
- Local Wharton County Off-Channel Reservoir(s) – Lane City Reservoir
- Reuse of Municipal Effluent (El Campo)

- Lavaca River Off-Channel Reservoir
- LNRA Desalination
- LNRA Aquifer Storage and Recovery
- Municipal Conservation

11.2.7 Alternative Water Management Strategies

There were no Alternative strategies included in the 2011 RWP for the Lavaca Region. Because the recommended strategy from the 2011 RWP was not allowed as a recommended strategy in the 2016 RWP, the LRWPG is including a version of the strategy as an Alternative strategy. In case the groundwater availability volumes increase in the future, or regional water planning rules change with respect to the MAG, the following strategy of using additional groundwater to meet Irrigation needs is included in the 2016 RWP:

- Expand Use of the Gulf Coast Aquifer – Wharton County

In addition, an alternative version of the Lavaca Off-Channel Reservoir recommended strategy was included to identify a potential alternative site location.

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APPENDIX 11A

Implementation Survey Template for 2011 RWP Projects

Appendix 11A - Implementation Survey Template for 2011 RWP Projects

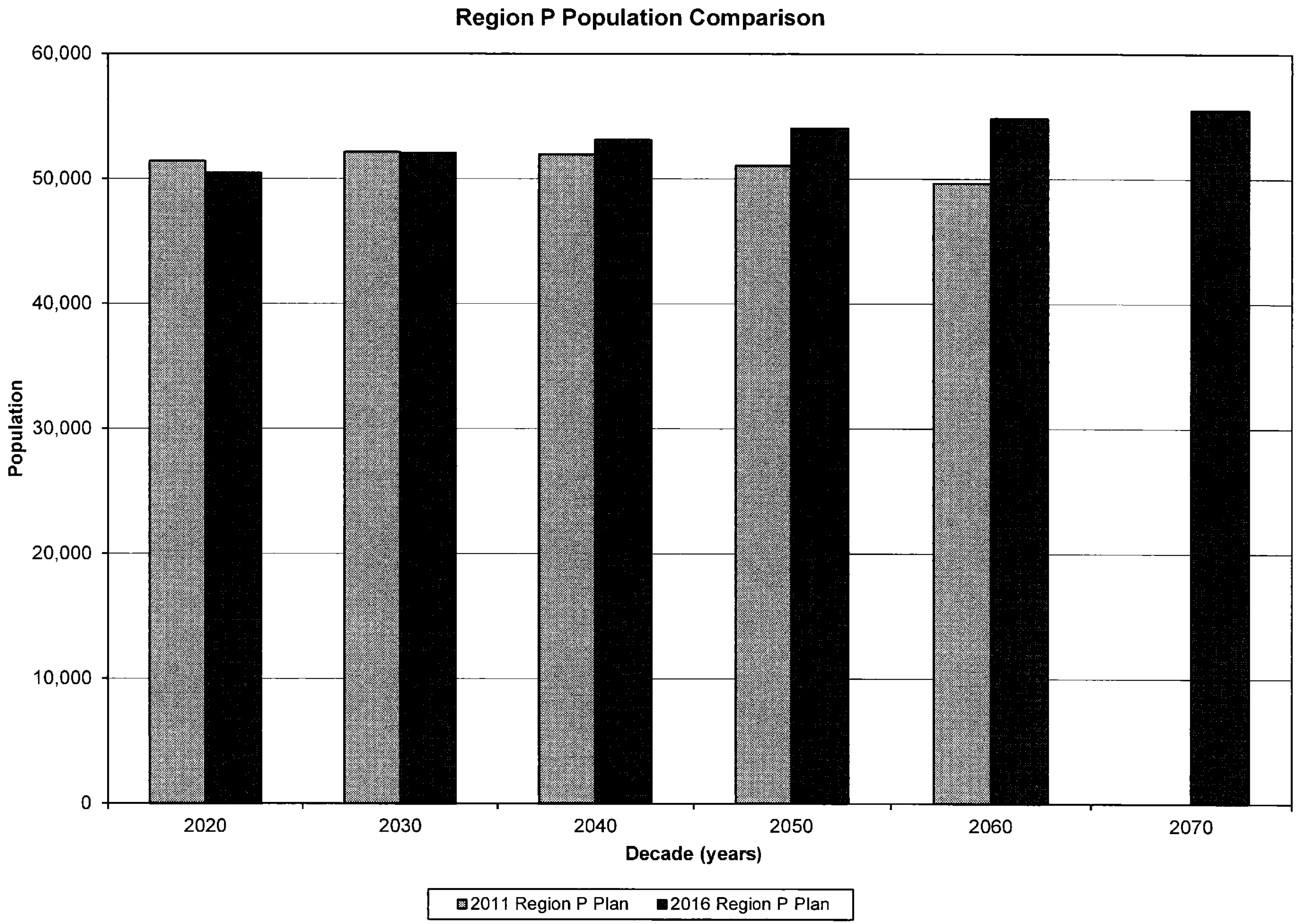
Sponsor Region	WMS Sponsor Entity Id	Sponsor	Recommended Water Management Strategy	DB Project Id	Capital Cost	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	Y denotes strategies with supply volumes included in other strategies	Project Description	Infrastructure Type*	At what level of Implementation is the project?*	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($) (should include development and construction costs)	Year the Project is Online?*	Is this a phased project?*	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Included in the 2016 Plan?*
P	1093	IRRIGATION, JACKSON	Conjunctive use of groundwater (temporary overdraft) - Jackson County	44	0	5053	5053	5053	5054	5053	5053	N	Using additional groundwater during times of drought	No Infrastructure	All Phases Fully Implemented	5053	0	0	2011	No	2011	Self (cash)	No
P	1205	IRRIGATION, WHARTON	Conjunctive use of groundwater (temporary overdraft) - Wharton County	45	0	62686	62686	62686	62686	62686	62686	N	Using additional groundwater during times of drought	No Infrastructure	All Phases Fully Implemented	62686	0	0	2011	No	2011	Self (cash)	No

