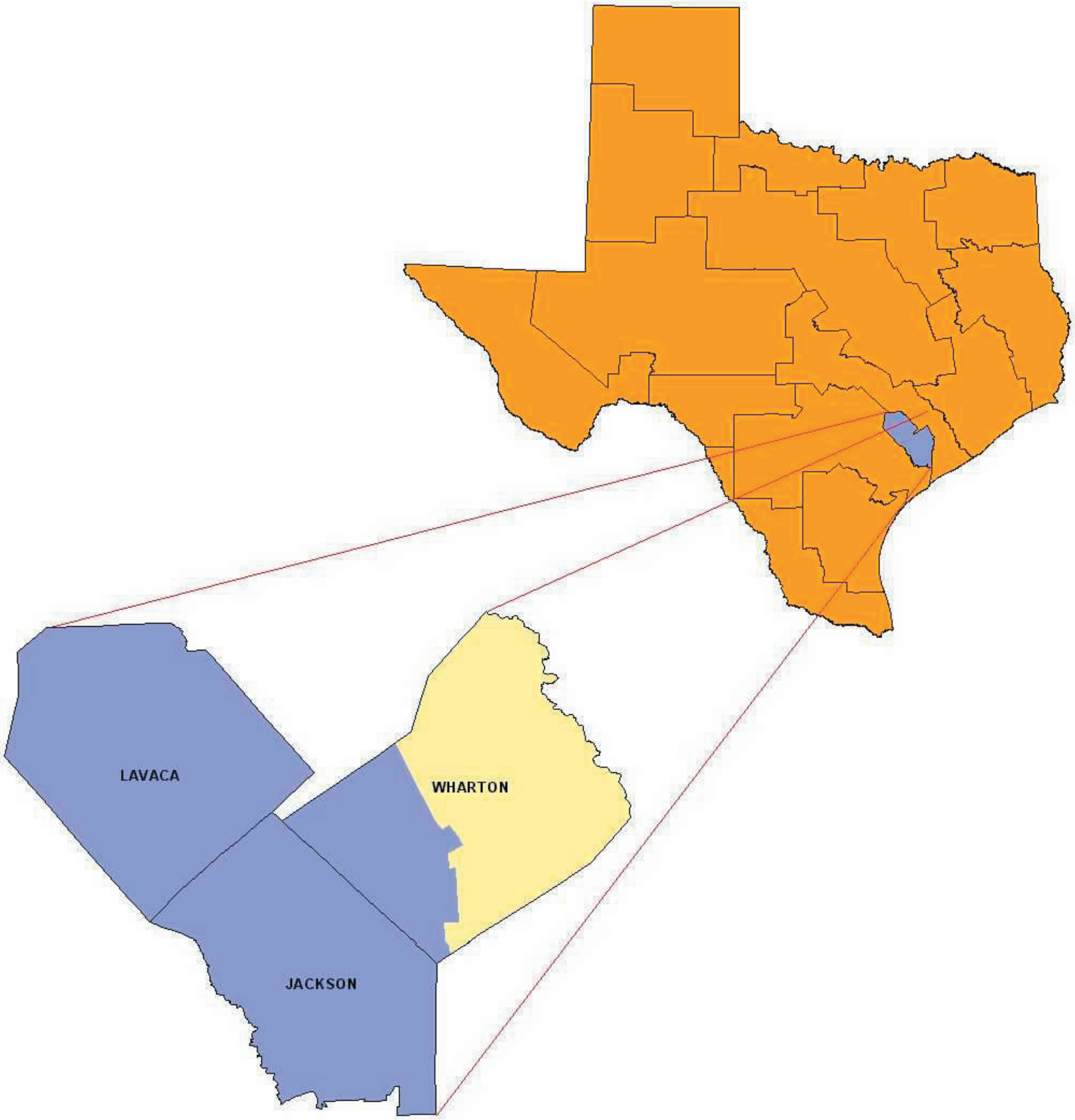
LAVACA REGIONAL PLANNING GROUP



REGIONAL WATER PLAN

TCB | AECOM

LBG GUYTON

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Lavaca Regional Water Planning Group

2006 Regional Water Plan

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ACRONYMS AND ABBREVIATIONS

°F	degree Fahrenheit
ac	acres
ac-ft	acre-feet
ac-ft/ac	acre-feet per acre
ac-ft/yr	acre-feet per year
BMP	best management practices
BOD	biochemical oxygen demand
CAFOs	Confined Animal Feeding Operations
CCN	Certificate of Convenience and Necessity
cfs	cubic feet per second
CRP	Clean Rivers Program
CRU	Collective Reporting Unit
DO	dissolved oxygen
DOR	drought of record
ENR	Engineering News Record
EQIP	Environmental Quality Incentives Program
ft/yr	feet per year
GAM	groundwater availability model
GCD	Groundwater Conservation District
GIS	Geographic Information System
GLO	General Land Office
gpcd	gallons per capita per day
gpd/ft	gallons per day per foot
H-GAC	Houston-Galveston Area Council of Governments
IFR	Infrastructure Financing Report
IH	Interstate Highway
in/ac	inch per acre
LCRA	Lower Colorado River Authority
LNRA	Lavaca-Navidad River Authority
LRWPA	Lavaca Regional Water Planning Area
LRWPG	Lavaca Regional Water Planning Group
MCL	maximum contaminant level
mg/L	milligrams per liter
mgd	million gallons per day
mi^2	square miles
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NASS	National Agricultural Statistics Service

pCi/L	picocurie per liter
PET	Potential Evapotranspiration
QAPP	Quality Assurance Project Plan
Report 270	TDWR Report 270
RHWPG	Region H Water Planning Group
ROR	run-of-river
RWP	Regional Water Plan
RWPA	Regional Water Planning Area
RWPG	Regional Water Planning Group
SB 1	Senate Bill 1
SH	State Highway
SRF	State Revolving Fund
TAES	Texas Agricultural Experiment Station
TASS	Texas Agricultural Statistics Service
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDS	total dissolved solids
TDWR	Texas Department of Water Resources
TNRCC	Texas Natural Resource Conservation Commission (now TCEQ)
TNRIS	Texas Natural Resources Information System
TOC	Total Organic Carbon
TPWD	Texas Parks & Wildlife Department
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWDB DB07	TWDB online database
UAA	use attainability analysis
URS	unique reservoir site
USDA	U.S. Department of Agriculture
USGS	U.S. Geologic Survey
USS	unique stream segment
WAM	Water Availability Model
WMS	Watershed Modeling System
WRAP	Water Rights Analysis Package
WUG	water user group
WWP	wholesale water providers

EXECUTIVE SUMMARY

ES. Executive Summary

ES.1 Introduction

The 2006 Regional Water Planning process continues the planning process set forth by the 2001 Regional Water Plans for the State of Texas. Beginning in 2002, the 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 TWDB by June 1, 2005. Following a comment period from state agencies and the general public, these plans will be finalized and adopted by January 5, 2006, to be combined into the 2007 State Water Plan. In order to provide consistency and facilitate the compilation of the different regional plans, the Texas Water Development Board (TWDB) requires the incorporation of the data from the completed regional plans into a standardized online database, referred to as TWDB DB07.

ES.2 Scope of Work

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

ES.2.1 Task 1

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 geographical boundaries of the LRWPA, originally designated as Region P, are shown in *Figure 1-1* in *Chapter 1*. Information regarding irrigated acreage for agricultural water use was recognized as being of particular importance, and surveys were conducted in order to determine this data that would later be used for estimating irrigation water demand.

ES.2.2 Task 2

Task 2 presented the population and water demand projections for the LRWPA. The Task 2 interim report 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. Because 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 form both groundwater and surface water sources. Further information regarding population and water demand projections is available in *Chapter 2*.

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

Counties	2000	2010	2020	2030	2040	2050	2060
Jackson	92,045	92,248	92,401	92,495	92,565	92,639	92,749
Lavaca	16,973	16,925	16,921	16,841	16,708	16,574	16,471
Wharton (Region P)	121,429	116,388	112,417	108,538	104,761	101,111	97,688
LRWPA Total	230,447	225,561	221,739	217,874	214,034	210,324	206,908

ES.2.3 Task 3

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. 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.

Additional analysis of groundwater supplies was determined by LBG-Guyton Associates. These supplies would be 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 DOR. For additional information regarding the determination of available water supplies, see *Chapter 3*.

ES.2.4 Task 4

The fourth task was to determine the surpluses and shortages resulting from the division of available resources performed for Task 3 and to assign management strategies to meet these demands. It was assumed that irrigators, unlike municipal and industrial water users, would not have the economic ability to deepen groundwater wells to obtain additional supplies as DOR conditions caused an increased reliance on groundwater sources. For this reason, it was assumed that farmers would be impacted by limited supplies within the region. *Table ES.2* includes a summary of surpluses and shortages for the LRWPA. Additional information is shown in *Table ES.3* at the end of this summary report.

Table ES.2
Surpluses and Shortages in Acre-Feet per Year

County	WUG	Basin	2000	2010	2020	2030	2040	2050	2060
LAVACA	COUNTY-OTHER	GUADALUPE	0	0	0	0	1	1	1
LAVACA	COUNTY-OTHER	LAVACA	0	63	97	161	245	325	392
LAVACA	HALLETTSVILLE	LAVACA	0	24	32	54	87	121	155
LAVACA	MOULTON	LAVACA	0	7	10	18	28	38	47
LAVACA	SHINER	LAVACA	0	19	26	46	75	104	134
LAVACA	YOAKUM	LAVACA	0	26	39	65	102	139	172
LAVACA	IRRIGATION	LAVACA	20888	20869	20851	20828	20803	20778	20751
LAVACA	MANUFACTURING	LAVACA	251	184	143	107	72	42	0
LAVACA	MINING	LAVACA	3	2	1	1	1	1	0
LAVACA	MINING	LAVACA-GUADALUPE	8	4	3	2	1	0	0
JACKSON	COUNTY-OTHER	COLORADO-LAVACA	21	11	2	0	3	4	4
JACKSON	COUNTY-OTHER	LAVACA	37	20	3	0	5	7	6
JACKSON	COUNTY-OTHER	LAVACA-GUADALUPE	4	2	0	0	0	1	1
JACKSON	EDNA	LAVACA	68	45	11	0	5	6	6
JACKSON	GANADO	LAVACA	28	18	5	0	1	1	1
JACKSON	IRRIGATION	COLORADO-LAVACA	-15719	-15735	-15751	-15769	-15791	-15812	-15834
JACKSON	IRRIGATION	LAVACA	6801	6782	6760	6738	6709	6681	6652
JACKSON	IRRIGATION	LAVACA-GUADALUPE	5107	5100	5094	5086	5077	5068	5059
JACKSON	MANUFACTURING	COLORADO-LAVACA	1274	1191	1164	1144	1126	1110	1064
JACKSON	MANUFACTURING	LAVACA	1	1	1	1	0	0	0
JACKSON	MINING	COLORADO-LAVACA	8	5	3	2	1	0	0
JACKSON	MINING	LAVACA	12	7	5	4	2	1	0
JACKSON	MINING	LAVACA-GUADALUPE	21	13	10	7	5	2	0
WHARTON	COUNTY-OTHER	LAVACA	20	12	1	0	5	10	14
WHARTON	EL CAMPO	COLORADO	21	13	3	0	0	2	5
WHARTON	EL CAMPO	COLORADO-LAVACA	129	81	23	0	4	15	33
WHARTON	EL CAMPO	LAVACA	2	1	1	0	0	1	1
WHARTON	IRRIGATION	COLORADO-LAVACA	-5523	-4783	-4197	-3631	-3086	-2561	-2068
WHARTON	IRRIGATION	LAVACA	-34513	-30137	-26669	-23324	-20098	-16988	-14077
WHARTON	MANUFACTURING	COLORADO-LAVACA	35	24	19	14	10	6	0
WHARTON	MINING	LAVACA	0	1	2	3	4	4	4
Region Surpluses			34739	34525	34309	34281	34372	34468	34502
Region Shortages			-55755	-50655	-46617	-42724	-38975	-35361	-31979
Net Results			-21016	-16130	-12308	-8443	-4603	-893	2523

A process for the evaluation of feasibility of strategy implementation was developed. Alternative 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 affect these users. The only WMS that was found to be of a reasonable cost to farmers was the strategy of pumping groundwater in excess of the available supplies determined from Task 3. This would be a temporary condition and the aquifer would be allowed to recharge in years of normal rainfall when surface water supplies would be used for irrigation. In addition, an analysis was performed to determine the significance of irrigation return flows from groundwater irrigated rice fields on wildlife habitat when drought conditions would, otherwise, limit instream flows. Additional information regarding surpluses and shortages and recommended WMSs can be found in *Chapter 4*.

ES.2.5 Task 5

The purpose of Task 5 was to determine the effects of water management strategies on water quality and agriculture through the movement of water from these rural regions to population centers. The effect of water conservation and the overpumpage of groundwater on streamflows during DOR were considered. There are currently no strategies in place to export additional surface water from the area to serve municipal purposes outside of the region and therefore, no anticipated impacts upon the availability of water for agricultural uses. Additional information concerning impacts on water quality and rural water availability is shown in *Chapter 5*.

ES.2.6 Task 6

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. Additionally, drought contingency plans are required of certain water right owners and applicants. As these documents have become integral to providing a reliable supply of water throughout the State, *Chapter 6* was prepared to provide information to various water users. The chapter also provides model water conservation and drought contingency plans.

ES.2.7 Task 7

Task 7 summarized the status of water resources in each basin and the anticipated impacts of the recommended WMS. The Colorado-Lavaca and Lavaca basins were determined to have insufficient water supplies to meet all potential demands during DOR. As a result of these shortages, it was recommended that water be pumped from the Gulf Coast Aquifer to serve short-term demands in excess of the volumes presented in *Chapter 3* of this Plan. It was further determined that the net benefit of these groundwater withdrawals would result in beneficial streamflows driven by irrigation returns from rice crops.

ES.2.8 Task 8

The Lavaca Regional Water Planning Group (LPWPG) designated the Palmetto Bend Phase II reservoir site on the Lavaca River as a Unique Reservoir Site. No designation of unique stream segments was made, as the Group desired to have additional information on the potential impacts of such designation. Eight proposed policy issues were developed and 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
- 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.2.9 Task 9

Task 9 included the presentation of the result of the TWDB study, *Socioeconomic Impacts of Unmet Water Needs in Lavaca Regional Water Planning Area.* This report documented the projected impacts to the region in respect to jobs, income, and business taxes resulting from unmet water demands. The report anticipated that there would be a peak loss of $4.17 million in revenue for the region and as many as 125 jobs lost if alternate sources of water could not be found to satisfy unmet needs in Jackson and Wharton Counties.

An infrastructure needs survey for municipal water users was conducted as a portion of the Regional Water Planning process. This information was used in conjunction with the results of the *2002 LRWPG Infrastructure Finance Report* (IFR) to determine the total municipal needs for the region. This was found to be just over $20 million. A study was performed to estimate the financial needs of irrigators in order to make conservation improvements to rice fields. These costs were estimated to be nearly $37 million and included improvements such as land leveling, multiple inlets, the use of a reduced levee interval, and the installation of irrigation pipeline to replace canals.

Several policy recommendations were also made regarding funding opportunities that can benefit the Region in making the necessary infrastructure improvements. These recommendations regard the following programs and policies:

- State and Federal Agricultural Water Conservation Programs
- Drinking Water State Revolving Funds
- State Loan Program
- Water and Waste Disposal Loans and Grants from the USDA Rural Utilities Service
- TWDB Funding Through Taxation of Bottled Water Sales
- Desalination Research and Demonstration Projects
- Water Research Program – Agriculture

Additional information regarding infrastructure financing for the region and recommended policies can be found in *Chapter 9*.

ES.2.10 Task 10

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. Monthly meetings of the Planning Group were well attended by the members and non-voting members, but participation by the general public has been limited. The LRWPG held two public meetings and two public hearings to receive comments on the submitted Draft Plan. Meeting events are summarized in *Chapter 10*.