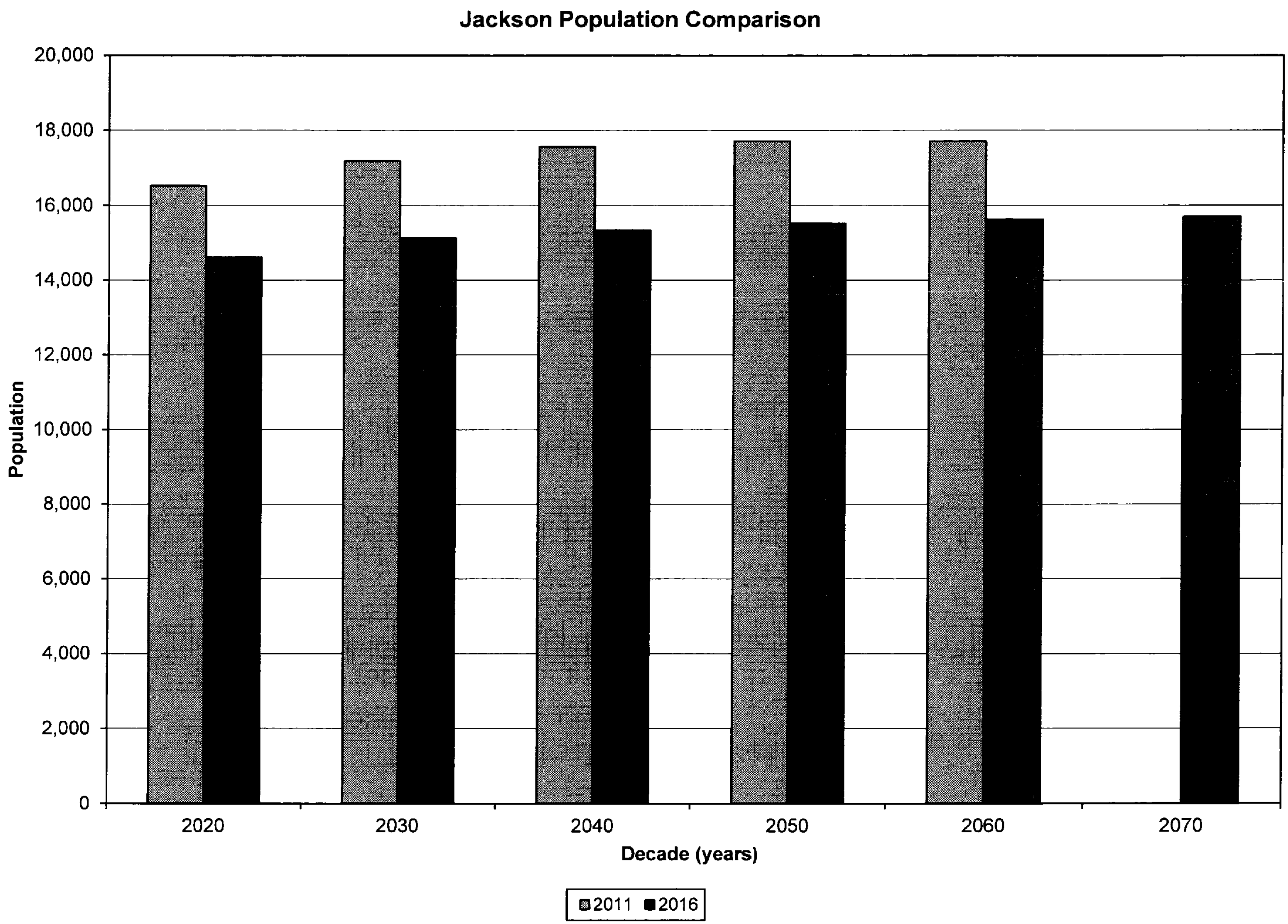
APPENDIX 11B

Comparison Tables and Graphs for Population and Demand Projections

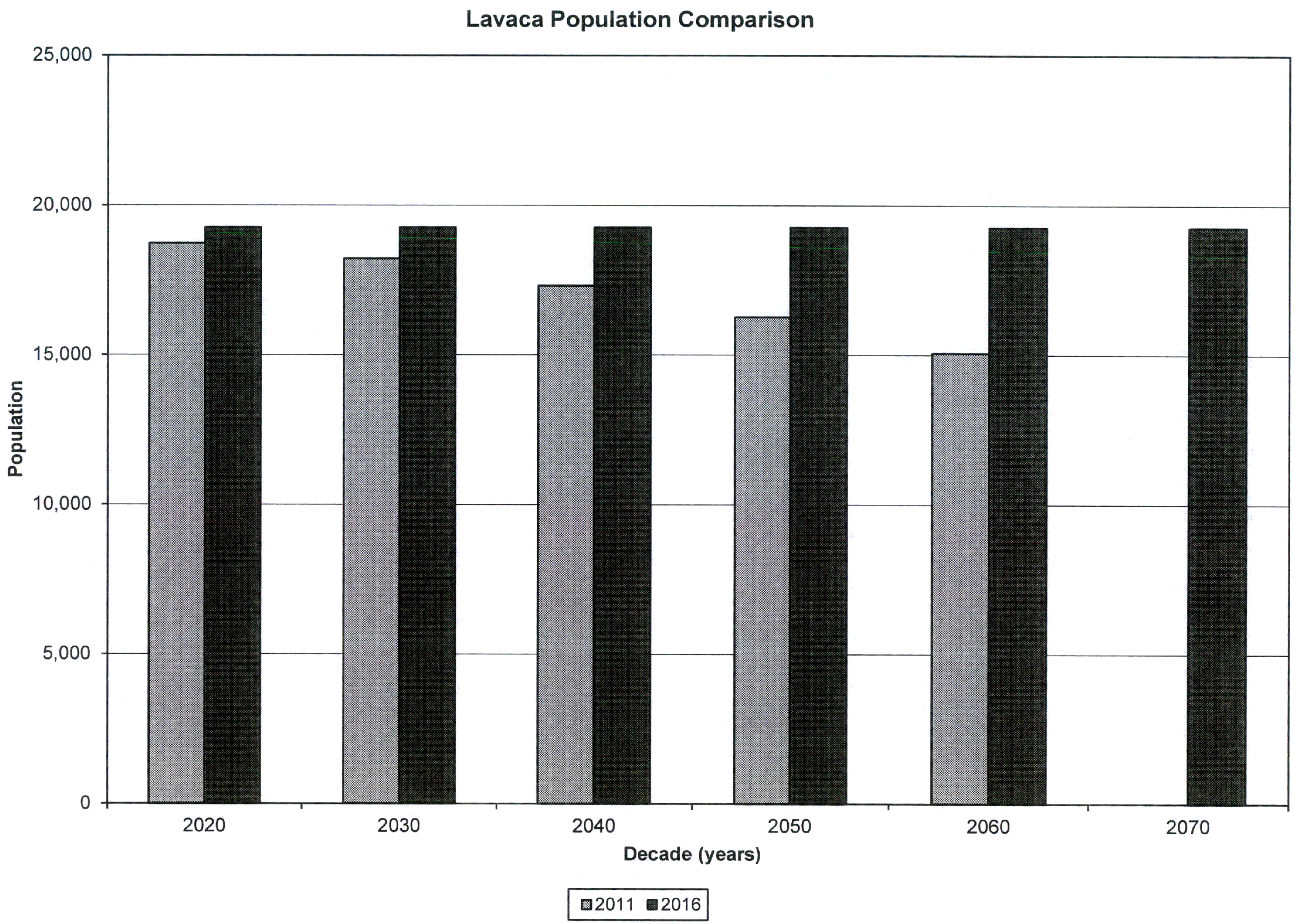
Region P Population

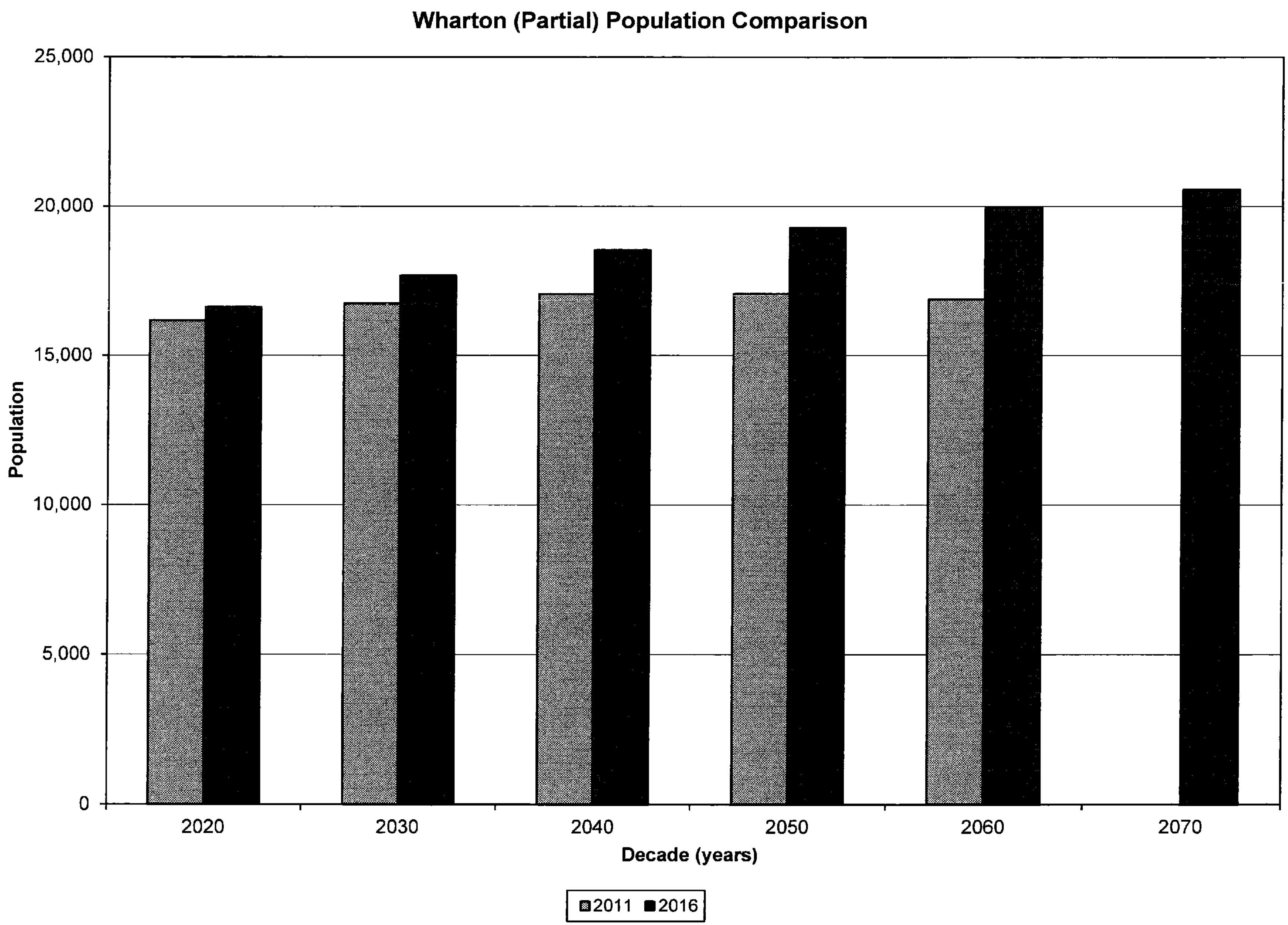
RWP	2010	2020	2030	2040	2050	2060	2070
Region P							
2016		50,489	52,068	53,137	54,053	54,846	55,522
2011	49,491	51,419	52,138	51,940	51,044	49,663	
Difference		-930	-70	1,197	3,009	5,183	
% Change		-1.8	-0.1	2.3	5.9	10.4	
Jackson							
2016		14,606	15,119	15,336	15,515	15,627	15,699
2011	15,441	16,515	17,183	17,567	17,713	17,716	
Difference		-1,909	-2,064	-2,231	-2,198	-2,089	
% Change		-11.6	-12.0	-12.7	-12.4	-11.8	
Lavaca							
2016		19,263	19,263	19,263	19,263	19,263	19,263
2011	18,750	18,731	18,219	17,314	16,264	15,061	
Difference		532	1,044	1,949	2,999	4,202	
% Change		2.8	5.7	11.3	18.4	27.9	
Wharton							
2016		16,620	17,686	18,538	19,275	19,956	20,560
2011	15,300	16,173	16,736	17,059	17,067	16,886	
Difference		447	950	1,479	2,208	3,070	
% Change		2.8	5.7	8.7	12.9	18.2	


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)
2011 Region P Plan
2016 Region P Plan



Jackson Population Comparison
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016


Lavaca Population Comparison
25,000
20,000
15,000
10,000
5,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016



Wharton (Partial) Population Comparison
25,000
20,000
15,000
10,000
5,000
0
Population
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016

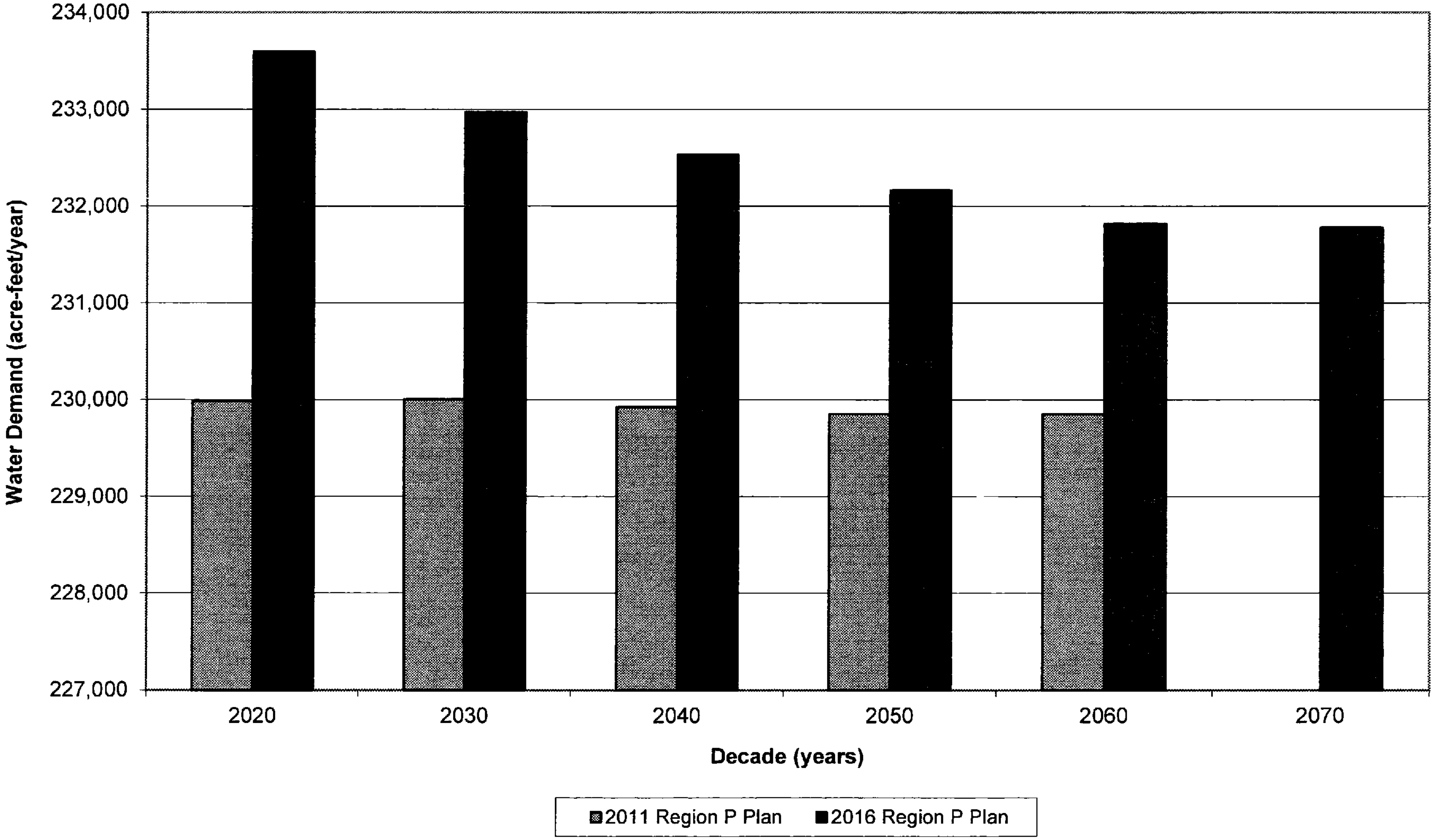
Water Demands* (in acre-feet per year) by WUG Category
Region P