Table ES.3
Lavaca County Summary Table

HALLETTSVILLE	2000	2010	2020	2030	2040	2050	2060
Population	2,345	2,289	2,287	2,224	2,114	1,985	1,839
Water Demand (ac-ft/yr)	575	551	543	521	488	454	420
Current Supply (ac-ft/yr)	575	575	575	575	575	575	575
Supply-Demand (ac-ft/yr)	0	24	32	54	87	121	155
Management Strategy (ac-ft/yr)							

MOULTON	2000	2010	2020	2030	2040	2050	2060
Population	944	921	920	895	851	799	740
Water Demand (ac-ft/yr)	165	158	155	147	137	127	118
Current Supply (ac-ft/yr)	165	165	165	165	165	165	165
Supply-Demand (ac-ft/yr)	0	7	10	18	28	38	47
Management Strategy (ac-ft/yr)							

SHINER	2000	2010	2020	2030	2040	2050	2060
Population	2,070	2,020	2,018	1,963	1,866	1,753	1,623
Water Demand (ac-ft/yr)	501	482	475	455	426	397	367
Current Supply (ac-ft/yr)	501	501	501	501	501	501	501
Supply-Demand (ac-ft/yr)	0	19	26	46	75	104	134
Management Strategy (ac-ft/yr)							

YOAKUM	2000	2010	2020	2030	2040	2050	2060
Population	3,594	3,508	3,504	3,409	3,239	3,043	2,818
Water Demand (ac-ft/yr)	592	566	553	527	490	453	420
Current Supply (ac-ft/yr)	592	592	592	592	592	592	592
Supply-Demand (ac-ft/yr)	0	26	39	65	102	139	172
Management Strategy (ac-ft/yr)							

COUNTY OTHER LAVACA	2000	2010	2020	2030	2040	2050	2060
Population	10,257	10012	10002	9728	9244	8684	8041
Water Demand (ac-ft/yr)	1240	1177	1143	1079	994	914	847
Current Supply (ac-ft/yr)	1240	1240	1240	1240	1240	1240	1240
Supply-Demand (ac-ft/yr)	0	63	97	161	246	326	393
Management Strategy (ac-ft/yr)							

IRRIGATION LAVACA	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	11492	11511	11529	11552	11577	11602	11629
Current Supply (ac-ft/yr)	32380	32380	32380	32380	32380	32380	32380
Supply-Demand (ac-ft/yr)	20888	20869	20851	20828	20803	20778	20751
Management Strategy (ac-ft/yr)							

LIVESTOCK LAVACA	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	2059	2059	2059	2059	2059	2059	2059
Current Supply (ac-ft/yr)	2059	2059	2059	2059	2059	2059	2059
Supply-Demand (ac-ft/yr)	0	0	0	0	0	0	0
Management Strategy (ac-ft/yr)							

MANUFACTURING LAVACA	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	319	386	427	463	498	528	570
Current Supply (ac-ft/yr)	570	570	570	570	570	570	570
Supply-Demand (ac-ft/yr)	251	184	143	107	72	42	0
Management Strategy (ac-ft/yr)							

MINING LAVACA	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	30	35	37	38	39	40	41
Current Supply (ac-ft/yr)	41	41	41	41	41	41	41
Supply-Demand (ac-ft/yr)	11	6	4	3	2	1	0
Management Strategy (ac-ft/yr)							

Table ES.4
Jackson County Summary Table

Water Demand (ac-ft/yr)	249	259	272	277	276	276	276
Current Supply (ac-ft/yr)	277	277	277	277	277	277	277
Supply-Demand (ac-ft/yr)	28	18	5	0	1	1	1
Management Strategy (ac-ft/yr)							

COUNTY OTHER JACKSON	2000	2010	2020	2030	2040	2050	2060
Population	6,577	7029	7491	7778	7943	8006	8008
Water Demand (ac-ft/yr)	774	803	831	836	828	824	825
Current Supply (ac-ft/yr)	836	836	836	836	836	836	836
Supply-Demand (ac-ft/yr)	62	33	5	0	8	12	11
Management Strategy (ac-ft/yr)							

IRRIGATION JACKSON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	88707	88749	88793	88841	88901	88959	89019
Current Supply (ac-ft/yr)	84896	84896	84896	84896	84896	84896	84896
Supply-Demand (ac-ft/yr)	-3811	-3853	-3897	-3945	-4005	-4063	-4123
Management Strategy (ac-ft/yr)	15719	15735	15751	15769	15791	15812	15834

LIVESTOCK JACKSON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	852	852	852	852	852	852	852
Current Supply (ac-ft/yr)	852	852	852	852	852	852	852
Supply-Demand (ac-ft/yr)	0	0	0	0	0	0	0
Management Strategy (ac-ft/yr)							

MANUFACTURING JACKSON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	560	643	670	690	709	725	771
Current Supply (ac-ft/yr)	1835	1835	1835	1835	1835	1835	1835
Supply-Demand (ac-ft/yr)	1275	1192	1165	1145	1126	1110	1064
Management Strategy (ac-ft/yr)							

MINING JACKSON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	110	126	133	138	143	148	151
Current Supply (ac-ft/yr)	151	151	151	151	151	151	151
Supply-Demand (ac-ft/yr)	41	25	18	13	8	3	0

Table ES.5
Wharton County Summary Table

EL CAMPO	2000	2010	2020	2030	2040	2050	2060
Population	10,945	11575	12236	12662	12906	12912	12775
Water Demand (ac-ft/yr)	1876	1933	2001	2028	2024	2010	1989
Current Supply (ac-ft/yr)	2028	2028	2028	2028	2028	2028	2028
Supply-Demand (ac-ft/yr)	152	95	27	0	4	18	39
Management Strategy (ac-ft/yr)							

COUNTY OTHER WHARTON	2000	2010	2020	2030	2040	2050	2060
Population	3,522	3,725	3,937	4,074	4,153	4,155	4,111
Water Demand (ac-ft/yr)	418	426	437	438	433	428	424
Current Supply (ac-ft/yr)	438	438	438	438	438	438	438
Supply-Demand (ac-ft/yr)	20	12	1	0	5	10	14
Management Strategy (ac-ft/yr)							

IRRIGATION WHARTON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	118494	113378	109324	105413	101642	98007	94603
Current Supply (ac-ft/yr)	78458	78458	78458	78458	78458	78458	78458
Supply-Demand (ac-ft/yr)	-40036	-34920	-30866	-26955	-23184	-19549	-16145
Management Strategy (ac-ft/yr)	40036	34920	30866	26955	23184	19549	16145

LIVESTOCK WHARTON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	588	588	588	588	588	588	588
Current Supply (ac-ft/yr)	588	588	588	588	588	588	588
Supply-Demand (ac-ft/yr)	0	0	0	0	0	0	0
Management Strategy (ac-ft/yr)							

MANUFACTURING WHARTON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	49	60	65	70	74	78	84
Current Supply (ac-ft/yr)	84	84	84	84	84	84	84
Supply-Demand (ac-ft/yr)	35	24	19	14	10	6	0
Management Strategy (ac-ft/yr)							

MINING WHARTON	2000	2010	2020	2030	2040	2050	2060
Water Demand (ac-ft/yr)	4	3	2	1	0	0	0
Current Supply (ac-ft/yr)	4	4	4	4	4	4	4
Supply-Demand (ac-ft/yr)	0	1	2	3	4	4	4
Management Strategy (ac-ft/yr)							

CHAPTER 1

1. Description of the Region

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 TWDB to amend the plan as needed in response to increased knowledge and changing conditions.

In February 1998, TWDB adopted rules establishing 16 regional water planning areas (RWPAs) 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 TWDB, and in accordance with planning guidelines it set forth, RWPGs prepared a consensus-based Regional Water Plan (RWP) by January 5, 2001. TWDB assembled RWPs into a new State Water Plan by January 5, 2002. It is anticipated that RWPs and the State Water Plan will be updated every 5 years. The second round of regional water planning started in Spring 2002. The second round "initially prepared" RWP were to be submitted to TWDB by June 1, 2005, and will be finalized and adopted by January 5, 2006. Subsequently, by January 5, 2007, TWDB will prepare a new State Water Plan which will incorporate the adopted RWPs.

This chapter summarizes the results of Task 1 and describes the Lavaca Regional Water Planning Area (LRWPA).

1.2 Description of LRWPA

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 entire City of El Campo, as shown in *Figure 1.1*. The eastern portion of Wharton County is included in the Region K planning area.

LRWPA 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 to the south. LRWPA is located in the Lavaca, Lavaca-Guadalupe Coastal, and the Colorado-Lavaca Coastal River Basins, as shown in *Figure 1.2*.

LRWPA 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. They 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.

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. The main crops supported by the Blackland Prairies are cotton, grain, sorghums, corn, wheat, oats, 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 (°F) in January to highs of 94°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 LRWPA.

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. Member cities from 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 (Golden Crescent Regional Planning Commission 1999). The Jackson County Soil and Water Conservation District, Jackson County Hospital District, Lavaca County Soil and Water Conservation District, and the Lavaca-Navidad River Authority (LNRA) are all the special districts created under the Texas law. Wharton County is included in the Houston-Galveston Area Council of Governments (H-GAC). H-GAC 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, water quality, geographic information systems (GIS) and demographic information, and social and nutrition services to senior citizens. El Campo is also a member of the H-GAC. The Jackson Countywide Drainage District and the Jackson County Rural Fire and Emergency Services District are also included in LRWPA.

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

Recent additions to the governmental entities in the region include 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. The management plans for the Coastal Bend and Texana districts were certified by TWDB on September 28, 2004.

1.2.2 General Economic Conditions

The regional planning area is described below on a county-by-county basis.

The economy of Jackson County includes petroleum production and operation, metal fabrication and tooling, sheet-metal works, plastics manufacturing, agribusiness, and lake recreation. The major agricultural interests in Jackson County include corn, cotton, rice, grain sorghums, soybeans, and beef cattle. These agricultural products had a market value of approximately $51 million in 2000.

The economy of Lavaca County includes varied manufacturing, leather goods center, agribusiness, oil and gas production, and tourism. The major agricultural interests in Lavaca County include livestock (especially beef cattle), eggs, poultry, hay, rice, corn, and sorghum, with a market value of approximately $47.9 million in 2000.

The economy of Wharton County includes oil, sulfur, other minerals, agribusiness, hunting leases, and varied manufacturing. The major agricultural interests in Wharton County include rice, sorghum, cotton, corn, eggs, turfgrass, beef cattle, hay, and soybeans, with a market value of approximately $167 million for the entire county in 2000 (the county is only partially contained in the Lavaca Region).

The distribution of personal income generated from each of the employment sectors for the period 1998 through 2000 is shown in *Table 1.1*.

The magnitudes of personal incomes for each county were based on an average of the data from 1998–2000. For Jackson County, the farm earnings increased significantly, from about 1.2 percent in 1998 to 11.8 percent in 1999, but declined slightly to about 8.7 percent in 2000. For Lavaca County in 1998, the farm earnings were approximately -0.5 percent. They rebounded significantly to 3.6 percent in 1999 and dropped to approximately 0.8 percent in 2000. For all of Wharton County, the farm earnings increased between 1998 and 1999 and decreased in 2000.

The 2002 median household income was approximately $33,850 for Jackson County, $30,798 for Lavaca County, and $32,889 for all of Wharton County. The Texas 2002 median household income was approximately $40,063.

Unemployment in March 2003 was approximately 3.8 percent in Jackson County, 1.9 percent in Lavaca County, and 6.1 percent in Wharton County (*Texas Almanac* 2004–2005).

Table 1.2 presents the market value of some crops in LRWPA for 2002.

Table 1.1
Magnitude of Personal Income in the Lavaca Region for 1998–2000

Income Sources	Jackson County % of Total County Earnings	Lavaca County % of Total County Earnings	Wharton County % of Total County Earnings
Farm Earnings	7.51	1.35	13.65
Agriculture Service, Forestry, Fishing, etc.	1.60	0.65	2.85
Mining-Metal, Coal, Oil and Gas, Minerals	6.39	2.25	6.36
Construction	8.88	4.80	3.51
Manufacturing	N/A	30.90	11.85
Transportation and Public Utilities	5.95	5.30	5.40
Wholesale Trade	N/A	6.60	6.38
Retail Trade	6.98	11.09	9.82
Finance, Insurance, and Real Estate	2.25	4.60	4.35
Services (Health, Business, Recreation, etc.)	9.09	18.10	18.04
Government and Government Enterprises	15.61	14.36	17.79

N/A – Not Available due to confidential information

Source: U.S. Department of Commerce, Bureau of Economic Analysis *CA05 Personal Income by Major Source and Earnings by Industry*

Table 1.2
Market Value of Agricultural Products Sold in Jackson, Lavaca, and Wharton Counties in 1997 and 2002 (in $1,000)

County	Jackson		Lavaca		Wharton (Entire County)	
Year	1997	2002	1997	2002	1997	2002
Grains, Oilseeds, Dry Beans, and Dry Peas	N/A	$19,697	N/A	$1,630	N/A	$43,218
Cotton and Cottonseed	$10,029	$10,533	N/A	N/A	$19,690	$26,011

N/A – Not Available

Source: United States Department of Agriculture and the National Agricultural Statistics Service, *2002 Census of Agriculture for Texas–County Data*

Census sales information for manufacturing in LRWPA was inconsistent or incomplete, since information was withheld when only one entity exists in a county, to avoid disclosing data tied to a specific company and because of the differences in the 1997 and 2002 Censuses. The 1997 Census broke out specific grain crops, whereas the 2002 Census grouped corn and sorghum for grains, soybeans, and rice as "Grains, oilseeds, dry beans, and dry peas." Therefore, the 1997 and 2002 numbers are not comparable for this category.

The value of properties within the Lavaca Region has increased substantially over the last 6 years, as shown in *Table 1.3*.

Table 1.3
Property Value by County

County	1995 Property Value	2001 Property Value
Jackson	$979,338,841	$1,488,427,224
Lavaca	$1,178,160,082	$1,632,936,514
Wharton	$1,824,622,440	$2,167,215,194

Source: *Texas Almanac* 2004–2005 and 1998–1999

1.3 Population and Water Demand in the Lavaca Region

A summary of population and water usage by county is shown in *Table 1.4*. LRWPA's 2000 Census population was 48,068. Cities in LRWPA include Hallettsville, Moulton, Shiner, and Yoakum in Lavaca County (total county population 19,210 in 2000); Edna and Ganado in Jackson County (total county population 14,391 in 2000); and El Campo in Wharton County, the largest city in the region (total city population 10,945 in 2000).

Table 1.4
Population and Water Usage by County for LRWPA

		County		
		Jackson	Lavaca	Wharton (LRWPA)
Year 2000 Census Population		14,391	19,120	10,945
Year 2000 Reported Water Usage (ac–ft)	Municipal	1,816	3,073	2,294
	Manufacturing	560	319	49
	Mining	110	30	4
	Steam-electric	0	0	0
	Livestock	852	2,059	588
	Irrigation	88,707	11,492	118,494

Municipal water usage, as reported by TWDB in the 2000 Water Use Survey Estimate for LRWPA, totaled 1816, 3073, and 2294 acre-feet (ac-ft) for Jackson, Lavaca, and Wharton Counties, respectively. *Figure 1.3* shows per capital water usage for cities in LRWPA (TWDB 2000 data). Irrigation usage in the region was, by far, the greatest demand in

LRWPA. The amount of water consumed by irrigated agriculture equaled 88707, 11492, and 118494 ac-ft for Jackson, Lavaca, and Wharton Counties, respectively. Regional demands for manufacturing, mining, and livestock were less significant and totaled 4,571 ac-ft for all three counties. No steam-electric demands were identified within LRWPA.

1.3.1 Major Demand Centers

Major demand centers were identified for municipal, manufacturing, livestock, and irrigation demands in the LRWPA. Wharton and Jackson Counties have, by far, the largest year 2000 reported water usage levels with 121,429 ac-ft and 92,045 ac-ft, respectively. The majority of this demand is due to the considerable mount of irrigation taking place in these counties.

El Campo is the largest municipal demand center, with a reported year 2000 water usage of 1,876 ac-ft. Other municipalities with year 2000 usage of greater than 500 ac-ft included Edna, Yoakum, Hallettsville, and Shiner, with reported usages of 793, 592, 575, and 501 ac-ft, respectively. However, Lavaca and Jackson Counties also have a considerable portion of their municipal demands distributed throughout County-Other WUGs.

Jackson and Lavaca Counties have the greatest reported manufacturing water usage with 560 and 319 ac-ft, respectively. Lavaca County has the greatest livestock water usage in the LRWPA with 2,059 ac-ft in 2000.

Irrigation represents nearly the entire demand of the LRWPA. The greatest water use for irrigation is found in the Lavaca River Basin of Jackson and Wharton Counties. Water usage in these two WUGs, alone, represents over 62 percent of the year 2000 water usage for the entire region.

1.4 Lavaca Regional Water Supply Sources and Providers

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

1.4.1 Groundwater Sources

Groundwater supplies most of the water currently used in the region. Of the 230,972 ac-ft total 1996 water demand, almost 90 percent, or 206,740 ac-ft was supplied by groundwater. This trend is expected to continue due to the current relatively low demand for water in the region and anticipated low growth in demand.

There are two aquifers in the Lavaca Region. These are the Jackson Group and Gulf Coast aquifers. The Gulf Coast aquifer is the predominant supply source, serving more than 90 percent of the total supply. The Jackson Group, a minor aquifer, is only available in the northwestern corner of Lavaca County; it is not found in Jackson or Wharton Counties.

Two components of the Gulf Coast aquifer, the Chicot and Evangeline aquifers, provide large amounts of fresh groundwater to Wharton County. Within the Lavaca Region in

Wharton County, the aquifers contain freshwater to depths that range from about 1,400 to 1,700 feet, based on data contained in Texas Department of Water Resources (TDWR) Report 270, *Groundwater Resources of Colorado, Lavaca, and Wharton Counties, Texas* (Report 270).

> The aquifers are composed of interbedded layers of sand, silt, and clay, with, in some locations, minor amounts of small gravel. The aquifers have been providing water to Wharton County for over 100 years, with the principal water use being irrigation of agriculture crops (John Seifert 1999).

The 2001 Lavaca Regional Water Plan estimated the groundwater availability of Wharton County to be 51,234 acre-feet per year (ac-ft/yr), based on observation of annual pumpage and historic well levels. This pumpage is consistent with the results from the latest available Gulf Coast Aquifer GAM.

As in Wharton County, large amounts of groundwater from the Gulf Coast aquifer are available in Jackson County. The 2001 RWP estimated the groundwater availability of Jackson County at 87,876 ac-ft/yr from this supply. Based on estimates from TWDB in the 1997 Texas State Water Plan, availability of groundwater in Lavaca County is approximately 38,123 ac-ft/yr from the Gulf Coast aquifer and the Jackson Group. This amount is consistent with the results from the latest available Gulf Coast Aquifer GAM.

1.4.2 Surface Water Sources

The Lavaca and Navidad Rivers are located within LRWPA. The main river basins in the area are the Lavaca, the Colorado-Lavaca, and the Lavaca-Guadalupe. These basins include the Arenosa, Big Rocky, Brushy, Chicolete, Clarks, Cox's, East Carancahua, Huisache, Mixon, Pinoak, Rocky, Sandy, West Carancahua, and West Mustang Creeks. Approximately 90 percent of LRWPA is within the Lavaca River Basin, which has a total drainage area of 2,318 mi^2. *Figure 1.2* shows the location of the Lavaca River Basin and adjacent basins. There are no major springs in LRWPA.

1.4.3 Use by Source

Water-level monitoring data for Wharton County was collected and analyzed by LBG-Guyton. "The pumpage, static water-level, and groundwater chemistry data show that the aquifers of the Lavaca Region within Wharton County have provided in the past, and can continue to provide, large quantities of good quality water for varied uses within the region" (John Seifert 1999). The total groundwater pumpage has averaged 81,600 ac-ft/yr over the past 15 years, with increases in 1968 through 1980. The pumpage over the last 15 years has not caused additional static water level decline, and some wells show a slight recovery. See *Figures 3.3*, *3.4*, and *3.5*, in *Chapter 3* for more detail as well as *Figure 3.7* which shows estimated pumpage in Wharton County within LRWPA.

Average groundwater pumpage for Jackson County from 1984 to 1997 was 75,000 ac-ft while static-water levels in heavily irrigated areas of northeastern Jackson County have risen

5 to 10 feet in the 1990s as shown on *Figure 3.6*. Static water levels in Lavaca County are shown in *Figure 3.7*.

In 1996, 24,232 ac-ft of the total demand in the Lavaca Region was supplied by surface water. The only reservoir in LRWPA 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 (ROR) water to LRWPA, primarily for irrigation purposes.

1.4.4 Wholesale Water Providers

A wholesale water provider (WWP) is an entity that delivers and sells a significant amount of raw or treated water on a wholesale basis (TWDB 1999). The Lavaca Region has one WWP, LNRA.

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, 84668 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
- 30,000 firm yield ac-ft to Formosa Plastics in Calhoun County
- 650 firm yield ac-ft to the Calhoun County Navigation District

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

1.5 Water Quality and Natural Resources

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

1.5.1 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.

The Lavaca River Basin is divided into five, 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 1-5*.

The primary agricultural issue in LRWPA is the availability of sufficient quantities of irrigation water for rice farming under drought of record (DOR) conditions. Natural resources, on the other hand, have impacts from both water quantity and water quality issues. Stream segments in the Lavaca River Basin with water quality concerns are listed in *Table 1.6*. The stream segments that have water quality concerns within LRWPA are discussed below.

The primary water quality issue for all of the surface water stream segments and the major groundwater aquifers in 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 springs 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.

Table 1.5
Stream Segment Uses and Water Quality Criteria in the Lavaca River Basin 2002

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	CR	H					4	6.5–9.0	200	95
1601A	Catfish Bayou	P	CR	H					4		200	
1601B	Redfish Bayou	P	CR	H					4		200	
1602	Lavaca River Above Tidal	P	CR	H	PS	200	100	700	5	6.5–9.0	200	91
1603	Navidad River Tidal	P	CR	H					4	6.5–9.0	200	91
1604	Lake Texana	P	CR	H	PS	100	50	500	5	6.5–9.0	200	93
1604A	East Mustang Creek	P	CR	I					4		200	
1604B	West Mustang Creek	P	CR	H					5		200	
1604C	Sandy Creek	P	CR	H					5		200	
1605	Navidad River Above Lake Texana	P	CR	H	PS	100	50	550	5	6.5–9.0	200	91

[1] Uses: CR = Contact Recreation; H = High Aquatic Life; E = Exceptional Aquatic Life; PS = Public Water Supply; AP = Aquifer Protection

[2] Criteria: Standards set by the TCEQ (formerly TNRCC) 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.

Source: TCEQ 2002. *Texas Surface Water Quality Viewer 2002* (Developed from water quality data collected between March 1, 1996 and February 28, 2001)

URL: http://www.tnrcc.state.tx.us/water/quality/data/ …

Table 1.6
Stream Segment Water Quality Concerns in the Lavaca Region[1]

Stream Segment#	Stream Segment	Aquatic Life Use	Nutrient Enrichment	Algal Growth	Sediment Contaminants	Public Water Supply	Narrative Criteria
1601	Lavaca River Tidal						
1601A	Catfish Bayou						
1601B	Redfish Bayou						
1602	Lavaca River Above Tidal	Concern*					
1603	Navidad River Tidal						
1604	Lake Texana		Concern				
1604A	East Mustang Creek		Concern				
1604B	West Mustang Creek						
1604C	Sandy Creek						
1605	Navidad River Above Lake Texana						

* Only the Upper 29 miles of Segment 1602 in Lavaca County has been identified as being of concern

[1]Source: TCEQ 2004 Texas Water Quality Inventory

There are few water quality concerns in the Lavaca River Basin. *Table 1.5* lists the concerns found in the 2004 Texas Water Quality Inventory conducted by TCEQ. The concerns are discussed below:

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 man-made 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 2004 indicate that there is a portion of one classified stream segment with a concern for DO, based on the State Stream Standards Criteria in LRWPA (*Tables 1.5* and *1.6*). A Use Attainability Analysis (UAA) is scheduled to begin in the Spring of 2005 by TCEQ to determine the appropriateness of the current standards for this stream segment.

Another set of surface water quality indicators is 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 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 U.S. Geologic Survey (USGS) or data collected by TCEQ are used to determine the level of concern for nutrients. Based on 2004 data, there is one classified and one unclassified stream segment with a concern in LRWPA (*Tables 1.5* and *1.6*).

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 floodwaters. In recent years, TCEQ has changed the indicator bacteria from the generic “fecal coliform” to *Escherichia Coli* for non-tidal surface waters and *Enterococci* for tidal waters. Data reported for 2004 indicate that there are no classified stream segments with a concern for fecal coliform, based on the State Stream Standard Criteria in LRWPA (*Tables 1.5* and *1.6*).

1.5.2 Recreational and Natural Resources

Lake Texana is the main recreational area in LRWPA. There are public boat ramps, a 250-acre (ac) Mustang Wilderness Campground for primitive camping, a marina, picnic sites, Brackenridge Plantation Park and Campground, Lake Texana State Park, sailing, and canoeing. Brackenridge Plantation Park and Lake Texana State Park are located across State Highway (SH) 111 from each other, on the western side of the SH 111 Bridge. Some of the recreational activities enjoyed at these parks are camping, boating, fishing, and picnicking. The area has good nature-viewing opportunities including birding, and sometimes alligators can be found in park coves. Hunting and fishing are very popular recreational activities throughout the entire Lavaca Region. Deer and waterfowl hunting are the most common.

The Gulf Coastal Plains support a wide variety of animal species. The threatened, endangered, or rare species within Jackson, Lavaca, and Wharton Counties are shown in *Table 1.7*.

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.

1.5.3 Navigation

The LRWPA relies upon groundwater for supplies during DOR conditions. Because there are no known springs of significant size, there is little possibility for impacts upon navigation resulting from water usage in the region.

Table 1.7
Threatened, Endangered, and Rare Species
Found in Jackson, Lavaca, and Wharton Counties

Threatened	
Artic Peregrine Falcon	*Falco peregrinus tundrius*
Bald Eagle	*Haliaeetus leucocephalus*
Black Bear	*Ursus americanus*
Cagle's Map Turtle	*Graptemys caglei*
Louisiana Black Bear	*Ursus americanus luteolus*
Piping Plover	*Charadrius melodus*
Reddish Egret	*Egretta rufescens*
Sooty Tern	*Sterna fuscata*
Texas Horned Lizard	*Phrynosoma cornutum*
Texas Scarlet Snake	*Cemophora coccinea lineri*
Texas Tortoise	*Gopherus berlandieri*
Timber/Canebrake Rattlesnake	*Crotalus horridus*
White-faced Ibis	*Plegadis chihi*
White-tailed Hawk	*Buteo albicaudatus*
Wood Stork	*Mycteria americana*
Endangered	
American Peregrine Falcon	*Falco peregrinus anatum*
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*
Brown Pelican	*Pelecanus occidentalis*
Eskimo Curlew	*Numenius borealis*
Houston Toad	*Bufo houstonensis*
Interior Least Tern	*Sterna antillarum athalassos*
Red Wolf	*Canis rufus*
West Indian Manatee	*Trichechus manatus*
Whooping Crane	*Grus americana*
Rare	
American Eel	*Anguilla rostrata*
Guadalupe Bass	*Micropterus treculi*
Gulf Saltmarsh Snake	*Nerodia clarkia*
Henslow's Sparrow	*Ammodramus henslowii*
Mountain Plover	*Charadrius montanus*
Plains Spotted Skunk	*Spilogale putorius interrupta*
Sharpnose Shiner	*Notropis oxyrhynchus*
Snowy Plover	*Charadrius alexandrinus*
Texas Diamondback Terrapin	*Malaclemys terrapin littoralis*
Texas Garter Snake	*Thamnophis sirtalis annectens*

Source: TPWD, Wildlife Division, Non-game and Rare Species and Habitat Assessment programs. County Lists of Texas' Special Species (Jackson, Lavaca, and Wharton Counties, revised September 25, 2004).

1.6 Existing Water Plans

1.6.1 Existing Regional and Local Water Management Plans

LNRA has published a *Land and Water Resource Management Plan for Lake Texana and Associated Project Lands*. This plan was 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 emergency demand management plan. LNRA, TCEQ, and USGS/LNRA Cooperative Program has routinely collected water quality monitoring data in Lake Texana since 1988. Through this program, USGS/LNRA has 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 USGS and the Guadalupe-Blanco River Authority, which provide laboratory analyses of water samples. This program was developed under the auspices of CRP, a statewide effort administered by 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 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 River Basin CRP Steering Committee to advise LNRA on water quality issues and priorities. At present (FY 2005), LNRA is conducting the following water quality monitoring under the CRP's QAPP:

- 22 parameters including field data (e.g. DO, 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 USGS to do additional flow and water quality monitoring in the Lavaca River 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 GIS electronic database to store geographic and attribute data for the Lavaca River 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 streamflow gages

LNRA is notified of TCEQ discharge permit applications, and EPA's National Pollutant Discharge Elimination System or TCEQ's Texas Pollutant Discharge Elimination System applications for point source discharges and industrial stormwater runoff permits. These are reviewed by LNRA and appropriate actions taken (i.e., submission of written comments, negotiation with applicants, requests for hearings and party status) for the 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.

1.6.2 Current Preparations for Drought

LNRA developed a Water Conservation and Drought Management Plan in 1995 which was updated in January 2000 and again in 2002, in accordance with 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 Management Plan provides procedures for both voluntary and mandatory actions to temporarily reduce water usage during a water shortage crisis.

1.7 Recommendations Made in the 2001 Lavaca Regional Water Plan

1.7.1 Unique Reservoir Sites

Lavaca Regional Water Planning Group (LRWPG) recommended the use of Palmetto Bend Phase II reservoir site for future consideration. The site is currently permitted and is awaiting sufficient funding and a customer for the water supply in order to proceed. Impacts upon environmental flows by the reservoir are subject to consideration by TCEQ.

1.7.2 Creation of Regulatory Entities

LRWPG voted for a resolution to support the creation of a groundwater management district in order to most efficiently meet the shortages associated with agricultural usage in the region. The purpose of such a district would be to conserve the available groundwater resources within the region and not to market these resources to entities outside of LRWPA. As noted above, districts were formed in Jackson and Wharton Counties to meet this need.

1.7.3 Desalination

LRWPG, in conjunction with TWDB, TPWD, the TCEQ, the Texas General Land Office (GLO), and the Texas Department of Agriculture (TDA), funded a study to investigate the feasibility of locating a desalination facility at the Joslin Steam-electric Station. This project would potentially create a reliable source of water for surrounding regions that will be experiencing shortages in the future and may intend to utilize the groundwater resources of LRWPA to meet these demands. However, property ownership issues have prevented this site from being a viable candidate for a desalination facility.

1.8 Recommendations Made in the 2002 State Water Plan

The plans and recommendations of RWPGS were compiled into *Water for Texas 2002*. Several of these recommendations impact LRWPG directly.

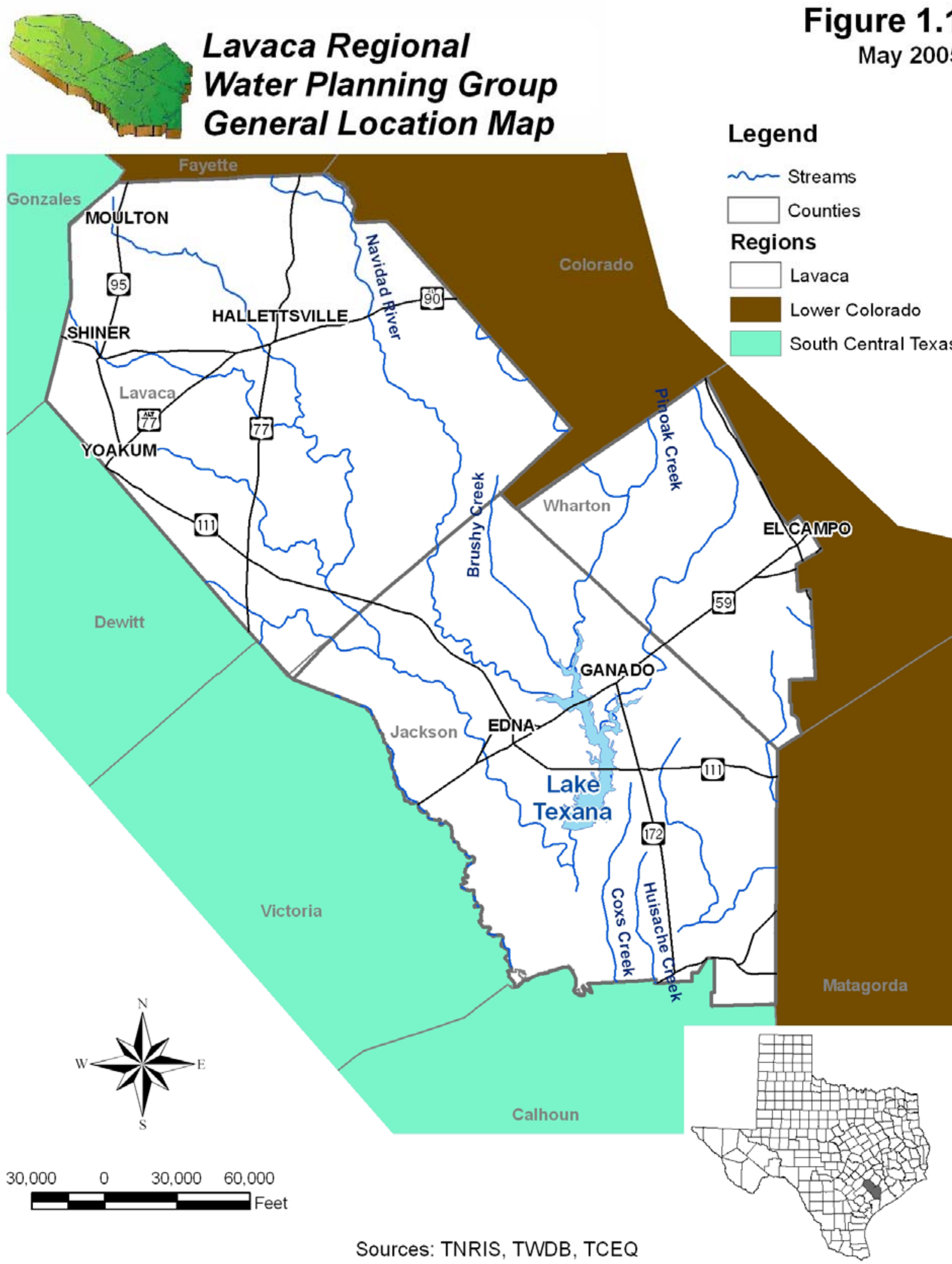
- In order to meet demands in DOR conditions, conjunctive use of groundwater supplies was recommended to meet demands during periods when surface water supplies are not available. Groundwater would be pumped at a rate exceeding the sustainable yield for a short time to meet these demands. It is assumed the resulting lower aquifer levels would be made up during times of sufficient recharge.

- Water conservation was recommended for all user groups in order to enhance the sustainability of existing aquifer supplies.

- No new reservoirs were recommended at this time, although Palmetto Bend Phase II was recommended as a unique reservoir site (URS).

- As the groundwater supplies of LRWPA are an attractive resource to neighboring regions without sufficient water to meet future demands, a desalination project was recommended to provide supplies to the surrounding area. This facility would consist of a multi-stage distillation or a reverse-osmosis operation located on Lavaca Bay that would be financed by the entities receiving water from the plant.