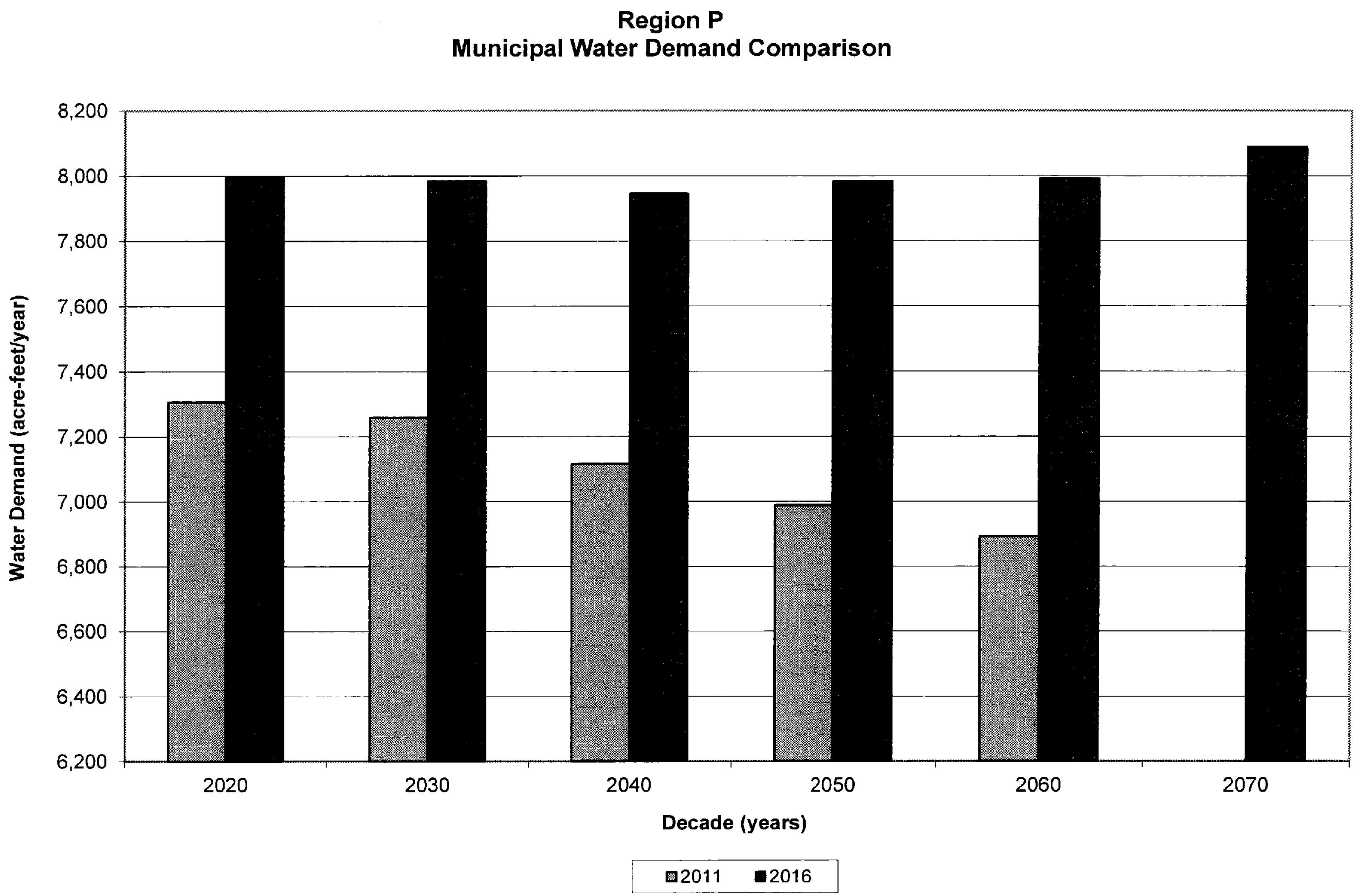
RWP	2010	2020	2030	2040	2050	2060	2070
Municipal							
2016		7,997	7,984	7,946	7,984	7,991	8,088
2011	7,215	7,305	7,258	7,115	6,989	6,892	
Difference		692	726	831	995	1,099	
% Change		9.5	10.0	11.7	14.2	15.9	
Livestock							
2016		3,866	3,866	3,866	3,866	3,866	3,866
2011	3,499	3,499	3,499	3,499	3,499	3,499	
Difference		367	367	367	367	367	
% Change		10.5	10.5	10.5	10.5	10.5	
Irrigation							
2016		217,846	217,846	217,846	217,846	217,846	217,846
2011	217,846	217,846	217,846	217,846	217,846	217,846	
Difference		0	0	0	0	0	
% Change		0.0	0.0	0.0	0.0	0.0	
Manufacturing							
2016		1,255	1,323	1,388	1,444	1,547	1,658
2011	1,089	1,162	1,223	1,281	1,331	1,425	
Difference		93	100	107	113	122	
% Change		8.0	8.2	8.4	8.5	8.6	
Mining							
2016		2,632	1,952	1,485	1,027	570	320
2011	164	172	177	182	188	192	
Difference		2,460	1,775	1,303	839	378	
% Change		1430.2	1002.8	715.9	446.3	196.9	
Steam-Electric Power Generation							
2016		0	0	0	0	0	0
2011	0	0	0	0	0	0	
Difference		0	0	0	0	0	
% Change		NA	NA	NA	NA	NA	