FIGURES



Sources: TNRIS, TWDB, TCEQ

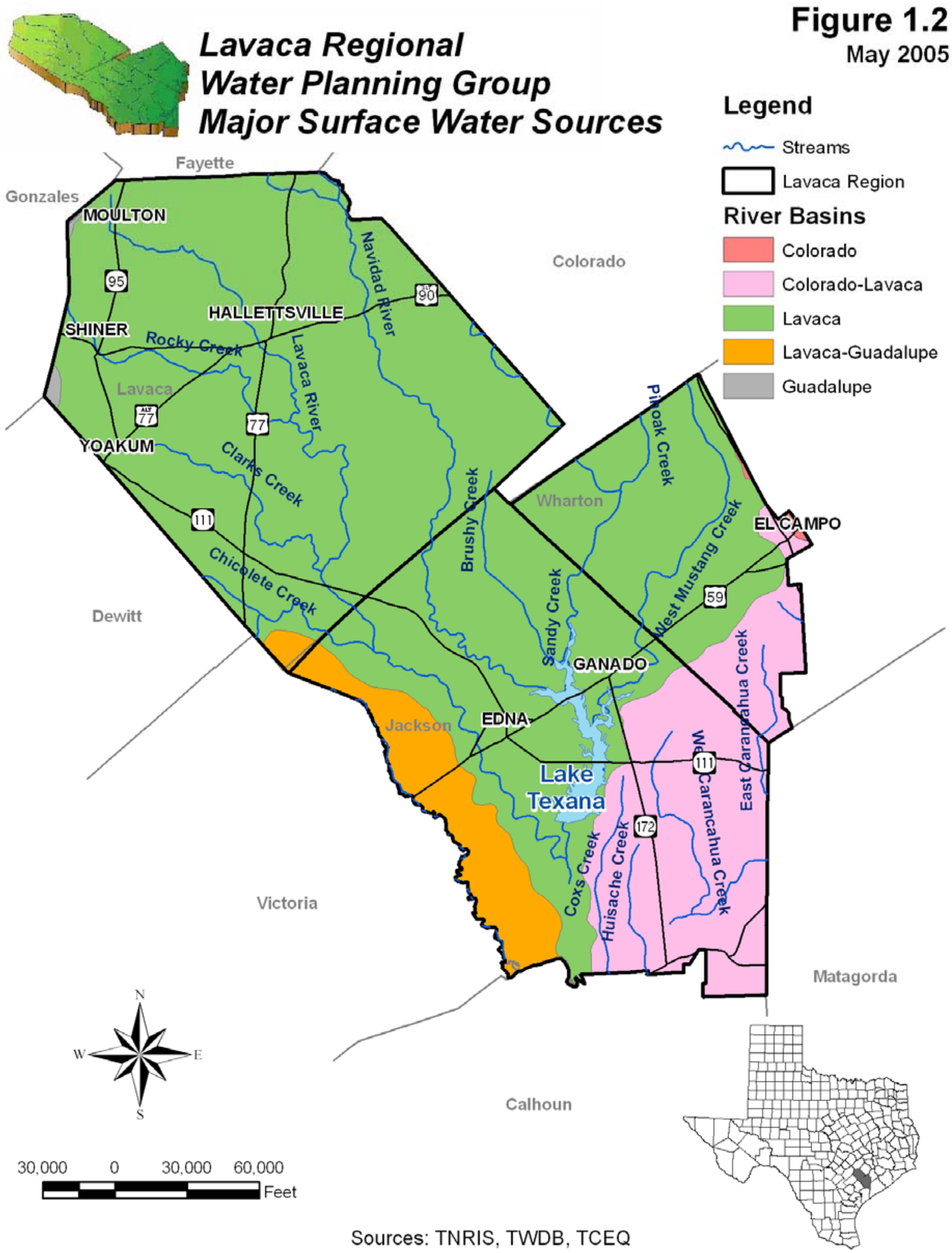
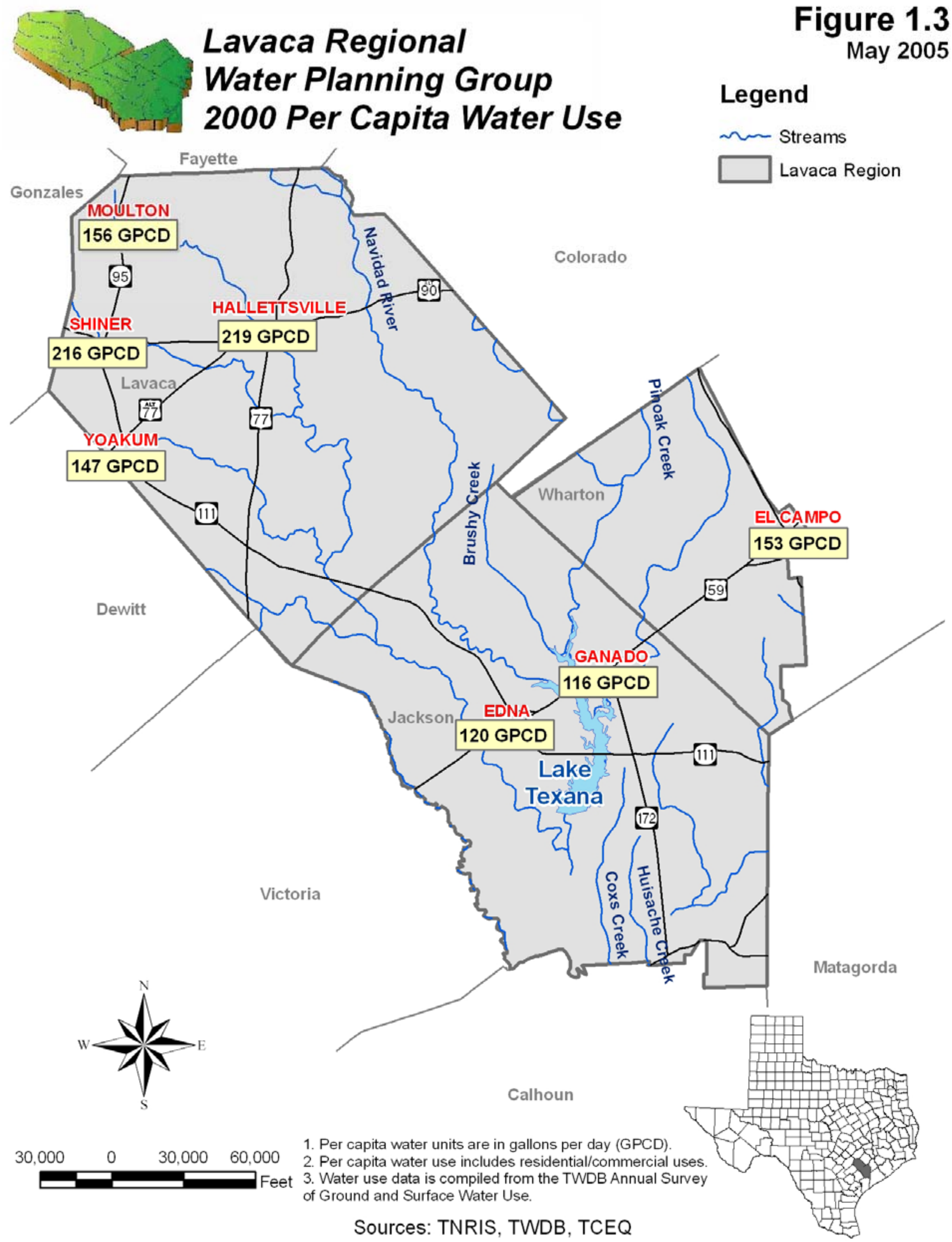


Figure 1.2
May 2005
Lavaca Regional
Water Planning Group
Major Surface Water Sources
Legend
Streams
Lavaca Region
River Basins
Colorado
Colorado-Lavaca
Lavaca
Lavaca-Guadalupe
Guadalupe
Fayette
Gonzales
Colorado
Lavaca
Wharton
Dewitt
Jackson
Victoria
Matagorda
Calhoun
MOULTON
SHINER
HALLETTSVILLE
YOAKUM
EL CAMPO
GANADO
EDNA
Lake Texana
Navidad River
Rocky Creek
Lavaca River
Clarks Creek
Chicolete Creek
Brushy Creek
Sandy Creek
Pinoak Creek
West Mustang Creek
East Carancahua Creek
West Carancahua Creek
Coxs Creek
Huisache Creek
95
90
77
111
59
172
N
S
E
W
30,000
0
30,000
60,000
Feet
Sources: TNRIS, TWDB, TCEQ

Figure 1.3
May 2005

Lavaca Regional Water Planning Group 2000 Per Capita Water Use



1. Per capita water units are in gallons per day (GPCD).
2. Per capita water use includes residential/commercial uses.
3. Water use data is compiled from the TWDB Annual Survey of Ground and Surface Water Use.

Sources: TNRIS, TWDB, TCEQ

CHAPTER 2

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 DB07. This information is contained in the following tables.

- *Table 2.2* – Population by City, Collective Reporting Unit (CRU), Individual Retail Public Utility, and Rural County
- *Table 2.3* – Water Demand by City and Category
- *Table 2.4* – Water Demand by WWP of All Water Use Categories

2.1.2 Background[1]

The increased demand for water, combined with recent droughts, has increased awareness of water supply availability issues in Texas. Currently, estimates of future Texas population anticipate the population will more than double, increasing from about 21 million (current population) to more than 45 million people by the year 2060. According to the 2002 State Water Plan, by 2050, almost 900 cities (representing 38 percent of the projected population) and other water users will need to either reduce demand (through conservation and/or drought management) or develop additional sources of water beyond those currently available to meet their needs during droughts. Total inability of current water sources to meet demands increases from 2.4 million ac-ft/yr in 2000 to 7.5 million ac-ft/yr in 2050. This includes water users that cannot rely on current sources because contracts expire during the planning period. Twenty percent of irrigation demand cannot be met by existing sources if a DOR were to occur today. Seven percent of municipal demand would not be met by existing sources if a drought were to occur now.

However, if a drought occurs in 2050, almost half (43 percent) of the municipal demand could not be satisfied by current sources. Similar percentages of manufacturing and steam-electric power generation demands could not be met in 2050.

Water resource planning and management in Texas is a shared responsibility of local utilities, regional special purpose districts, and state agencies. Local and regional water development authorities and municipalities have had primary responsibility for financing and constructing

[1] Some of the information used for describing the background came from *Water for Texas*, published and distributed by the TWDB, January 2002, and referenced as the 2002 State Water Plan.

new water resource projects. The state's primary role has been providing guidance, regulatory governance, and limited financial assistance.

Senate Bill 1 (SB 1), 75th Texas Legislature, established a new approach to the preparation of the state water plan consisting of local consensus on regional plans first. LRWPG prepared and submitted a regional plan in 2001. LWRPG is now responsible for completing an update to that consensus-based regional water supply management plan for submittal to TWDB by January 5, 2006. LRWPG contracted with Turner Collie & Braden and LBG-Guyton to develop technical data needed to prepare a RWP.

2.1.3 Description of the Region[2]

The Lavaca Region consists of Jackson and Lavaca Counties, and Precinct 3 of Wharton County, including the entire City of El Campo. The eastern portion of Wharton County is included in the Region K planning area. The region had a population of 48,068 in 2000. *Table 2.1* contains detailed crop acreages for the Lavaca Region. Most of the water demand in the Lavaca Region is associated with agricultural irrigation. See *Figure 1.1* for a map of LRWPA.

2.2 Methodology[3]

2.2.1 General

A key task in the preparation of the water supply plan for LRWPA is to determine current and future water demands within the region. Projections of future water demand will be compared with estimates of currently available water supply to identify future water shortages. TWDB, TCEQ, TPWD, TDA, and RWPG prepared draft population and water demand projections for all water user groups (WUGs) within the Lavaca Region.

The term "default estimates" or TWDB projections is used throughout this report to refer to the 2000 Census-based municipal population and demand projections and the 2003 consensus-based estimates developed by TWDB in conjunction with TCEQ and TPWD. The default estimate population projections were developed using a standard cohort-component procedure in conjunction with data from the 2000 Census and other sources. The municipal water use estimates were initially developed based on data collected from TWDB Water Use Survey data through the year 2000. This section discusses the guidelines and methodology used to evaluate these projections and to select projections for use in RWP for LRWPA.

[2] Lavaca Regional Water Management Plan: Description of Region, submitted by Consulting Team.
[3] Exhibit B Guidelines for Regional Water Plan Development

Table 2.1
NASS Crop Acreages – Jackson, Lavaca, Wharton Counties

Year	Rice Irrigated	Corn Total	Cotton Total	Soybean Total	Milo Total
NASS Jackson County Crop Acreages					
1990	30,600	39,700	16,700	2200	-
1991	30,100	37,400	34,200	1900	-
1992	31,600	45,000	24,400	2400	-
1993	25,800	46,500	22,500	3600	-
1994	31,000	60,000	19,900	5700	-
1995	27,900	56,700	31,600	3500	21,200
1996	27,700	74,800	25,300	5000	29,800
1997	20,200	37,600	22,500	9000	49,800
1998	20,800	59,600	21,400	14900	25,200
1999	19,300	40,700	40,600	15100	28,200
2000	18,000	44,700	45,200	9600	28,900
5-yr av ('95–'99)	21,200	51,480	31,000	10,720	32,380
6-yr av ('95–'00)	**22,317**	**52,350**	**31,100**	**9,517**	**30,517**
NASS Lavaca County Crop Acreages					
1990	4,600	6,700	-	-	-
1991	4,200	6,900	-	-	-
1992	3,800	6,300	-	-	-
1993	3,600	5,900	-	-	-
1994	4,000	6,000	-	-	-
1995	3,600	5,800	-	-	1,400
1996	4,700	7,900	-	-	2,100
1997	2,700	7,800	-	-	1,600
1998	2,700	7,000	-	-	1,200
1999	2,100	6,200	-	-	1,100
2000	1,700	6,300	-		1,200
5-yr av ('95–'99)	2,780	7,040	-	-	1,440
6-yr av ('95–'00)	**2,917**	**6,833**	**-**	**-**	**1,433**
NASS Wharton (100%) County Crop Acreages					
1990	64,300	62,300	29,300	7000	-
1991	63,500	51,400	62,500	4800	-
1992	66,700	52,900	41,200	8200	-
1993	55,000	51,100	42,000	8100	-
1994	68,300	58,800	40,600	6300	-
1995	61,800	51,100	68,400	4600	61,000
1996	60,000	66,500	60,600	9800	90,400
1997	55,200	24,400	56,300	26100	89,000
1998	59,800	58,400	61,400	19400	63,800
1999	58,700	37,400	89,100	12300	64,300
2000	53,000	34,200	86,500	13300	66,100
5-yr av ('95–'99)	57,340	44,180	70,780	16,180	74,720
6-yr av ('95–'00)	**58,083**	**45,333**	**70,383**	**14,250**	**72,433**

Milo = Sorghum
Note: "-" designates No Data for this table

TWDB rules require that the analysis of current and future water demands be performed for each WUG within LRWPA. To be considered a WUG within the municipal category, an entity must fall into one of the following categories:

- Cites with a population of 500 or more
- Individual utilities providing more than 280 ac-ft/yr of water for municipal use (for counties having four or less of these utilities)
- CRUs consisting of grouped utilities having a common association

All smaller communities and rural areas, aggregated at the county level, are considered a WUG and are referred to as "County-Other" for each county. Additionally, for each county, the categories of manufacturing, irrigation, steam-electric power generation, mining, and livestock water use are each considered a WUG.

Furthermore, TWDB rules require the determination of demands associated with each of WWPs designated by RWPG. Lavaca RWPG defines wholesale providers as any persons or entities, including river authorities and irrigation districts, that have contracts to sell more than 1,000 ac-ft of water wholesale in any one year during the five years immediately preceding the adoption of the last RWP. RWPG will also include other persons and entities that enter or that the Planning Group expects or recommends to enter into contracts to sell more than 1,000 ac-ft of water wholesale during the period covered by the plan. The designated WWP in LRWPA is LNRA.

Throughout this section, verbiage excerpted directly from TWDB published guidelines for changes to the draft TWDB projections appears in italics. The applicable TWDB criteria used to support and develop revisions to the TWDB numbers are designated in bold, italic type.

2.2.2 Methodology

This section describes the methodology used to develop projections for population and for water demand for each municipal, manufacturing, irrigation, steam-electric power generation, mining, and livestock WUG in the Lavaca Region.

2.2.2.1 Population Projection Methodology

The following procedure was used to develop population projections for each city and County-Other:

a) **Identify the Baseline Projection:** The baseline population projection for the 2006 RWP was determined for each:

1. County
2. Incorporated area (city) of 500 population and greater.

3. Retail public utility for counties that have less than five retail public utilities which provide more than 280 ac-ft/yr for municipal use.

4. Individual retail public utility or collective data for all such retail public utilities that form a logical reporting unit, such as being served by a common WWP or having a common source or other association appropriate for the area, in the judgment of RWPG, for counties with more than five retail public utilities which provide more than 280 ac-ft/yr for municipal use.

5. Categories of water use including municipal not otherwise reported (County-Other), for each county or portion of a county in the regional water planning area. If a county or portion of a county is in more than one river basin, data shall be reported for each river basin.

These projections were presented by decade from 2000 (actual reported data from 2000 Census) to 2060 to the RWPG for consensus. These TWDB draft projections were used unless revisions were justified per TWDB guidelines.

b) **County Population Projections:** *The cohort-component procedure, which uses separate cohorts such as age, sex, race, ethnic groups, and components of change such as fertility rates, survival rates, and migration rates, was used to calculate future county populations.*

There are four main steps in applying the cohort-component method:

1. *The first step is to project the population alive at the beginning of the year who will survive to the target year. Survival rates for each cohort are used to compute the change in the cohort size relating to the number of deaths anticipated to occur between each projection interval.*

2. *The second step is to project net migration by multiplying net migration rates by the adjusted population in the launch year. Net migration rates for each cohort are used to compute the change in each cohort due to in-migration or out-migration in a specific county.*

3. *The third is to project the number of births and the net impact of mortality and migration on the youngest age group. Fertility rates for each female cohort are incorporated into the projection procedure for calculating the number of births anticipated to occur between each projection interval.*

4. *The fourth is to combine the results from the mortality, migration, and fertility modules.*

The combinations of the six racial groups used in the 2000 Census results in 63 separate racial categories, as opposed to the eight separate racial categories in the 1990 Census. Before the 2000 Census, the Census Bureau had used four race categories: white; black; American Indian, Eskimo, or Aleut; and Asian or Pacific Islander (U.S. Bureau of the Census, 1992). More detailed categories based on ethnicity and national origin were also used (i.e. Chinese, Filipino, and Samoan). In addition, the population was classified as Hispanic or non-Hispanic, an ethnic category, not a race category. The 2000 Census expanded the number of basic categories from four to five: white; black; American Indian or Alaska Native; Asian; and Native Hawaiian or Other Pacific Islander. It may currently be impossible to construct racial-ethnic categories that are fully comparable with past categories, but the Texas State Data Center has constructed categories that approximate past categories and are "roughly comparable for those in earlier decades." Because Texans are substantially concentrated in single-race groups, the TWDB has modeled their racial category allocations after those of the Texas State Data Center who has chosen to allocate the 2.4 percent of population found in multiple-race categories to the four single-race categories of Anglo, Black, Hispanic, and Other.

Many counties in Texas have special populations generally referred to as "institutional" populations. These groups of people are assumed not to participate in the same demographic processes as the base population and generally tend to move in and out of these institutional arrangements in fixed intervals. More specifically, these groups are defined as college/university populations, military populations, prison populations, and populations in other institutional arrangements. Institutional populations are removed from the base population for computing future cohort populations, but are added back into the total projected base cohort population at the end of each projection interval.

c) ***Sub-County Population Projections:*** *The 2006 Regional Water Plan will include specific plans for a greater number of entities by projecting population and water demands for unincorporated areas supplied by public water utilities (non-municipal retail water suppliers) above a particular size (see below). In the current, and previous State Water Plans, these unincorporated areas were aggregated into the County-Other WUGs. With a greater public awareness of water planning and a greater emphasis placed on watershed modeling systems for any area that may face a water shortage, this aggregation of unincorporated areas has now been reduced.*

Population projections for areas below the county level were calculated for the following:

1. *Incorporated areas (cities) with populations of 500 or more in the 2000 Census.*

2. *The county population outside cities of more than 500, previously considered as a single Water User Group called County-Other, may be further subdivided based on the following criteria:*

   a. *If the County-Other population for a county is served by at least one, but fewer than five, utilities which in Year 2000 provided more than 280 ac-ft of water to its entire service area, the population served by each utility will be considered a separate WUG. TWDB staff will develop draft estimates and projections of population and water demand for these WUGs and for the remaining County-Other population outside these utility service areas.*

   b. *If the County-Other population for a county is served by five or more utilities which in 2000 provided more than 280 ac-ft of water to its entire service area, the Planning Group shall determine if and how the County-Other population will be subdivided and designate in its contract whether such utilities, in these counties, will be treated as individual WUG or combined with other utilities in logical reporting units (such as being served by a common WWP, having a common source or other association appropriate for the area). TWDB staff will be responsible for developing estimates and projections of population and water demand for the chosen WUGs and for the remaining County-Other population outside utility service areas.*

As described above, the use of the cohort-component procedure for the projection of county populations requires detailed data that are not available for areas smaller than the county level. For this reason, the projections for cities, water utilities and the County-Other will be based on a share of the county's population growth between 1990 and 2000.

The share-of-growth ratio method examines the city's (or utility's) share of the county's population growth between 1990 and 2000. It is then assumed that the area's share of the county's population growth will be the same in the future as it was between 1990 and 2000.

Problems arise in this method if the area experienced population decrease between 1990 and 2000 while the county experienced an increase. If the county is then projected to experience greater growth in the future, the city or utility will experience dramatic decreases throughout the planning horizon. In these cases, the share-of-growth ratios will be adjusted by staff to appropriate levels based on historical data.

While the share-of-growth ratio method will be used as the base for sub-county level projections, adjustments may be made in cases where reliable local input may identify cities which have reached their maximum growth potential or cities which are expected to experience significantly greater growth rates than shown by historical data.

The base year for the city, utility and county-other projections will be the Year 2000. All cities will use the Census 2000 figures for the base population. For the utilities, a Year 2000 population will be estimated through the use of Water Use Survey information and the sum of Census Block populations within the utility's service area.

2.2.2.2 Municipal Water Demand Projection Methodology

Municipal water demand projections were calculated for all WUGs identified in the population projections process. The components of the water demand projection process are population projection and per capita water use. *Section 2.2.2.1* discussed the methodology used to determine the population projections for the region. Per capita water use and conservation as applied to water demand projections are discussed below.

a) Per Capita Water Use

The second key variable in the TWDB's municipal water demand projections is per capita use, expressed as gallons of water used per person per day. TWDB estimates of per capita water use are derived from data provided by water suppliers annually, and are simply the total annual reported municipal water use divided by total estimated population, and then divided by 365 (days in a year). The starting point in TWDB's default projections is a per capita use estimate for a year with below-normal rainfall when water use is typically high. LRWPA per capita use values were developed from year 2000 data. The year 2000 was chosen for the following reasons:

1) Due to the year 2000 Census, the population figures will be more accurate than any single-year population estimates between 1990 and 2000.

2) According to the Palmer Drought Severity Index for the past decade, the year 2000 was the driest year in the last decade for the majority of the regions and for the state as a whole.

3) Year 2000 water use data also takes into account not only a dry-year water usage, but the water use savings that have resulted to date from the 1991 State Water-Efficient Plumbing Act or conservation programs supported by the city or utility.

TWDB guidelines for revisions to municipal water demand projections provide that adjustments in per capita use rates can be proposed if more recent data indicate that per capita use has changed. The guidelines for revision also provide for the modification of TWDB conservation assumptions, if changes to the assumptions are justified.

b) Municipal Water Demand

The municipal water demand projections are the product of the proposed population projections and the proposed per capita usage projections described above. These projections were adopted by TWDB and are presented for each municipal WUG by county, river basin, and decade in *Table 2.2*. For all WUGs, including non-municipal categories, they are presented by county, basin, and decade, in *Table 2.3*.

2.2.2.3 Manufacturing Water Demand Projection Methodology

Manufacturing water demand methodology and projections were developed for TWDB by Waterstone Environmental Hydrology and Engineering, Inc. and the Perryman Group. The contracted firms developed water demand estimates by decade at the county level for years 2000 to 2050. Manufacturing demand trends were then used to project the 2060 manufacturing demands.

The plan of research included:

- *Complete industry surveys to update water use efficiency estimates developed for the 2002 State Water Plan.*
- *Analyze the impact of technology adoption and input substitution on the relationship of water used to output.*
- *Develop projections of industry output and associated water use by county.*

2.2.2.4 Irrigation Water Demand Projection Methodology

TWDB, with the aid of other state and federal agencies, developed baseline water demand estimates for irrigation.

A comprehensive irrigation survey was performed in 2000 that provided up to date crop and irrigation data for consideration in making changes to the 2002 State Water Plan water demand projections. These estimates for acreage under irrigation and individual crop needs, supplied by the Natural Resources Conservation Service (NRCS), data developed in the previous two State Water Plans (1997 and 2002), and new data based on Potential Evapotranspiration (PET), will be used for verification of baseline values and for trends.

The process of estimating irrigation demand in the Irrigation Survey is straightforward. The acreage planted for each crop under irrigation is estimated for *each county. The crop water applications for each crop are estimated by NRCS and multiplied by the acreage to give total irrigation used.*

Research is ongoing at TWDB to develop PET-based crop water demands, reduced by the amount of beneficial rainfall received, to be used for comparison to NRCS estimates of irrigation applications. That amount (irrigation needed) is multiplied by the irrigated acreage planted as reported by the Texas Agricultural Statistics Service (TASS).

The results are total irrigation water demands by crop for each county. These individual crop irrigation water demands are added and the county totals and regional totals are calculated. The final step is to add back in water amounts that are lost in the process of transportation to the field for crops using surface water.

Crop acreage data developed from comparing the 2000 Irrigation Survey and the 2002 State Water Plan will be used to represent cropping patterns for the 50-year planning period, unless limited by processes known to exist or anticipated to develop during this time frame. Examples such as water non-availability due to aquifer overdraft thereby reducing cropping, or farmland conversion to municipal land use are two processes that could alter cropping patterns. The rates of change for irrigation water use as projected in the 2002 State Water Plan will be largely retained. The crop water demands contained in the 2002 State Water Plan were approved by each Planning Group and reflect increased on-farm efficiencies and anticipated cropland losses.

The 2007 State Water Plan will use the 2002 State Water Plan projections as a baseline. The 2000 Irrigation Survey (completed after the 2002 projections were approved) will be used to detect changing trends in the most recent years. PET-based estimates, where available and appropriate, may also be considered during the development of demand projections.

Adjustments to the 2002 State Water Plan projections will be made based on several factors. One factor is recent increases or decreases in the amount of acreage under irrigation (if the change in irrigated acreage is reasonably expected to be maintained). Another factor is increases or decreases in canal losses (for surface water diversion losses) for those counties reporting canal losses in the past.

The projected irrigation demands developed by TWDB were not adopted by LRWPG for use in this study. LRWPG developed irrigation projections based on more accurate local knowledge. LRWPG projections were developed with assistance from Dr. Garry McCauley, of Texas A&M University's Agricultural Extension Service and L. G. Raun, Jr., a rice farmer and member of the regional planning group. The irrigation demand projections were based on the six-year average (1995–2000) demand for agriculture. Irrigation water demands were developed by determining the amount of water applied to specific crop types and total irrigated acreage of that crop.

The baseline acreage was then projected using the same decadal changes in demand, as found in the 2001 Regional Water Plan.

2.2.2.5 Steam-Electric Power Generation Water Demand Projection Methodology

The steam-electric power generation water use projections developed by consultants to TWDB were approved for use by LRWPG. The TWDB consultant's plan of research included the following:

- *Description of water consuming systems currently used in power generation facilities.*
- *Estimation of water consumption rates for each identified water consuming system.*
- *Correlation of current State population with current electric use by region.*
- *Projection of electric power consumption requirements by county and for the State, based on population projections.*
- *Identify current and potential water sources for demand by power generation.*
- *Estimate future water use by power generation.*
- *Develop and apply allocation methodology to derive demand projections by county.*

2.2.2.6 Mining Water Demand Projection Methodology

Mining water demand methodology and projections were developed for TWDB by Waterstone Environmental Hydrology and Engineering, Inc and the Perryman Group. The TWDB consultants developed water demand estimates by decade at the county levels for years 2000 through 2050. The mining demand trends were then used to project the 2060 mining demands. The TWDB consultant's plan of research included the following:

- *Complete industry surveys to update water use efficiency estimates developed for the 2002 State Water Plan.*
- *Analyze the impact of technology adoption and input substitution on the relationship of water used to output.*
- *Develop projections of industry output and associated water use by county.*

2.2.2.7 Livestock Water Demand Projection Methodology

The TWDB, with the cooperation of state and federal agencies, developed baseline water demand projections for livestock.

Estimating livestock water consumption is a straightforward procedure that consists of estimating water consumption for a livestock type and the total number of livestock of that type in each county. Texas A&M University Agricultural Extension Service has published information on water use rates, estimated in gallons per day per head, for each type of livestock: cattle, poultry, sheep and lambs, and hogs and pigs. The Texas Agricultural Statistics Service provides current and historical numbers of livestock by livestock type and county.

The 2006 Regional Water Plan will maintain the same rates of change in livestock water demand as included in the 2002 State Water Plan. Base water use for 2000 will be adjusted using the 2000 livestock inventory along with adjustments in water use per unit, based on research by the Texas Agricultural Experiment Station (TAES).

2.2.3 TWDB Guidelines for Revisions to Population and Water Demand Projections

TWDB established criteria and data requirements to be used in evaluating and developing revisions to the state's census-based and/or consensus-based population and water demand projections. The criteria applied in developing revisions to the draft TWDB projections for LRWPA are displayed in bold, italic type below and are described in detail.

2.2.3.1 Population Projections

Population is the principal determinant for projected future municipal water demand when combined with estimates of per capita water use and water conservation assumptions. As such, emphasis has been placed on evaluating the state's draft population projections and on developing revisions in accordance with the following criteria.

County-Level Population

Population projections by decade for each county in the state were developed by TWDB. The county populations were summed to determine regional population totals. Adjustments to the county-level population projections must involve the redistribution within the counties within the region so that regional totals remain the same.

Criteria: *One or more of the following criteria must be verified by the RWPG and the Executive Administrator of the TWDB for consideration of revising the county population projections.*

a) *A possible census undercount took place in the county and action is currently being pursued to request a Census Bureau correction.*

b) *If there is evidence that the 2000–2010 net migration rate will be significantly different than the net migration rate used for the original projection.*

c) *There are statistically significant birth and survival rate differences (by appropriate cohorts) between the county and the State.*

Data Requirements: *The Planning Group must provide the following data associated with the identified criteria to the Executive Administrator for justifying any revisions to the county-level population projections:*

1. *Documentation of an action requesting the Census Bureau correct an undercount of population within a county.*

2. *Projected in-migration and out-migration of a county, indicating that the net migration of a county will be significantly different than the net migration rates previously used.*

3. *Birth and/or survival rates for a county population between 1990–2000 by gender, race/ethnicity, and single-year age cohorts.*

4. *Other data that the Planning Group believes is important to justify any changes to the population projections.*

Sub-County Population

The projected sub-county population growth from planning decades 2000 to 2060 for municipalities, utilities, and county-other within a county is determined from the county's share-of-growth between 1990 to 2000 and is assumed to be the same in the future. Base populations will be from 2000 Census data.

Any revisions to municipality, utility, or County-Other population involved a redistribution of the population within the county so that the county total remained the same. The criteria and data requirements for revisions are discussed below.

Criteria: *One or more of the following criteria must be verified by the Planning Group and the Executive Administrator for consideration of revising the sub-county population projections:*

a) *The population growth rate for a city, utility or County-Other over the most recent five years is substantially greater than the growth rate between 1990 and 2000.*

b) *Identification of areas that have been annexed by a city since the 2000 Census.*

c) Identification of the expansion of a utility's Certificate of Convenience and Necessity (CCN) or service area since the last update by the Texas Natural Resource Conservation Commission (TNRCC) to the digital boundary data.

d) Identification of growth limitations or build-out conditions in a city or utility that would result in maximum population that is less than was originally projected.

Data Requirements: *The Planning Group must provide the following data associated with the identified criteria to the Executive Administrator for justifying any revisions to the sub-county-level population projections:*

a) Population estimates for cities developed and published by the State Data Center or by a regional council of governments will be used to verify criteria (a) for cities.

b) The verified number of residential connections and permanent population served will be used to verify criteria (a) for utilities.

c) The estimated population of an area that has been annexed by a city (for criteria b) or has become part of a CCN or service area for a water utility (for criteria c). In addition, the geographical boundary of the area must be presented in an acceptable map or ArcView shapefile.

d) Documentation from an official of a city or utility describing the conditions expected to limit population growth and estimating the maximum expected population will be used to verify criteria (d).

e) Other data that the Planning Group believes is important to justify any changes to the population projections.

2.2.3.2 Municipal Water Use

Updated municipal water use estimates are based on TWDB Water Use Survey data through the year 2000. As indicated above, per capita water use rates and assumptions regarding water conservation are additional variables in municipal water demand projections. Accordingly, the following criteria were applied in the evaluation of the state's municipal water demand projections and in the development of revisions to those projections.

Criteria: *One or more of the following criteria must be verified by the Planning Group and the Executive Administrator for consideration of revising the municipal water demand projections:*

a) A revision by the Census Bureau of a city's 2000 population will require revision of the city's annual per capita water use.

b) *Any changes to the population projections for an entity will require revisions to the municipal water use projections.*

c) *Errors identified in the reporting of municipal water use for an entity.*

d) *Evidence that the year 2000 water use was abnormal due to temporary infrastructure constraints.*

e) *Evidence that per capita water use from a year between 1995–1999 would be more appropriate because that year was more representative of below-normal rainfall conditions.*

f) *Trends indicating that per capita water use for a city, utility, or rural area of a county have increased over the latest period of analysis, beginning in 1990, and evidence that these trends will continue to rise in the short-term future.*

g) *Evidence that the number of fixture installations to water-efficient fixtures between 1990 and 2000 is different than the TWDB schedule.*

Data Requirements: *The Planning Group must provide the following data associated with the identified criteria to the Executive Administrator of the TWDB for justifying any revisions to the municipal water use projections:*

a) *Annual municipal water production (total surface water diversions and/or groundwater pumpage and water purchased from other entities) for an entity measured in ac-ft.*

b) *The volume of water sales by an entity to other water users (cities, industries, water districts, water supply corporations, etc.) measured in ac-ft.*

c) ***Net annual municipal water use, defined as total water production less sales to other water users (cities, industries, water districts, water supply corporations, etc.) measured in ac-ft.***

d) *Documentation of temporary infrastructure constraints.*

e) *Drought index or growing season rainfall data to document a year different than 2000 as the dry year.*

f) *Documentation of the number of water-efficient fixtures replaced between 1990 and 2000.*

g) *In order to verify increasing per capita water use trends for a city or rural area of a county and therefore revising projections of per capita water use to reflect this increasing trend, the following data must be provided with the request from the Planning Group:*

1. *Historical per capita water use estimates based on net annual municipal water use for the city, utility or rural area of a county, beginning in 1990.*

2. *A trend analysis which must take into account the variation in annual rainfall.*

3. *Revised projections of per capita water use for a city, utility or rural area of a county will be submitted by the Planning Group, where an increasing trend in per capita water use has been verified for a city or rural area of a county.*

4. *Growth data in the residential, commercial and/or public sectors that would justify an increase in per capita water use.*

h) Other data the Planning Group believes is important to justify any revisions to the State Water Plan municipal water use projections.

2.2.3.3 Agricultural Irrigation Water Demand Basis For Revision

The basis for requesting a revision to the agricultural irrigation water demands is described in detail herein.

Criteria: *One or more of the following criteria must be verified by the RWPG and the Executive Administrator of the Texas Water Development Board for consideration of revising the irrigation water use projections:*

- *Evidence that a year between 1995–1999 would be more representative of typical irrigated acreage or below-normal rainfall than 2000.*
- *Evidence that irrigation water use estimates for a county from another source are more accurate than those used by TWDB.*
- *Evidence that the expectation of conditions in the region are such that the projected annual rates of change for irrigation water use in the 2002 State Water Plan are no longer valid.*

Data Requirements: *The RWPG must provide the Executive Administrator of the Texas Water Development Board the following data associated with the identified criteria for justifying any revisions to the irrigation water demand projections.*

- ***Acreage and water use data for irrigated crops grown in a region, as published by the Texas Agricultural Statistics Service, TAES, or the USDA's Farm Service Agency, for the base year 2000 and/or a different year that the Planning Group wishes to present for consideration.***

- *Any economic, technical, and/or water supply-related evidence that may show cause for revision in the future rate of change in irrigation water use.*

2.2.3.4 Other WUGs

TWDB's default water demand projections were adopted by the Planning Group for other categories of water users (e.g., manufacturing, steam-electric power generation, mining, and livestock).

2.3 Population and Water Demand Projections

This section discusses the projections for population and for municipal, manufacturing, irrigation, mining, livestock, and steam-electric power generation water demands for each of the three counties in LRWPA. These projections were developed using the general methodology described in *Section 2.2,* with any exceptions described by WUG for each county. As previously described, *Tables 2.2*, *2.3*, and *2.4* present data on population and water demands. *Table 2.5* presents a summary of LRWPA's total revised water demand projections by water user category from the 2006 RWP and the 2001 RWP at a county level and *Figure 2.1* depicts a graphical summary of the total water demand for LRWPA by water use category, respectively.

After the revised population and water demand projections were approved by RWPG and formally adopted by TWDB, the projections were incorporated into TWDB DB07.