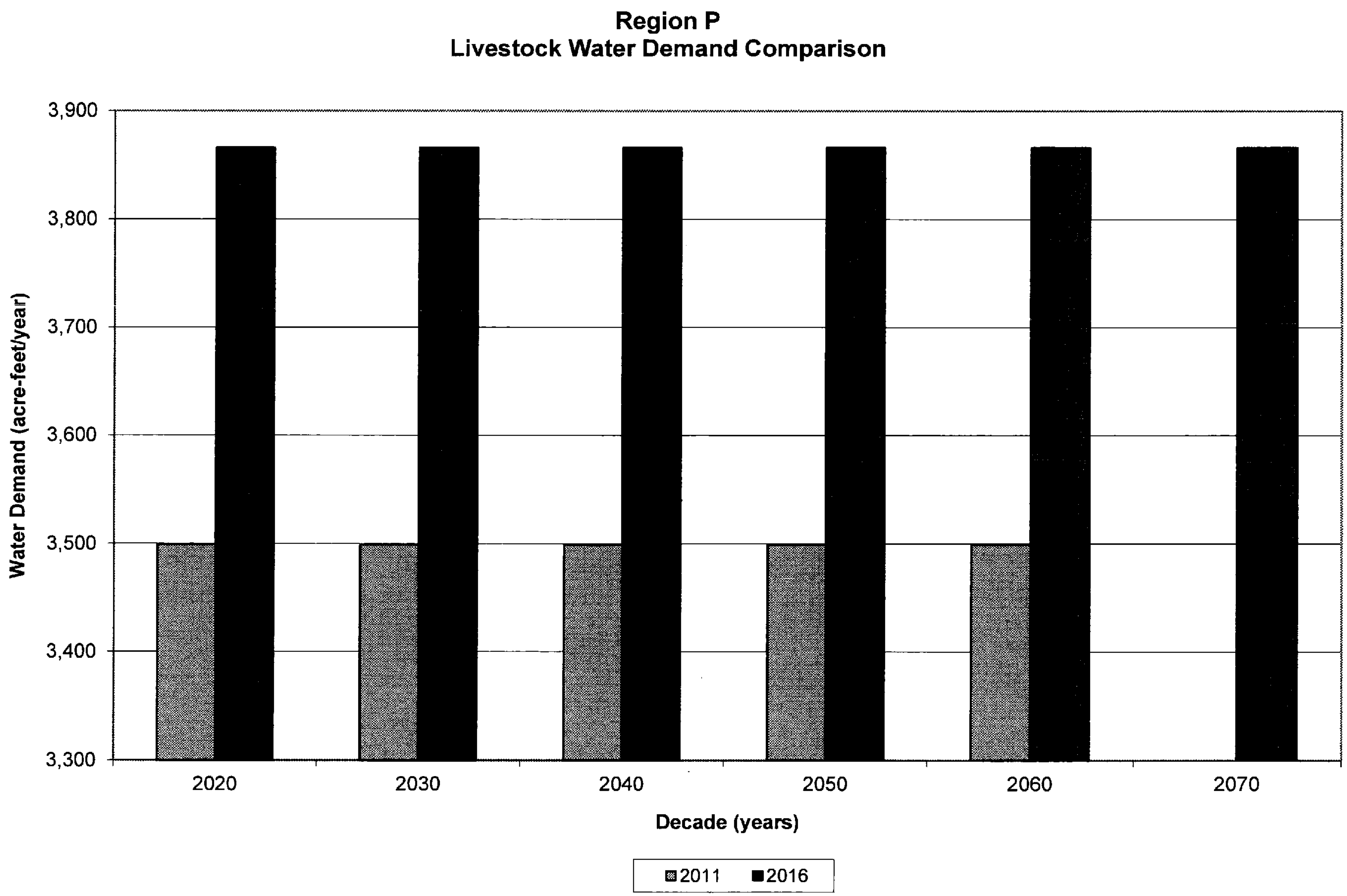
*All values are presented in acre-feet per year

Total Water Demand							
2016		233,596	232,971	232,531	232,167	231,820	231,778
2011	229,813	229,984	230,003	229,923	229,853	229,854	
Difference		3,612	2,968	2,608	2,314	1,966	
% Change		1.6	1.3	1.1	1.0	0.9	