2.3.1 Regional Summary of Projections by Category

Population

The revised population projections indicate that LRWPA population will grow from 48,068 in year 2000 to 49,663 in the year 2060. When comparing the 2001 plan and 2006 plan population estimates for the region, there is a 6.7 percent increase in year 2000 and 15.1 percent decrease in 2050. *Table 2.2* presents the population projections by county, river basin, and decade.

Table 2.2
Population by City, Collective Reporting Unit, Individual Retail Public Utility, and Rural County

Region	Water User Group	County Name	P2000 (1)	P2010	P2020	P2030	P2040	P2050	P2060	Region Split Pop.(2)	County Split Pop.(3)
P	EDNA	JACKSON	5,899	6,331	6,773	7,048	7,206	7,266	7,267		
P	GANADO	JACKSON	1,915	2,081	2,251	2,357	2,418	2,441	2,441		
P	COUNTY-OTHER	JACKSON	6,577	7,029	7,491	7,778	7,943	8,006	8,008		
		JACKSON Total	***14,391***	***15,441***	***16,515***	***17,183***	***17,567***	***17,713***	***17,716***		
P	HALLETTSVILLE	LAVACA	2,345	2,289	2,287	2,224	2,114	1,985	1,839		
P	MOULTON	LAVACA	944	921	920	895	851	799	740		
P	SHINER	LAVACA	2,070	2,020	2,018	1,963	1,866	1,753	1,623		
P	YOAKUM	LAVACA	3,594	3,508	3,504	3,409	3,239	3,043	2,818	P	P
P	COUNTY-OTHER	LAVACA	10,257	10,012	10,002	9,728	9,244	8,684	8,041		
		LAVACA Total	***19,210***	***18,750***	***18,731***	***18,219***	***17,314***	***16,264***	***15,061***		
P	COUNTY-OTHER	WHARTON	3,522	3,725	3,937	4,074	4,153	4,155	4,111	P	
P	EL CAMPO	WHARTON	10,945	11,575	12,236	12,662	12,906	12,912	12,775		
		WHARTON Total	***14,467***	***15,300***	***16,173***	***16,736***	***17,059***	***17,067***	***16,886***	***P***	
		LRWPA TOTAL	**48,068**	**49,491**	**51,419**	**52,138**	**51,940**	**51,044**	**49,663**		

1) The year 2000 population for cities and county totals are from the 2000 Census. For utilities, TWDB staff estimated the population served by the utility in 2000. Some of the 2000 population estimates for utilities were revised by the Regional Water Planning Groups. 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 this column, the WUG is located in more than one region, and the projections listed in the row represent only the WUG’s population projections within that particular region, not the WUG’s total population projections. If the “P” is present for a county total entry, then the county has been split by regional boundaries, and the projections listed in the row represent only the county’s populations within the particular region, not the county’s total population projections.

3) If “P” is present in this column, the WUG is located in more than one county, and the projections listed in the row represent only the WUG’s population projections within that particular county, not the WUG’s total population projections.

Projections last updated 02/17/2004

Table 2.3
Water Demand by City and Category

WUG Name	WUG Basin	WUG County	WUG ID	City ID	Water Demand (ac-ft/yr)						
					2000	2010	2020	2030	2040	2050	2060
COUNTY-OTHER	COLORADO-LAVACA	JACKSON	2959	0757	256	266	275	277	274	273	273
COUNTY-OTHER	LAVACA	JACKSON	2960	0757	461	478	495	498	493	491	492
COUNTY-OTHER	LAVACA-GUADALUPE	JACKSON	2961	0757	57	59	61	61	61	60	60
EDNA	LAVACA	JACKSON	2951	0183	793	816	850	861	856	855	855
GANADO	LAVACA	JACKSON	2954	0228	249	259	272	277	276	276	276
IRRIGATION	COLORADO-LAVACA	JACKSON	2976	1004	32,732	32,748	32,764	32,782	32,804	32,825	32,847
IRRIGATION	LAVACA	JACKSON	2977	1004	42,492	42,511	42,533	42,555	42,584	42,612	42,641
IRRIGATION	LAVACA-GUADALUPE	JACKSON	2978	1004	13,483	13,490	13,496	13,504	13,513	13,522	13,531
LIVESTOCK	COLORADO-LAVACA	JACKSON	2982	1005	298	298	298	298	298	298	298
LIVESTOCK	LAVACA	JACKSON	2983	1005	418	418	418	418	418	418	418
LIVESTOCK	LAVACA-GUADALUPE	JACKSON	2984	1005	136	136	136	136	136	136	136
MANUFACTURING	COLORADO-LAVACA	JACKSON	2966	1001	558	641	668	688	706	722	768
MANUFACTURING	LAVACA	JACKSON	2967	1001	2	2	2	2	3	3	3
MINING	COLORADO-LAVACA	JACKSON	2970	1003	22	25	27	28	29	30	30
MINING	LAVACA	JACKSON	2971	1003	33	38	40	41	43	44	45
MINING	LAVACA-GUADALUPE	JACKSON	2972	1003	55	63	66	69	71	74	76
COUNTY-OTHER	LAVACA	LAVACA	2962	0757	1,235	1,172	1,138	1,074	990	910	843
COUNTY-OTHER	GUADALUPE	LAVACA	2964	0757	5	5	5	5	4	4	4
HALLETTSVILLE	LAVACA	LAVACA	2955	0259	575	551	543	521	488	454	420
IRRIGATION	LAVACA	LAVACA	2979	1004	11,492	11,511	11,529	11,552	11,577	11,602	11,629
LIVESTOCK	LAVACA	LAVACA	2985	1005	1,997	1,997	1,997	1,997	1,997	1,997	1,997
LIVESTOCK	LAVACA-GUADALUPE	LAVACA	2986	1005	21	21	21	21	21	21	21
LIVESTOCK	GUADALUPE	LAVACA	2987	1005	41	41	41	41	41	41	41
MANUFACTURING	LAVACA	LAVACA	2968	1001	319	386	427	463	498	528	570
MINING	LAVACA	LAVACA	2973	1003	7	8	9	9	9	9	10
MINING	LAVACA-GUADALUPE	LAVACA	2974	1003	23	27	28	29	30	31	31
MOULTON	LAVACA	LAVACA	2956	0723	165	158	155	147	137	127	118

Table 2.3
Water Demand by City and Category (Continued)

WUG Name	WUG Basin	WUG County	WUG ID	City ID	Water Demand (ac-ft/yr)						
					2000	2010	2020	2030	2040	2050	2060
SHINER	LAVACA	LAVACA	2957	0557	501	482	475	455	426	397	367
YOAKUM	LAVACA	LAVACA	2958	0670	592	566	553	527	490	453	420
COUNTY-OTHER	LAVACA	WHARTON	2965	0757	418	426	437	438	433	428	424
EL CAMPO	COLORADO	WHARTON	2952	0184	269	277	287	290	290	288	285
EL CAMPO	COLORADO-LAVACA	WHARTON	2953	0184	1,584	1,632	1,690	1,713	1,709	1,698	1,680
EL CAMPO	LAVACA	WHARTON	3795	0184	23	24	24	25	25	24	24
IRRIGATION	COLORADO-LAVACA	WHARTON	2980	1004	17,132	16,392	15,806	15,240	14,695	14,170	13,677
IRRIGATION	LAVACA	WHARTON	2981	1004	101,362	96,986	93,518	90,173	86,947	83,837	80,926
LIVESTOCK	LAVACA	WHARTON	2988	1005	588	588	588	588	588	588	588
MANUFACTURING	COLORADO-LAVACA	WHARTON	2969	1001	49	60	65	70	74	78	84
MINING	LAVACA	WHARTON	2975	1003	4	3	2	1	0	0	0

Table 2.4
Water Demand by WWP of all Water Use Categories*

WUG Name	WUG Basin	WUG County	WUG ID	City ID	Water Demand (ac-ft/yr)						
					2000	2010	2020	2030	2040	2050	2060
Manufacturing	Colorado-Lavaca	Jackson	2960	1001	1,832	1,832	1,832	1,832	1,832	1,832	1,832

*LRWPA contracts only.

Table 2.5
Comparison Between 2001 RWP and 2006 RWP
Water Demands* (in ac-ft/yr) by WUG Category
Jackson County

RWP	2000	2010	2020	2030	2040	2050	2060
Municipal							
2001	2,733	2,648	2,521	2,468	2,400	2,384	NA
2006	1,816	1,878	1,953	1,974	1,960	1,955	1,956
Difference	-917	-770	-568	-494	-440	-429	NA
% Change	-33.6	-29.1	-22.5	-20.0	-18.3	-18.0	NA
Livestock							
2001	923	923	923	923	923	923	NA
2006	852	852	852	852	852	852	852
Difference	-71	-71	-71	-71	-71	-71	NA
% Change	-7.7	-7.7	-7.7	-7.7	-7.7	-7.7	NA
Irrigation							
2001	107,754	107,804	107,859	107,920	107,986	108,060	NA
2006	88,707	88,749	88,793	88,841	88,901	88,959	89,019
Difference	-19,047	-19,055	-19,066	-19,079	-19,085	-19,101	NA
% Change	-17.7	-17.7	-17.7	-17.7	-17.7	-17.7	NA
Manufacturing							
2001	1,002	1,803	1,899	2,164	2,435	2,712	NA
2006	560	643	670	690	709	725	771
Difference	-442	-1,160	-1,229	-1,474	-1,726	-1,987	NA
% Change	-44.1	-64.3	-64.7	-68.1	-70.9	-73.3	NA
Mining							
2001	94	50	38	27	21	21	NA
2006	110	126	133	138	143	148	151
Difference	16	76	95	111	122	127	NA
% Change	17.0	152.0	250.0	411.1	581.0	604.8	NA
Steam-Electric Power Generation							
2001	0	0	0	0	0	0	NA
2006	0	0	0	0	0	0	0
Difference	0	0	0	0	0	0	NA
% Change	NA	NA	NA	NA	NA	NA	NA

*All values are presented in ac-ft/yr

Table 2.5
Comparison Between 2001 RWP and 2006 RWP
Water Demands* (in ac-ft/yr) by WUG Category
Lavaca County (Continued)

RWP	2000	2010	2020	2030	2040	2050	2060
Municipal							
2001	3,489	3,442	3,354	3,434	3,504	3,654	NA
2006	3,073	2,934	2,869	2,729	2,535	2,345	2,172
Difference	-416	-508	-485	-705	-969	-1,309	NA
% Change	-11.9	-14.8	-14.5	-20.5	-27.7	-35.8	NA
Livestock							
2001	2,023	2,023	2,023	2,023	2,023	2,023	NA
2006	2,059	2,059	2,059	2,059	2,059	2,059	2,059
Difference	36	36	36	36	36	36	NA
% Change	1.8	1.8	1.8	1.8	1.8	1.8	NA
Irrigation							
2001	15,778	15,803	15,830	15,860	15,894	15,930	NA
2006	11,492	11,511	11,529	11,552	11,577	11,602	11,629
Difference	-4,286	-4,292	-4,301	-4,308	-4,317	-4,328	NA
% Change	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2	NA
Manufacturing							
2001	318	343	365	383	415	447	NA
2006	319	386	427	463	498	528	570
Difference	1	43	62	80	83	81	NA
% Change	0.3	12.5	17.0	20.9	20.0	18.1	NA
Mining							
2001	57	40	27	13	8	0	NA
2006	30	35	37	38	39	40	41
Difference	-27	-5	10	25	31	40	NA
% Change	-47.4	-12.5	37.0	192.3	387.5	NA	NA
Steam-Electric Power Generation							
2001	0	0	0	0	0	0	NA
2006	0	0	0	0	0	0	0
Difference	0	0	0	0	0	0	NA
% Change	NA	NA	NA	NA	NA	NA	NA

*All values are presented in ac-ft/yr

Table 2.5
Comparison Between 2001 RWP and 2006 RWP
Water Demands* (in ac-ft/yr) by WUG Category
Wharton County (Continued)

RWP	2000	2010	2020	2030	2040	2050	2060
Municipal							
2001	1,912	2,334	2,332	2,337	2,386	2,459	NA
2006	2,294	2,359	2,438	2,466	2,457	2,438	2,413
Difference	382	25	106	129	71	-21	NA
% Change	20.0	1.1	4.5	5.5	3.0	-0.9	NA
Livestock							
2001	400	400	400	400	400	400	NA
2006	588	588	588	588	588	588	588
Difference	188	188	188	188	188	188	NA
% Change	47.0	47.0	47.0	47.0	47.0	47.0	NA
Irrigation							
2001	102,476	102,976	103,526	104,131	104,796	105,528	NA
2006	118,494	113,378	109,324	105,413	101,642	98,007	94,603
Difference	16,018	10,402	5,798	1,282	-3,154	-7,521	NA
% Change	15.6	10.1	5.6	1.2	-3.0	-7.1	NA
Manufacturing							
2001	73	78	82	85	93	100	NA
2006	49	60	65	70	74	78	84
Difference	-24	-18	-17	-15	-19	-22	NA
% Change	-32.9	-23.1	-20.7	-17.6	-20.4	-22.0	NA
Mining							
2001	4	3	2	1	0	0	NA
2006	4	3	2	1	0	0	0
Difference	0	0	0	0	0	0	NA
% Change	0.0	0.0	0.0	0.0	0	0	NA
Steam-Electric Power Generation							
2001	0	0	0	0	0	0	NA
2006	0	0	0	0	0	0	0
Difference	0	0	0	0	0	0	NA
% Change	NA	NA	NA	NA	NA	NA	NA

*All values are presented in ac-ft/yr

Municipal Water Demand

Revised municipal water demand projections for LRWPA show a decrease in projected demand from 7,183 ac-ft/yr in the year 2000 to 6,541 ac-ft/yr in the year 2060. When comparing the RWP municipal water demand estimates for the region in the 2001 RWP versus the 2006 RWP, there is a 16 percent and 21.8 percent decrease for the 2000 and 2050 decades' municipal water demand, respectively. The change in the baseline municipal water demand is a result of more accurate baseline population projections and per capita water use estimates. The revised projections by county and by river basin for each municipal WUG are provided in *Table 2.3*.

Manufacturing Water Demand

The proposed manufacturing water demands for all counties in LRWPA are the TWDB default projections. The proposed manufacturing water demand for LRWPA is projected to increase from 928 to 1,425 ac-ft/yr from 2000 to 2060. The revised projections are provided in *Table 2.3* as well as in TWDB DB07.

Irrigation Water Demand

The TWDB total irrigation water demand for the region is projected to decrease from 218,693 to 195,251 ac-ft/yr between the decades 2000 and 2060. The TWDB draft demand estimates show a decline over the planning period for irrigation. LRWPA's main agricultural crop is rice. LRWPG prepared a revised rice irrigation projection based on LRWPA's most current information available. The revised projections are provided in *Table 2.3* as well as in TWDB DB07. The 2000 estimates for agricultural water use by category are shown in *Table 2.6* for each county and for the Lavaca Region.

Steam-Electric Power Generation Water Demand

The steam-electric water demands used for the Lavaca Region are the default TWDB projections. There are no steam-electric power generation facilities in the region and none planned, so the water demand for the Lavaca Region is zero throughout the period from 2000 to 2060.

Mining Water Demand

The proposed mining water demands for the Lavaca Region are the TWDB default projections that include adjustments to the 2002 State Water Plan's projected demands. Adjustments were made to the base projections using industry water use surveys to update water efficiency estimates and the analysis of the impact of technology and input substitution on the relationship of water used to output.

The proposed mining water demand by decade for LRWPA is 144 ac-ft/yr in the year 2000 and 192 ac-ft/yr in 2060. When comparing the 2001 and 2006 RWP mining water demand estimates for the region, there is a 7.1 percent decrease and 795 percent increase for mining

Table 2.6
Agricultural Water Use by Category
West Wharton County

Water Use Category	1995–2000 Average NASS Acreage (ac)	Acres in Region P (%)	1st Crop Acres Irrigated (%)	1st Crop Land Planted (ac)	1st Crop Irrigation Rate (in/ac)	1st Crop Irrigation Rate (ac-ft/ac)	1st Crop Conduit Loss (%/acre)	1st Crop Conduit Loss Rate (ac-ft/ac)	1st Crop Total Water Use Rate (ac-ft/ac)	1st Crop Total Water Demand (ac-ft)	2nd Crop Acreage (% of 1st crop)	2nd Crop Land Planted (ac)	2nd Crop % Water Use Rate (% of 1st crop)	2nd Crop Water Use Rate (ac-ft/ac)	2nd Crop Total Water Demand (ac-ft)	Year 2000 Total Water Demand (ac-ft)	% of Region P Demand (%)
RICE	58,083	42		**24,395**								**16,345**					
Groundwater Source			90	21,956	28	2.33	20	0.58	2.92	64,037	65	14,271	65	1.90	27,056	91,092	75.0
Surface Water Source			10	2,440	31	2.58	35	1.39	3.97	9,695	85	2,074	75	2.98	6,181	15,876	13.1
												Rice Overall Water Use Rate (ac-ft/1st crop acres)					**88**
COTTON	70,383	29		20,411								groundwater		**4.15**			
Irrigated crop			20	4,082	8	0.67			0.67	2,721		surface water		**6.51**		2,721	2.2
CORN	45,333	19		8,613								combined		**4.38**			
Irrigated crop			30	2,584	8	0.67			0.67	1,723						1,723	1.4
MILO (= Sorghum)	72,433	52		37,665													
Irrigated crop			10	3,767	6	0.50			0.50	1,883						1,883	1.6
SOYBEANS	14,250	19		2,708													
Irrigated crop			25	677	6	0.50			0.50	338						338	0.3
TURFGRASS	9,300	14		1,300	30	2.50			2.50	3,250						3,250	2.7
TOTAL IRRIGATION				**36,805**	acres											**116,885**	**96.3**
													Total Irrigation Planning Value				
WATERFOWL HABITAT			5	1,220	6	0.50			0.50	610			(Irrigation + Waterfowl + Aquaculture)			610	0.5
AQUACULTURE				200	60	5.00			5.00	1,000				**Sum =**	**118,494**	1,000	0.8
LIVESTOCK *				13,000		0.028			0.028	364						588	0.5
MUNICIPAL																2,294	1.9
MANUFACTURING																49	0.04
POWER COOLING																0	0
MINING																4	0.003
TOTALS																**121,429**	**100**
* Note: LIVESTOCK water demand = (# head of livestock) * (25 gallons water per head per day) * (365 days per year) * (1 ac-ft per 325,851 gallons)												Loss Rate = (Diversion Rate) * (% Loss)					