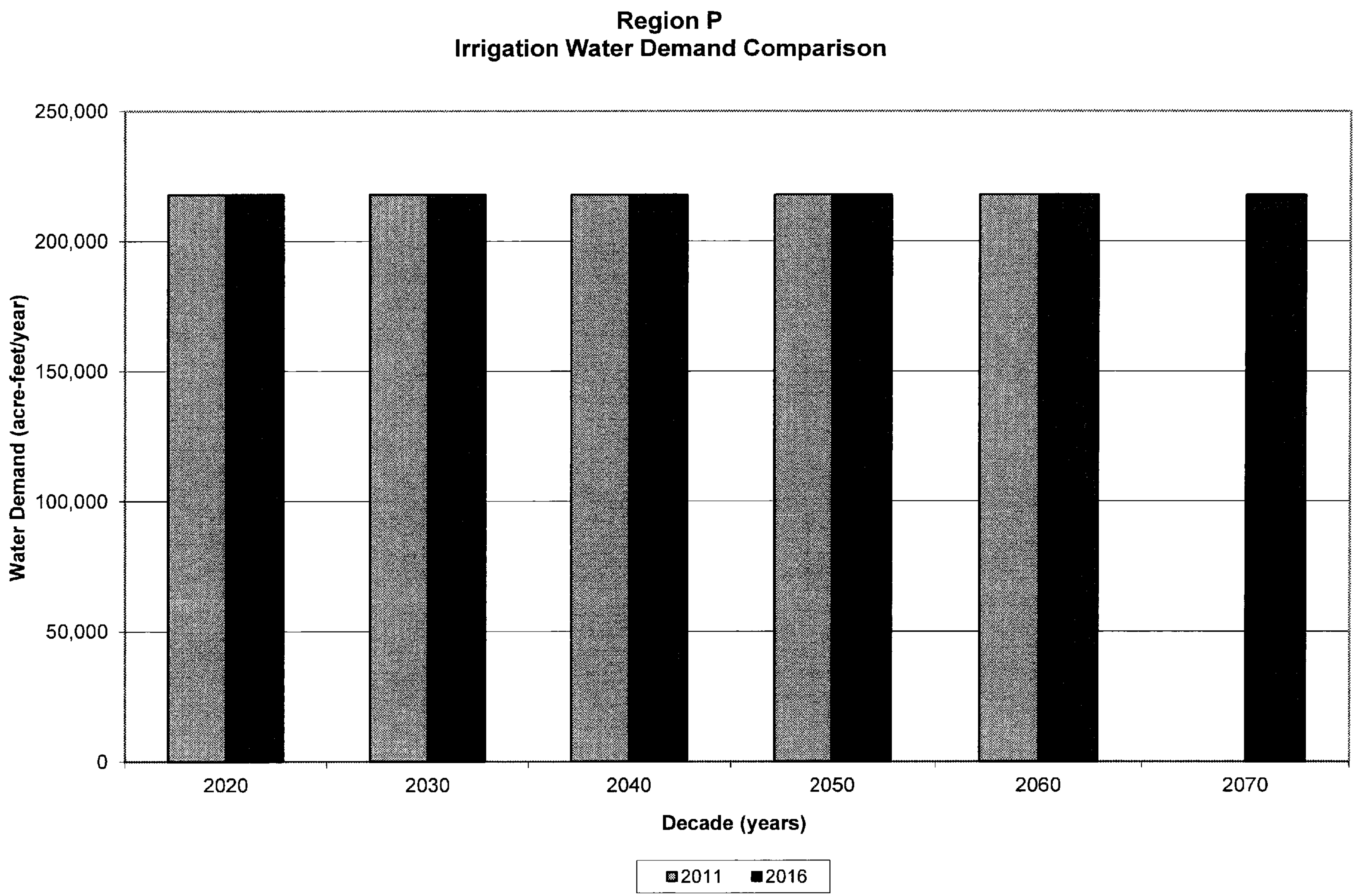
Region P
Total Water Demand Comparison



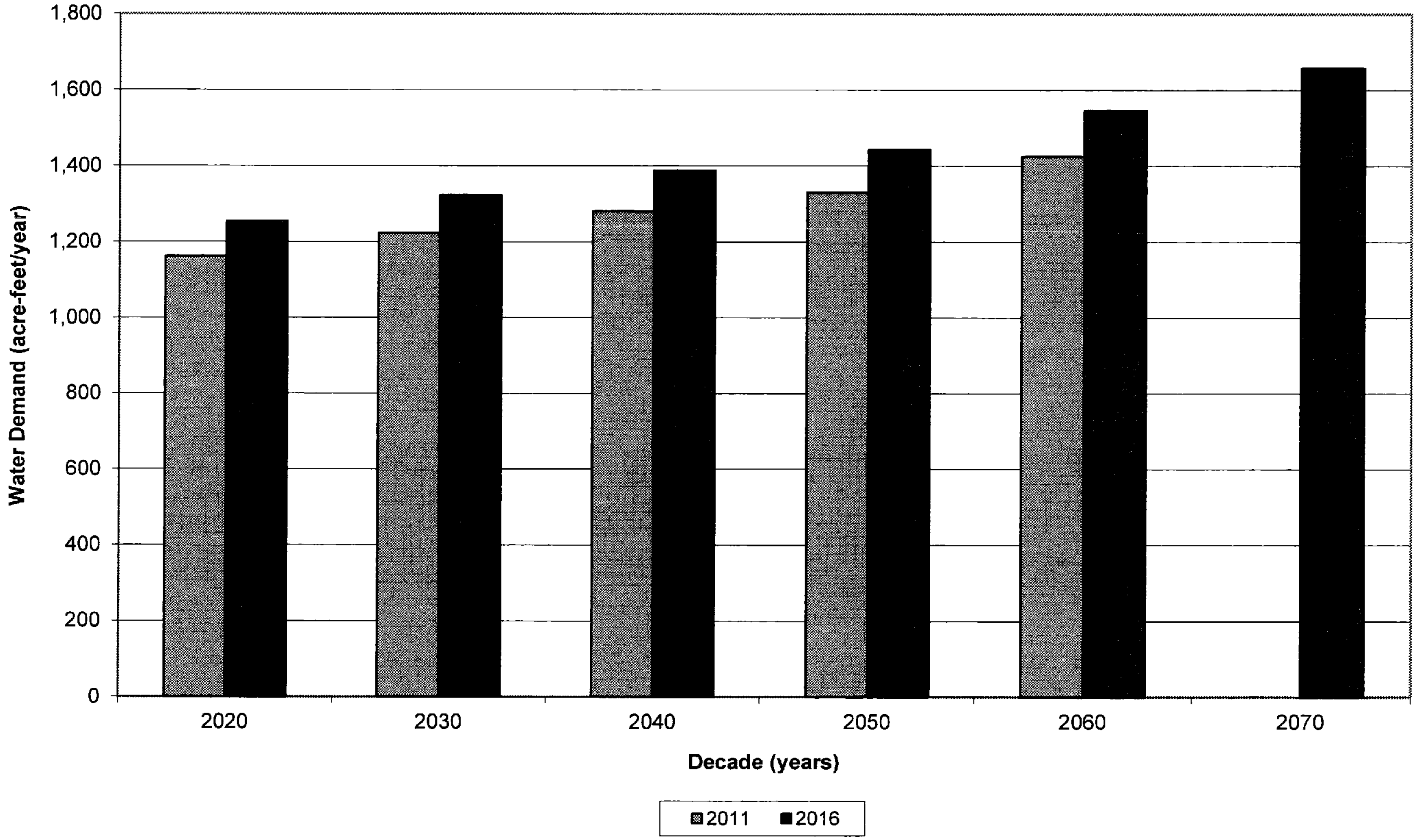

Region P
Municipal Water Demand Comparison
8,200
8,000
7,800
7,600
7,400
7,200
7,000
6,800
6,600
6,400
6,200
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016



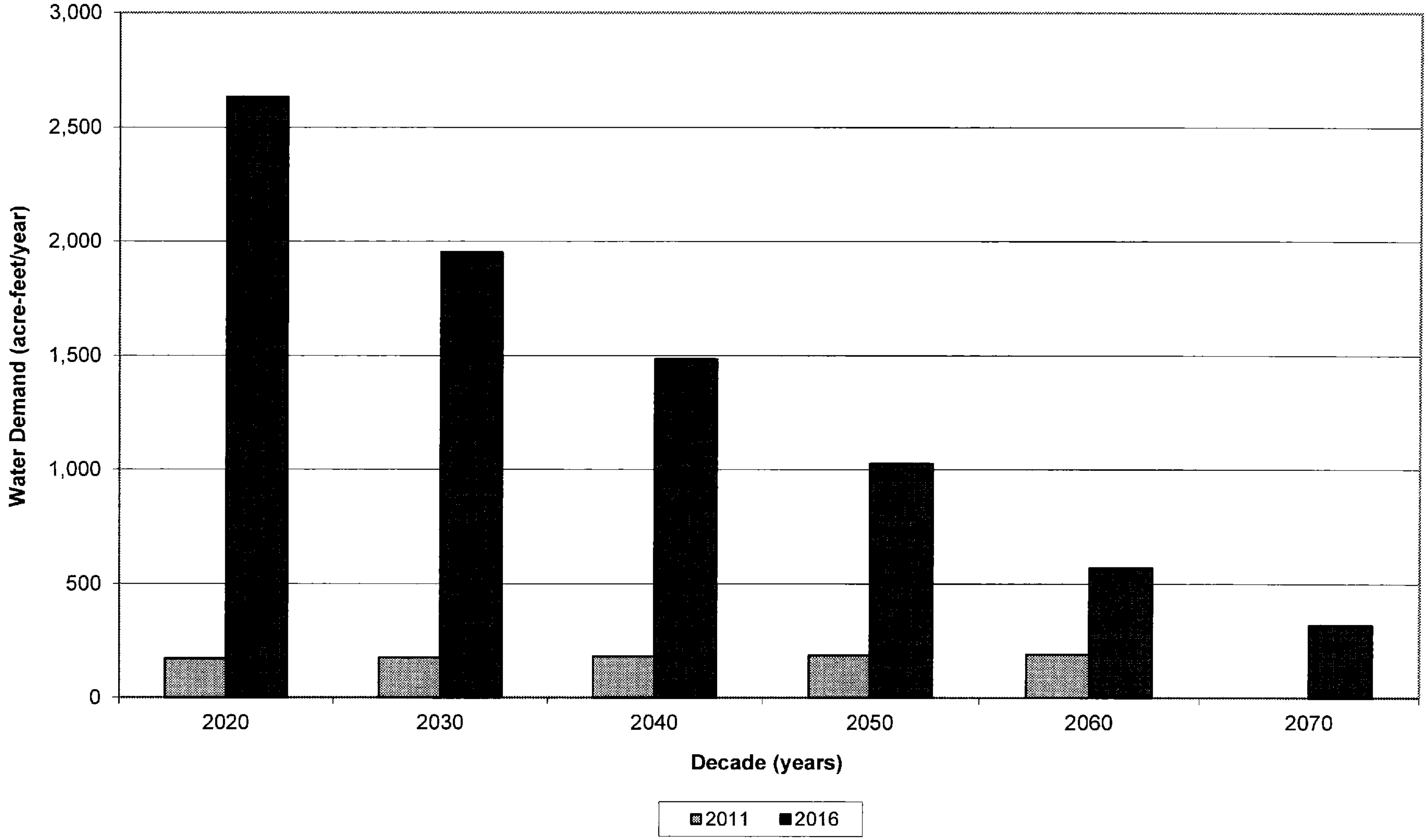
Region P
Livestock Water Demand Comparison
3,900
3,800
3,700
3,600
3,500
3,400
3,300
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016