Table 2.6
Agricultural Water Use by Category
Jackson County (Continued)

Water Use Category	1995–2000 Average NASS Acreage (acres)	Acres in Region P (%)	1st Crop Acres Irrigated (%)	1st Crop Land Planted (acres)	1st Crop Irrigation Rate (in/acre)	1st Crop Irrigation Rate (ac-ft/ac)	1st Crop Conduit Loss (%/acre)	1st Crop Conduit Loss Rate (ac-ft/ac)	1st Crop Total Water Use Rate (ac-ft/ac)	1st Crop Total Water Demand (ac-ft)	2nd Crop Acreage (% of 1st crop)	2nd Crop Land Planted (acres)	2nd Crop Water Use Rate (% of 1st crop)	2nd Crop Water Use Rate (ac-ft/ac)	2nd Crop Total Water Demand (ac-ft)	Year 2000 Total Water Demand (ac-ft)	% of Region P Demand (%)
RICE	22,317	100		**22,317**								**5,747**					
Groundwater Source			95	21,201	31	2.58	20	0.65	3.23	68,461	25	5,300	65	2.10	11,125	79,586	86.5
Surface Water Source			5	1,116	34	2.83	35	1.53	4.36	4,864	40	446	75	3.27	1,459	6,323	6.9
												Rice Overall Water Use Rate (ac-ft/1st crop acres)					**93.3**
COTTON	31,100	100											groundwater	**3.75**			
Irrigated crop			5	1,555	8	0.67			0.67	1,037			surface water	**5.67**		1,037	1.1
CORN	52,350	100											combined	**3.85**			
Irrigated crop			2	1,047	8	0.67			0.67	698						698	0.8
MILO (= Sorghum)	30,517	100															
Irrigated crop			0	0	6	0.50			0.50	0						0	0.0
SOYBEANS	9,517	100															
Irrigated crop			0	0	6	0.50			0.50	0						0	0.0
TURFGRASS				0	60	5.00			5.00	0						0	0.0
TOTAL IRRIGATION				**2,602**	acres											**87,644**	**95.2**
													Total Irrigation Planning Value				
WATERFOWL HABITAT			2	446	6	0.50			0.50	223			(Irrigation + Waterfowl + Aquaculture)			223	0.2
AQUACULTURE				200	50.4	4.20			4.20	840				**Sum =**	**88,707**	840	0.9
LIVESTOCK *				26,000		0.028	10	0.003	0.03	801						852	0.9
MUNICIPAL																1,815	2.0
MANUFACTURING																560	0.6
POWER COOLING																0	0.0
MINING																110	0.1
TOTALS																**92,044**	**100**
* Note: LIVESTOCK water demand = (# head of livestock) * (25 gallons water per head per day) * (365 days per year) * (1 ac-ft per 325,851 gallons)												Loss Rate = (Diversion Rate) * (% Loss)					

Table 2.6
Agricultural Water Use by Category
Lavaca County (Continued)

Water Use Category	1995–2000 Average NASS Acreage (acres)	Acres in Region P (%)	1st Crop Acres Irrigated (%)	1st Crop Land Planted (acres)	1st Crop Irrigation Rate (in/acre)	1st Crop Irrigation Rate (ac-ft/ac)	1st Crop Conduit Loss (% / acre)	1st Crop Conduit Loss Rate (ac-ft/ac)	1st Crop Total Water Use Rate (ac-ft/ac)	1st Crop Total Water Demand (ac-ft)	2nd Crop Acreage (% of 1st crop)	2nd Crop Land Planted (acres)	2nd Crop Water Use Rate (% of 1st crop)	2nd Crop Water Use Rate (ac-ft/ac)	2nd Crop Total Water Demand (ac-ft)	Year 2000 Total Water Demand (ac-ft)	% of Region P Demand (%)
RICE	2,917	100		**2,916**								**696**					
Groundwater Source			95.5	2,785	31	2.58	20	0.65	3.23	8,995	25	696	65	2.10	1,462	10,456	59.1
Surface Water Source			4.5	131	34	2.83	35	1.53	4.36	572	0	0	75	3.27	0	572	3.2
												Rice Overall Water Use Rate (ac-ft/1st crop acres)					**62.4**
COTTON	0	100											groundwater	**3.75**			
Irrigated crop			20	0	8	0.67			0.67	0			surface water	**4.36**		0	0.0
CORN	6,833	100											combined	**3.78**			
Irrigated crop			0	0	8	0.67			0.67	0						0	0.0
MILO (= Sorghum)	1,433	100															
Irrigated crop			0	0	6	0.50			0.50	0						0	0.0
SOYBEANS	0	100															
Irrigated crop			25	0	6	0.50			0.50	0						0	0.0
TURFGRASS	0	100		0	60	5.00			5.00	0							
TOTAL IRRIGATION					acres											**11,028**	**62.4**
													Total Irrigation Planning Value				
WATERFOWL HABITAT			3	88	6	0.50			0.50	44			(Irrigation + Waterfowl + Aquaculture)			44	0.2
AQUACULTURE				100	50	4.20			4.20	420				**Sum =**	**11,492**	420	2.4
LIVESTOCK *				90,000		0.028	10	0.003	0.03	2,772						2,772	15.7
MUNICIPAL																3,074	17.4
MANUFACTURING																319	1.8
POWER COOLING																0	0.0
MINING																30	0.2
TOTALS																**17,687**	**100**
* Note: LIVESTOCK water demand = (# head of livestock) * (25 gallons water per head per day) * (365 days per year) * (1 ac-ft per 325,851 gallons)												Loss Rate = (Diversion Rate) * (% Loss)					

Table 2.6
Water Planning Area Summary
Water Use by County (Continued)

Water Use Category	Total Water Demand			Total Acres Planted			Region P Total		Region P	
	Wharton Co. (ac-ft)	Jackson Co. (ac-ft)	Lavaca Co. (ac-ft)	Wharton Co. (acres)	Jackson Co. (acres)	Lavaca Co. (acres)	Water Demand (%)	Water Demand (ac-ft)	Water Use Rate (all 3 counties) (ac-ft/ac)	
RICE										
Groundwater Source	91,092	79,586	10,456	36,227	26,501	3,482	78.4	181,135	**2.74**	avg. all rice
Surface Water Source	15,876	6,323	572	4,513	1,562	131	9.9	22,771	**3.67**	**2.82**
							88.2			
COTTON Irrigated crop	2,721	1,037	0	4,082	1,555	0	1.6	3,758		
CORN Irrigated crop	1,723	698	0	2,584	1,047	0	1.0	2,421		
MILO Irrigated crop	1,883	0	0	3,767	0	0	0.8	1,883		
SOYBEAN Irrigated crop	338	0	0	677	0	0	0.1	338		
TURFGRASS	3,250	0	0	1,300	0	0	1.4	3,250		
TOTAL IRRIGATION	**116,885**	**87,644**	**11,028**	**53,149**	**30,665**	**3,613**	**93.2**	**215,557**		
WATERFOWL HABITAT	610	223	44				0.4	877		
AQUACULTURE	1,000	840	420				1.0	2,260		
TOTAL IRRIGATION	118,494	88,707	11,492				94.6	218,693		
PLANNING VALUE										
LIVESTOCK *	588	852	2,772				1.8	4,212		
MUNICIPAL	2,294	1,815	3,074				3.1	7,183		
MANUFACTURING	49	560	319				0.4	928		
POWER COOLING	0	0	0				0.0	0		
MINING	4	110	30				0.1	144		
TOTALS	**121,429**	**92,044**	**17,687**				**100.0**	**231,161**		

* Note: LIVESTOCK water demand = (# head of livestock) * (25 gallons water per head per day) * (365 days per year) * (1 ac-ft per 325,851 gallons)

County	Region P Summary Rice Irrigation Water Use Rates (ac-ft/1st crop acres) *								
	Groundwater Use Rates				Surface Water Use Rates				Overall Water Use Rates (ac-ft/ac)
	canal loss (%)	1st crop total	2nd crop total	1st & 2nd combined	canal loss (%)	1st crop total	2nd crop total	1st & 2nd combined	
West Wharton	20	2.92	1.90	**4.15**	35	3.97	2.98	**6.51**	**4.38**
Jackson	20	3.23	2.10	**3.75**	35	4.36	3.27	**5.67**	**3.85**
Lavaca	20	3.23	2.10	**3.75**	35	4.36	3.27	**4.36**	**3.78**
Total Region P	-	**3.08**	**1.96**	**3.94**	-	**4.10**	**3.03**	**6.18**	**4.11**
* Note: Water Use Rate = water demand/acres planted									

Table 2.7
Summary of Methodology Used for Revised Projections –
Jackson, Lavaca, Wharton Counties

	Category	TWDB Default	Other	Notes
Jackson	Municipal	X		
	Livestock	X		
	Irrigation	hg	X	LRWPG developed irrigation projections based on the six-year average (1995–2000) demand for agriculture determining the amount of water applied to specific crop types and total irrigated acreage of that crop.
	Manufacturing	X		
	Mining	X		
	Steam-Electric	X		
Lavaca	Municipal	X		
	Livestock	X		
	Irrigation		X	LRWPG developed irrigation projections based on the six-year average (1995–2000) demand for agriculture determining the amount of water applied to specific crop types and total irrigated acreage of that crop.
	Manufacturing	X		
	Mining	X		
	Steam-Electric	X		
Wharton	Municipal	X		
	Livestock	X		
	Irrigation		X	LRWPG developed irrigation projections based on the six-year average (1995–2000) demand for agriculture determining the amount of water applied to specific crop types and total irrigated acreage of that crop.
	Manufacturing	X		
	Mining	X		
	Steam-Electric	X		

water demand for the 2000 and 2050 decades, respectively. The revised projections are provided in *Table 2.3* as well as in TWDB DB07.

Livestock Water Demand

The proposed livestock water demands for the Lavaca Region are the TWDB default projections, which are found using the same rates of change in livestock water demand as the 2002 State Water Plan. The base water use for 2000 was developed using adjusted livestock inventories and adjustments in water usage developed by TAES.

The proposed livestock water demand by decade for LRWPA is 3,499 ac-ft/yr, which was held constant for all decades between 2000 to 2060. This represents a 4.6 percent livestock demand decrease when compared to the 2001 RWP. The revised projections are provided in *Table 2.3* as well as in TWDB DB07.

Demand of WWPs

The only WWP within LRWPA was identified as LNRA. LNRA maintains current customer contracts for 1,832 ac-ft of supply to the Colorado-Lavaca Coastal Basin of Jackson County. LNRA assumes the continuation of municipal contracts across the 60-year planning period, at least to the level of existing obligations.

2.3.2 County Summary of Projections

The revised projections by county and by river basin for each municipal WUG are provided in *Table 2.3*. *Table 2.7* is a reference table that summarizes which methodology was used for each water demand category in each county within LRWPA. Unless otherwise stated, TWDB default population and water demand projection methodologies, as described in *Section 2.2.3*, were used.

Jackson

Municipal population projections for Jackson County show population increasing from 14,391 in year 2000 to 17,716 in year 2060. This represents a 23.1 percent increase in projected population over the six-decade planning period.

When comparing the 2001 and 2006 RWP municipal water demand estimates for Jackson County, there is a 33.6 and 18 percent municipal water demand decrease in the 2006 RWP for the 2000 and 2050 decades, respectively. The decrease in municipal water demand is a result of more accurate baseline population projections and per capita water use estimates.

The livestock and irrigation demand for Jackson County decreased by 7.7 and 17.7 percent, respectively. Manufacturing demands ranged from 560 to 725 ac-ft/yr from 2000 to 2060. The overall manufacturing demand, when compared to the 2001 RWP, decreased significantly—approximately 73 percent in year 2050. The mining demand increased by over 600 percent during the six-decade planning period.

Lavaca

Municipal population projections for Lavaca County show population decreasing from 19,210 in year 2000 to 15,061 in year 2060. This represents a 27.5 percent decrease in projected population over the six-decade planning period.

When comparing the 2001 and 2006 RWP municipal water demand estimates for Lavaca County, there is an 11.9 and 35.8 percent municipal water demand decrease in the 2006 RWP for the 2000 and 2050 decades, respectively. The decrease in municipal water demand is a result of more accurate baseline population projections and per capita water use estimates.

Livestock demands increased by 1.8 percent and irrigation demands decreased by 27.2 percent when compared to the 2001 RWP projections. Lavaca County manufacturing demand projections have increased slightly compared to the 2001 RWP. Mining demands, when compared to the 2001 RWP, decrease in year 2000 and increase substantially by year 2050.

Wharton

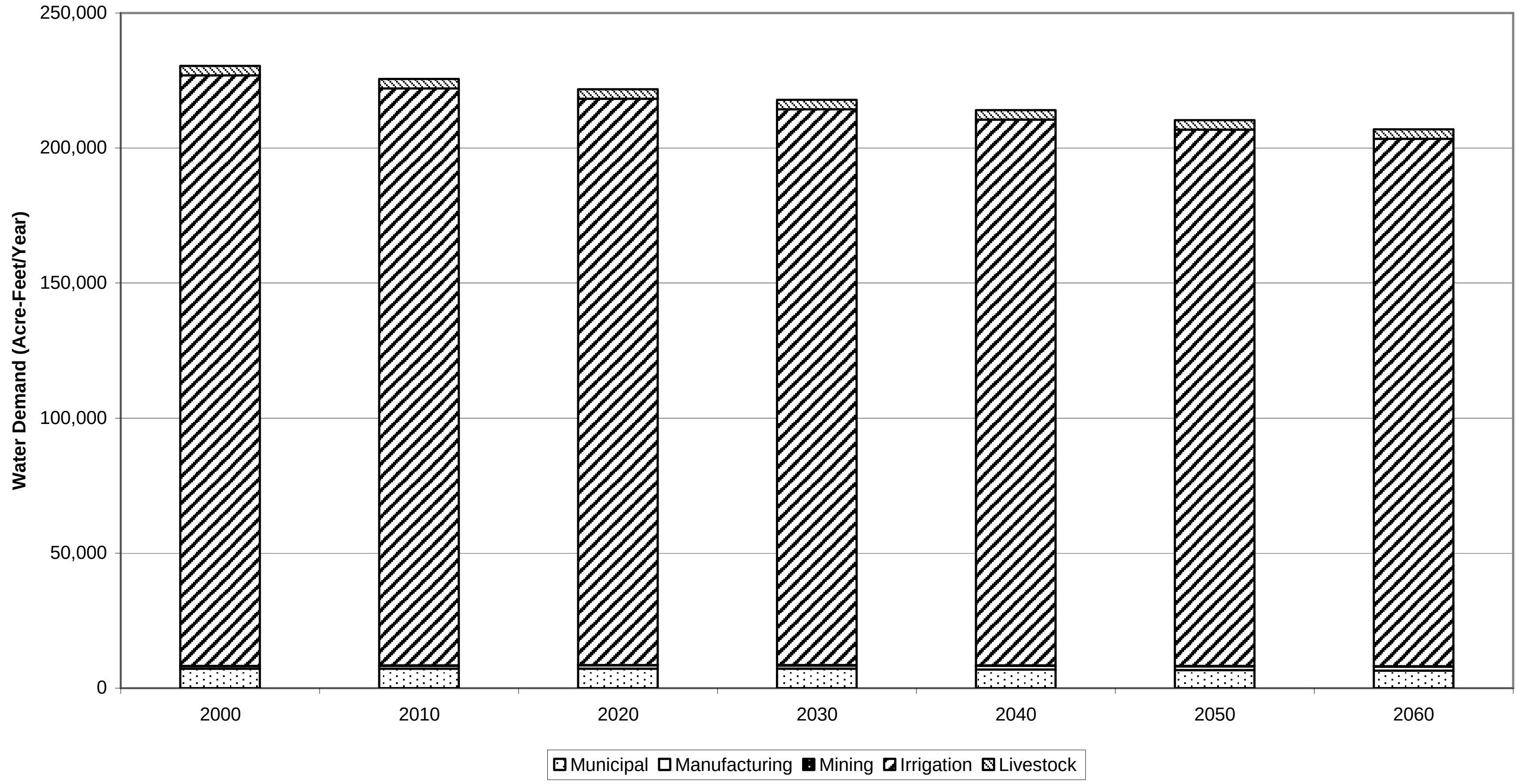
Municipal population projections for Wharton County show population increasing from 14,467 in the 2000 decade to 16,886 in the 2060 planning decade. This represents a 16.7 percent increase in projected population over the six decades.

When comparing the 2001 and 2006 RWP municipal water demand estimates for Wharton County, there is a 20 percent increase and 1 percent municipal water demand decrease in the 2006 RWP for the 2000 and 2050 decades, respectively. The change in the baseline municipal water demand is a result of more accurate baseline population projections and per capita water use estimates.

Livestock water demands increase by 47 percent when compared to the 2001 RWP projection values. Irrigation water demand projections, when compared to the 2001 RWP projection values, increase by 15.6 percent in year 2000 and decreased by 7.1 percent in year 2050. The manufacturing demands in Wharton County, when compared to the 2001 RWP, decreased from 33 to 22 percent for the 2000 and 2050 decade, respectively. The mining demands, when compared to the 2001 RWP, do not change.

FIGURES

Figure 2.1
Water Demand by Decade



CHAPTER 3

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. Of the total 2000 water demand, approximately 90 percent, or 208,389 ac-ft, was supplied by groundwater. The Gulf Coast aquifer is the predominant supply source.

Surface water supplies are obtained from Lake Texana and ROR flows from the Lavaca and Navidad Rivers and some creeks. The majority of LRWPA is located in the Lavaca River Basin. Surface water supplies accounted for approximately 10 percent of the total 2000 water demand. The only reservoir in the Lavaca Region is Lake Texana, and there are no major springs in LRWPA.