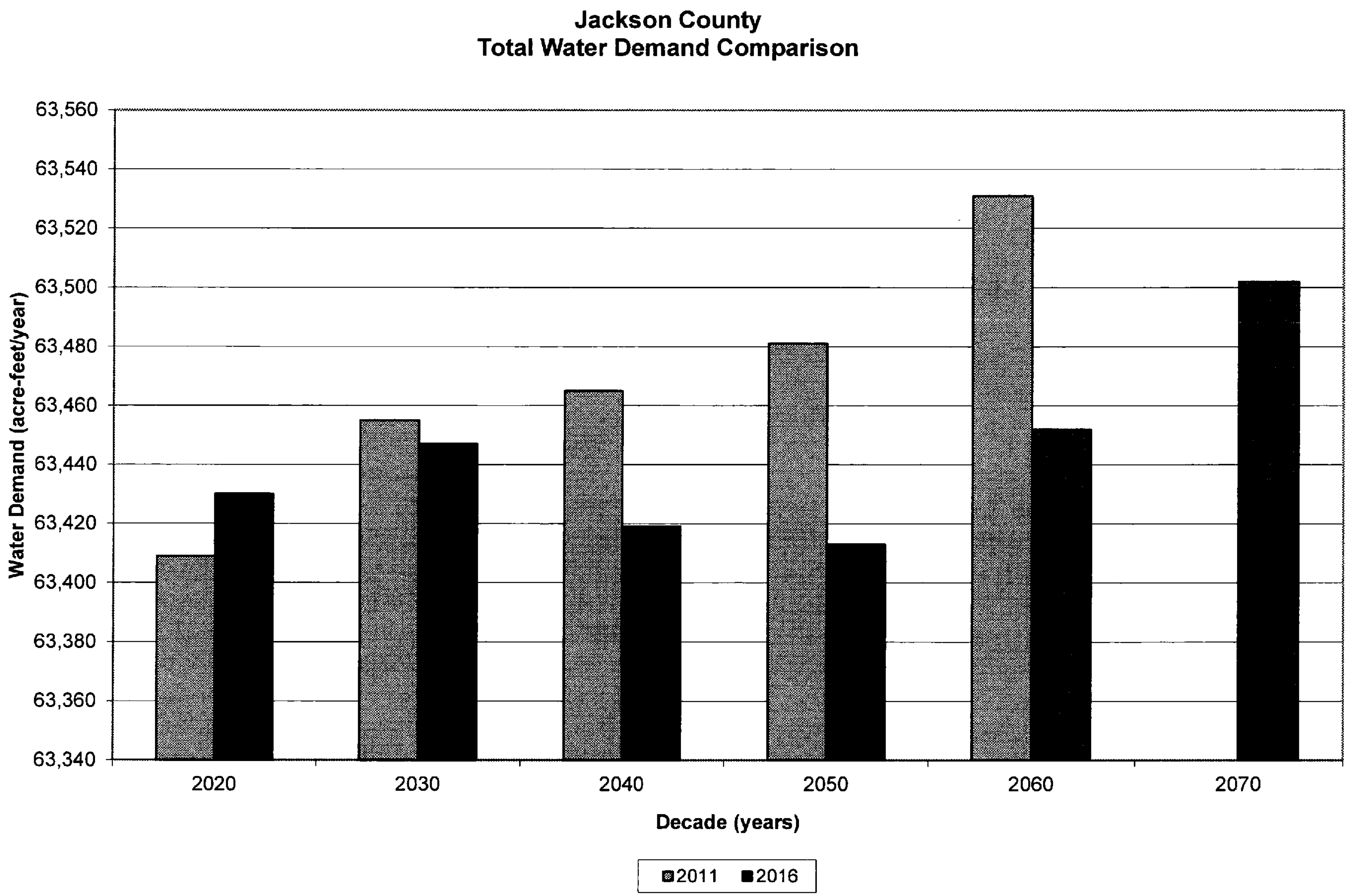

Region P
Irrigation Water Demand Comparison
250,000
200,000
150,000
100,000
50,000
0
Water Demand (acre-feet/year)
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016

Region P
Manufacturing Water Demand Comparison



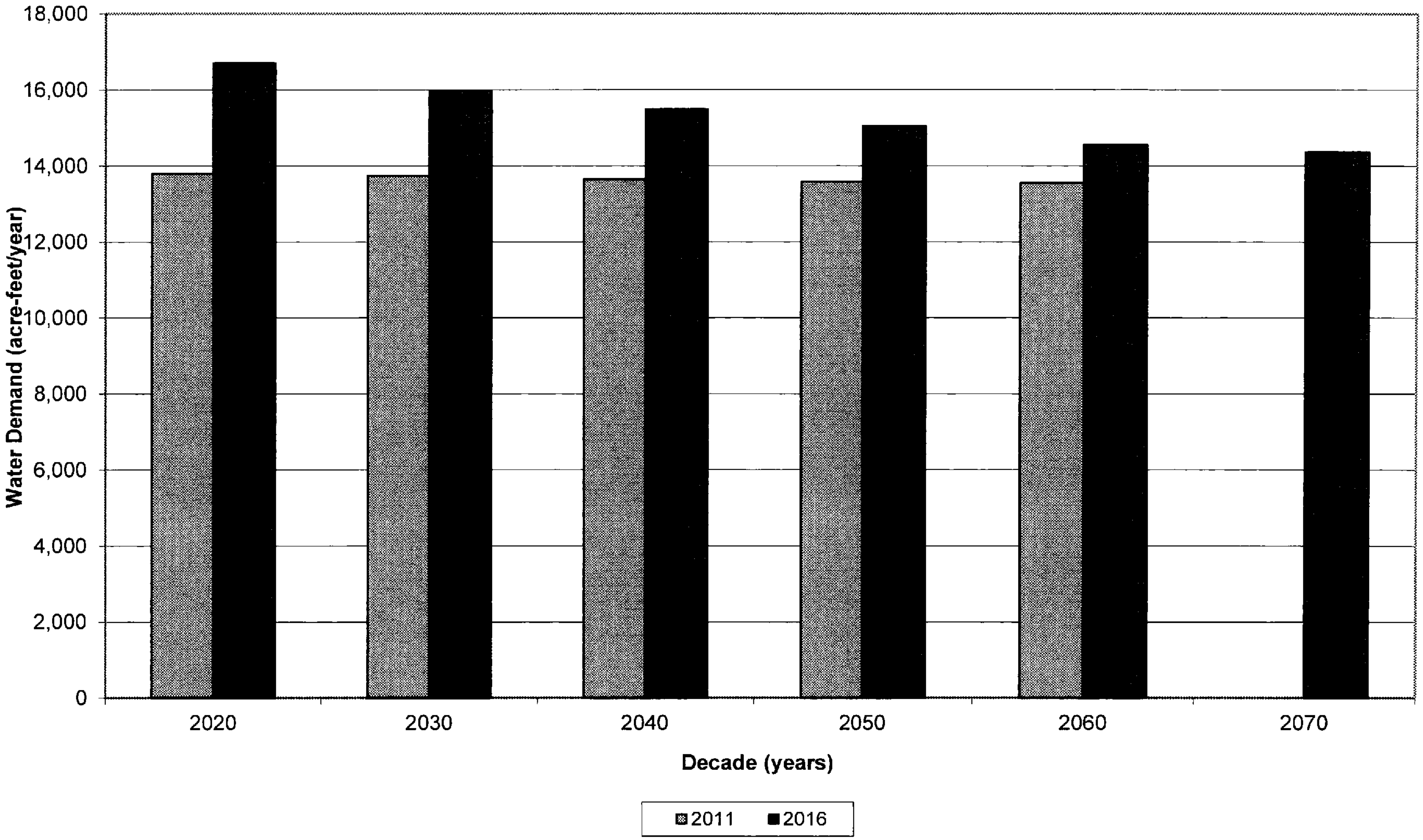
Region P
Mining Water Demand Comparison



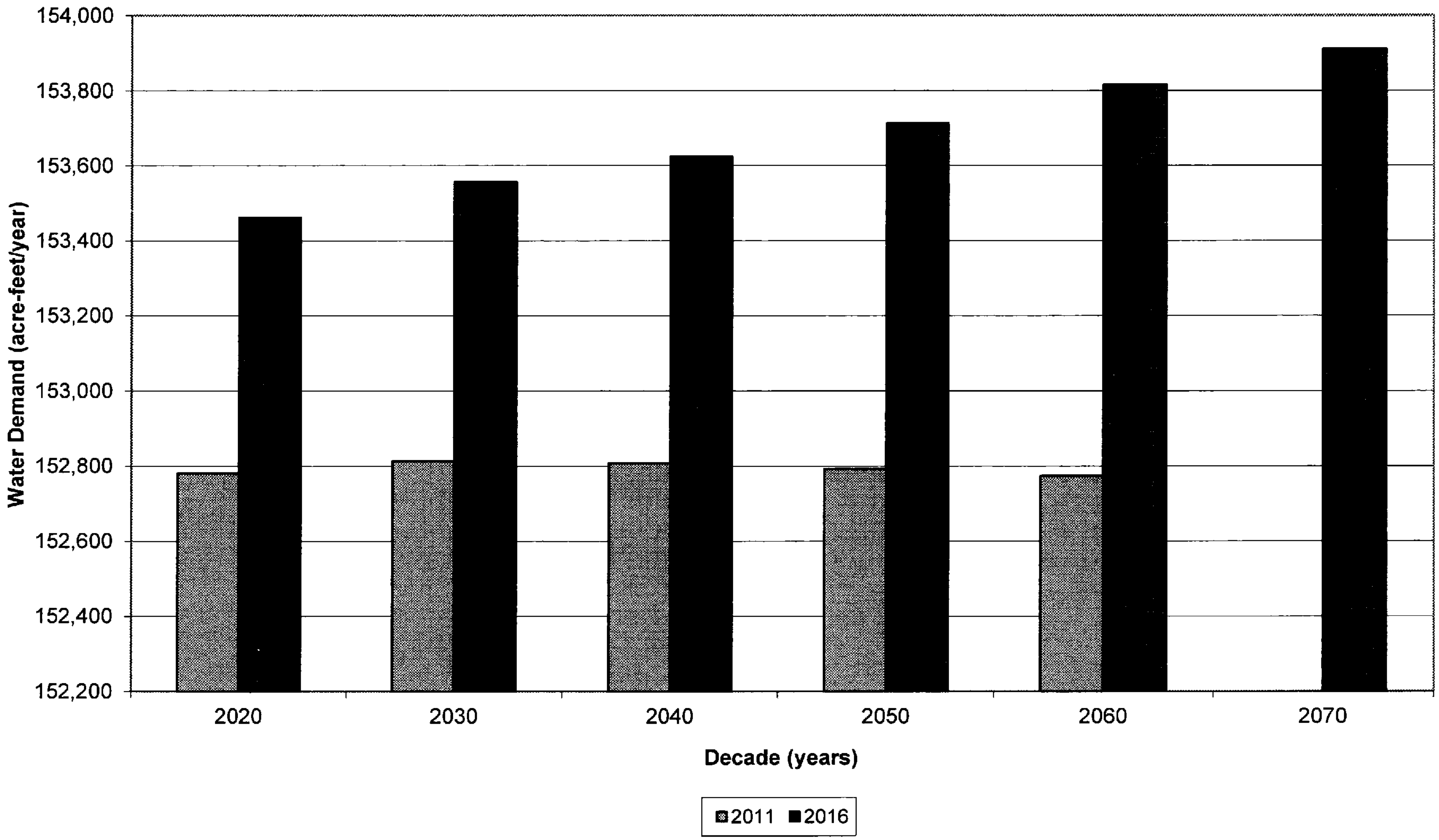


Jackson County
Total Water Demand Comparison
Water Demand (acre-feet/year)
63,560
63,540
63,520
63,500
63,480
63,460
63,440
63,420
63,400
63,380
63,360
63,340
2020
2030
2040
2050
2060
2070
Decade (years)
2011
2016

Lavaca County
Total Water Demand Comparison



Wharton County (Partial)
Total Water Demand Comparison



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