This chapter summarizes the results of Task 3 and describes the resources available to LRWPA and their allocation to WUGs throughout 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 DB07. Tables that contain this information are identified below and are located in the appendices accompanying this chapter.

- *Table 3B.1* – Current Water Supply Sources
- *Table 3B.2* – Current Water Supplies Available to the Lavaca RWPA by City and Category

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 [1]

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 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

[1] The information contained in this portion of Chapter 3 was provided by LBG-Guyton Associates.

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 LRWPA, according to Report 270.

Recharge to the aquifers is principally from the infiltration of precipitation and streamflow. Average annual rainfall in 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 outcrop area of the Gulf Coast aquifer within the Lavaca Region is shown in *Figure 3.1*. The outcrop area includes the Jasper, Evangeline, and Chicot aquifer outcrops. The outcrop parallels the coast and is at times 40 miles wide and also extends outside 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 LRWPA. A small part of the Jackson Group outcrop 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. Geologic Survey reports for Wharton and Jackson Counties do not reference minor aquifers in these two counties.

3.2.2 Groundwater Use Overview

Groundwater in the region is pumped for domestic, agricultural, municipal, and industrial uses. In 2000, the Lavaca Region pumped approximately 208,389 ac-ft of groundwater for these purposes. Agricultural irrigation accounts for approximately 96 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 3.4 percent of the groundwater pumped. Less than 1 percent of groundwater pumped in LRWPA is for industrial needs, including manufacturing and other industrial uses.

3.2.3 Aquifer Conditions

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.

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 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).

A Central Gulf Coast Groundwater Availability Model (GAM) was developed for the Central Gulf Coast aquifer in 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. Utilization of the model provides an additional method to evaluate the groundwater resources in LRWPA.

Based on GAM, the estimated transmissivity for the Chicot aquifer in LRWPA ranges less than 15,000 gallons per day per foot (gpd/ft) near the outcrop and 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 and 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 GAM model estimates of the Jasper aquifer transmissivity could be improved in Lavaca County as additional pumping test data for wells in the county becomes available. 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 LRWPA has resulted in potentiometric head decline in the Gulf Coast aquifer. Data in 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 depths interval screened by the large capacity wells in the Lavaca Region normally range 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 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 locations of observation wells within Wharton and Lavaca Counties and in the eastern part of Jackson County are circled on *Figure 3.2.* The wells screen the Chicot and/or Evangeline aquifers. *Figure 3.3* is a graph showing static water levels in wells located in the western part of Wharton County. The data show a gradual decline in water levels in the 1960s and into the 1970s as pumpage generally increased within LRWPA. From about 1984 to 2000, total pumpage averaged about 102,100 ac-ft/yr in LRWPA part of Wharton County, while water levels have fluctuated but show essentially no net static water-level decline; the exception being Well 66-52-207 which had about 5 feet of water-level decline during the period. Recent static water level data indicate the Well 66-52-207 water level is slightly fluctuating. Wells 66-52-304 and 66-53-804 show a static water level rise over the past 4 years of about 1.1 and about 1.6 feet per year (ft/yr), respectively.

Figure 3.4 shows static water levels in wells located in the central Wharton County with measurements in one well extending as far back as 1934. The water-level data show some water-level decline occurring in the 1960s and 1970s as pumpage in the region increased. From about 1983 through 2004, the data show essentially no net static water-level decline, and, in some wells, a slight rise, indicating that the aquifers are providing water at a rate that is not causing water levels to decline and that the aquifers can continue to sustain the rate of pumping. Pumping for irrigation over the last few years from 2001 through 2004 may have been of a lower amount because of the amount of precipitation that has occurred during the growing season and because of a possible reduction in the acres of rice grown. Static water level data from about 1998 to 2004 shows a rise in the water level ranging from about 0.4 ft/yr at Well 66-54-108 to about 1.6 ft/yr at Well 66-61-305. Well 66-46-402 shows fluctuation in the static water level during that period.

Static water levels have been measured in wells outside LRWPA, and data for some of the wells are shown on *Figure 3.5.* Again, the water-level data are showing that water levels have stabilized in the last 15 years, and in some wells, the water levels actually have risen about 10 to 15 feet through the period. The data show that the stabilization of static water levels in Wharton County is not confined to the part of the county within LRWPA. Data from 1998 to 2004 continue to indicate the stabilization or small rise of static water levels in wells in the area.

Water levels are also shown on *Figure 3.6* for wells located in the eastern part of Jackson County. The data from the four wells show that static water levels fluctuated some in the 1980s and have risen about 7 to 35 feet between 1990 and 2004. From 1984 to 2000, pumpage in Jackson County averaged about 75,100 ac-ft/yr based on data provided by TWDB. During the years from 1997 to 2004, pumpage averaged about 51,960 ac-ft/yr. The rise in static water levels from 1990 to 2004 can be related to the reduction in pumpage.

Static water levels for wells in the Lavaca County area are shown on *Figure 3.7*. The static water level in one well (67-39-507) in the western part of the county has been stable since 1960. The static water levels in Wells 66-44-402 and 66-42-902 in the southeast part of the county declined some during the 1970s and 1980s when irrigation pumpage was higher and have recovered a significant amount as overall pumpage in the area has decreased some, principally due to a reduction in irrigation. Groundwater pumpage in Lavaca County averaged about 21,100 ac-ft/yr in the 1980s, about 15,300 ac-f/yr in the 1990s, and was 8,520 ac-ft in 2000. Water levels in wells in the City of Hallettsville show an average decline rate of about 7 ft/yr for the 1984 to 1996 time period. Recent static water level data from Well 66-33-513 indicate a rise in the static water level in the City of Hallettsville area.

Total groundwater availability has been estimated by TWDB for the Lavaca Region at 207,599 ac-ft/yr. Of this estimated amount, 87,876 ac-ft are expected to be available to Jackson County, with Lavaca and Wharton Counties' projected available amounts being 38,123 and 81,600 ac-ft, respectively. Groundwater pumpage within the part of Wharton County in LRWPA has exceeded, during some years, the estimate of groundwater availability within that part of the county.

LRWPG investigated the static water levels and the pumpage of the regional wells and found adequate data to support the estimate of available aquifer supply of 81,600 ac-ft annually for the portion of Wharton County within the LRWPA. This determination is based primarily on the history of pumpage at levels similar to this amount without increasing the static water level. The estimates of groundwater availability were compared against the Central Gulf Coast GAM, although the GAM had just been reviewed by TWDB at the time the groundwater availability data was compiled.

As stated previously, groundwater pumpage in the Lavaca Region has resulted in acceptable amounts of static water level decline, and the recovery of static water levels in years when pumpage decreases occurred in various parts of LRWPA. Groundwater availability in the region is the amount of withdrawal that can be sustained by the aquifers on a long-term basis as shown by the response of the aquifer to long-term pumping.

There are millions of ac-ft of water in storage in sand layers of the aquifers. Water in storage fills the aquifer pore space and helps maintain the aquifer's artesian pressure which helps limit subsidence. The aquifers are a flow system with recharge infiltrating into the aquifers and water slowly flowing in the large aquifer storage volume from areas of recharge to areas or points (wells) of discharge. It should be noted here that not all of the stored water is recoverable and that the aquifer is currently being pumped at or near the sustainable demand. Future increases in pumpage will result in declining water levels.

3.2.4 Groundwater Quality

Water samples have been collected from wells for water chemistry analysis for over 40 years within LRWPA. Recent and historical water chemistry results for wells completed in the Chicot, Evangeline, and Jasper aquifers obtained from TWDB are shown in *Table 3A* in *Appendix 3A*. Analyses results are also given for some wells screening the Beaumont Clay that is part of the Chicot aquifer. The most recent TWDB water chemistry results that was available are from 2001. Data in the table show that the groundwater in Wharton County continues to be of good quality, particularly within LRWPA and that the quality has not changed significantly throughout the years. TDS generally range from about 300 to 700 mg/L in wells screening sands of the Chicot or Evangeline aquifers with the principal constituents being calcium and bicarbonate with smaller amounts of sodium, chloride, and sulfate. Shallow wells screening sands in the Beaumont Clay generally have a TDS content within the range of 540 to 1,600 mg/L. The wells screening shallow sands in the Beaumont Clay are not utilized as a municipal drinking water source though many domestic wells obtain water from this layer. The water in the area has been used principally for irrigation, domestic, municipal, manufacturing, and livestock supplies.

Analysis of the 2001 TWDB infrequent constituent report data show that almost all of the infrequent constituents are within the maximum contaminant level (MCL) in the Lavaca Region. There are a few wells screening the Evangeline aquifer in northern Lavaca County that have nitrite, manganese, or iron values which slightly exceed the MCLs. Two domestic wells and one unused well had sample values which exceeded the MCL of 1 mg/L for nitrite. One unused well, about 80 feet deep, screening sands of the Evangeline aquifer in Lavaca County, had a gross alpha value greater than the MCL of 15.0 picocurie per liter (pCi/L). Two wells screening Evangeline aquifer sands in Lavaca County exceeded the secondary limit of 0.3 mg/L for iron in water to be used for public supply. A Lavaca County unused Evangeline aquifer well had a manganese value greater than the secondary limit of 0.05 mg/L for water to be used for public supply.

A public supply well located in northwestern Lavaca County had a manganese value that was greater than the secondary MCL. TCEQ data from 2003 indicates water from the distribution system served by the well has manganese levels below the secondary MCL. A public supply well screening sands in the Oakville formation located in western Lavaca County had a reported iron level greater than the secondary limit in 2001.

There is a small area of the Gulf Coast aquifer that has been impacted by an industrial facility that operated in El Campo. A release from the facility contaminated a small area of shallow sands of the Gulf Coast aquifer. An assessment of the effects of the release and a mitigation plan are being addressed through the TCEQ.

In general, the areas with groundwater quality issues occur in Lavaca County where water demand is lower than the estimates of available groundwater supply. In Jackson and Wharton Counties, data show that the groundwater for large capacity production is of good quality, has not been adversely impacted by past pumping, and should not be adversely impacted by estimated future pumping.

3.2.5 Water Level Monitoring Program for the LRWPA

The Water Leveling Monitoring Program was designed to assess changes in groundwater pumping conditions that occur through the irrigation season. The program was started in the summer of 2001 and continued through the spring of 2005. The program was performed with a substantial contribution of time and effort by personnel with the LNRA. 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.

Over the course of the project, the consultant along with LNRA personnel and farmers within the region worked to locate wells that could be used in the study and contacted irrigation well owners, farmers, and representatives of towns that would be willing to participate in the study. Efforts were made to enlist additional farmers with wells for this study in geographic areas in addition to those that were part of the previous study concluded in 2001. Each county within the region develops a greater sense of participation when wells within that county are included in the study. In Lavaca County, the effort to locate additional irrigation wells was concentrated in the southeastern part of the county as that is the area of significant irrigation utilizing groundwater. The search for additional irrigation wells for the study included contacts with well owners and farmers and visiting the wells to assess access for measuring water levels and piping for measuring the well pump discharge rate. The ability to measure the water level in a well was assessed prior to including the well in the study. Construction and past static water level and pumping rate data and pumping equipment data for the wells were collected, if available. Past static water level and pumping rate data were very limited. As water level and pumping rate data were collected, the consultant was required to communicate and work with LNRA representatives to address questions at individual wells as problems occurred with water level measuring or flow rate equipment. Compared to the 2001 Study, two additional irrigational wells were added to the study in Lavaca County and three in Jackson County. Locations of the wells are shown on *Figure 3.9*.

Testing Protocol and Sampling Schedule

Well Construction Data

For any well that became part of the Water Leveling Monitoring Program, available data were collected on its construction including casing and screen settings and diameters along with information on whether the well was gravel packed. Data on the year of construction and drilling contractor were also collected, if available. Pump data were collected if available for the type and diameter of the pump; the diameter of the pump column; whether the pump is water- or oil-lubricated; the gear ratio of the right-angle gear box; the horsepower, manufacturer; and rpm of the driver engine or electric motor; whether the pump discharge piping was equipped with a flow meter and what type; whether the pump column was equipped with an airline; and if the airline was functional for measuring static and pumping water levels.

The location of the well was plotted on a U.S. Geological Survey 7.5 minute topographic quadrangle map. A GPS receiver was used to determine the latitude and longitude of the well. Field data were recorded in paper and electronic form. Collection of data utilized the following protocol.

Collection of Data During Well Pump Operating and Non-Operating Periods

Visits to wells occurred while they were pumping. During the visits, data were collected regarding the well location, well owner, well name and number, and State well number, if available. Information also was collected regarding the speed of the engine and gear ratio of the right-angle gear box, type of fuel for the engine, and nominal speed of the electric motor based on nameplate if the pump was electric-motor driven. The flow was measured using the propeller meter or pitot tube installed in the discharge piping.

The well pumping water level was measured, if possible, using an airline, electric sounder, or steel tape. If the well was not operating on arrival, the static water level was measured prior to beginning pumping using an airline, electric line, or steel tape. The data were recorded in paper form, and maintained in a paper and electronic data file for the well visit. Also the static water level in any nearby observation well was measured, if possible, during pumping or non-pumping of the production well.

Static water-level data were collected from wells during the irrigation season and during non-irrigation months. The data were collected using the same equipment as used to measure pumping water levels. If available, data were collected regarding the time a well pump had been off prior to measuring the static water level.

Sampling Schedule

When feasible and depending on the amount of water pumped in a growing season, pumping rates and/or water-level data were collected from pumping wells included in the study. If possible, the data were collected during pumping periods in the growing season and during non-pumping periods between the growing seasons.

Project Data Collected and Interpretation

Well Static Water-Level Data

Static water level data collected from the wells for the study from about July 2001 through June 2005 are given in *Table 3C.1* in *Appendix 3C* along with other well, pump, and pumping rate, and pumping water level data. The locations of the wells are shown on *Figure 3.9*. Analysis of the data generally shows that the static water levels have risen slightly over the past four years, as shown on *Figures 3.10* and *3.11*. The data also show that the static water levels in the irrigation wells decline during the irrigation season and recover during the non-pumping months. A greater fluctuation in the static water levels occurs in north Jackson County and southeast Lavaca County than in some areas of Wharton County. This could be due to a greater concentration of pumpage in the area and/or the aquifer having a lower transmissivity or ability to provide water to wells in southeastern Lavaca and north

Jackson Counties. Static water level fluctuations were less in 2004 than in 2003 due to less pumping because of higher growing season precipitation. In Hallettsville, precipitation for the April through June period in 2002, 2003, and 2004 was 10.44, 3.42, and 24.25 inches, respectively. The low precipitation in 2003 correlates with the greater static water level decline in 2003 resulting from higher pumpage. The data also show that the static water levels normally are shallower in the shallow wells and deeper in the deep wells, indicating a general downward gradient for water movement. This is apparent when comparing the static water level graph for Well 11 with the graph for nearby Well 12 on *Figure 3.11*.

Lavaca County Data

Static water level measurements were collected from two wells in southeastern Lavaca County. *Figure 3.10* includes static water level hydrographs for Wells 1 and 2. Wells 1 and 2 indicate a more pronounced water level change between the irrigation and post-irrigation seasons. Water level measurements at Well 1 began in September 2002 and the static water level was measured at 126.38 feet. A static water level of 84.25 feet was measured during the pre-irrigation season in April 2003. Static water levels declined to 161.50 feet during the summer of 2003 irrigation season. The static water level recovered to a level of 82.92 feet in March 2004. The data show a rise of about 5 feet in the static water level from December 2002 to December 2003 at Well 1. Data from Well 2 show a slight static water level rise between the spring of 2003 and the spring of 2005. The static water level at Well 2 had declined to a level of 123.42 feet in August 2004. The beginning of the post-irrigation season recovery was noted shortly after August 2004. A pre-irrigation static water level of 82.93 feet was measured prior to the 2004 irrigation season at Well 2 and again at about the same depth in the spring of 2005.

Jackson County Data

Well 3, located in northern Jackson County, had an average static water level rise of about 0.9 ft/yr during the November 2001 to November 2004 period. Seasonal water level fluctuations noted in this well ranged from about 13 to 38 feet in any one year. The water level hydrograph is shown on *Figure 3.10*.

Static water level measurements were collected in wells belonging to the Towns of Edna (Well 4) and Ganado (Well 5), and water level hydrographs are shown on *Figure 3.10*. Well 4 had an average static water level rise of about 4 ft/yr based on data collected in January 2003 and January 2005. Minor seasonal static water level fluctuations were noted at Well 4. Well 5 had a fairly stable static water level from December 2002 to December 2004. Well 6 had a small static water level rise from December 2001 to December 2003. Static water level changes between the irrigation and post-irrigation seasons ranged from about 14 to 21 feet during the 2001 to 2004 period for Well 6. Well 7, located to the south of Well 6, had a small static water level decline based on data from January 2003 to January 2005. Seasonal fluctuations were minor during the period from the fall of 2003 until the spring of 2005.

Wharton County Data

West Wharton County is an area with significant irrigation pumpage. Static water level hydrographs for Wells 8 through 14 are shown on *Figure 3.11*. The static water level in Well 8, while fluctuating some from December 2001 to December 2004, only had a small net rise. Seasonal fluctuations in the static water level noted in the well ranged from about 14 to 39 feet during this time. Similar trends and water level fluctuations were noted in Well 9. The static water level hydrographs in general show a small water level rise from 2002 to the spring of 2005. This is probably in response to less pumpage for irrigation. The irrigation season static water level fluctuation was less in 2004 than in 2002 or 2003, probably because pumpage was less due to precipitation being substantially more during 2004 than in 2002 and 2003. From April through June 2002, 2003, and 2004, precipitation at El Campo was 12.91, 5.71, and 22.5 inches, respectively. It was noted that while measuring water levels in wells in 2004, the irrigation well pumps were not in operation during many of the well visits.

The data show the static water level in Well 10 had a small rise from December 2001 to December 2004. Seasonal water level fluctuations ranged from about 18 to 36 feet between the irrigation season's deepest static water level and the post-irrigation season recovery during the 2001 to 2005 period. Well 11 had a static water level rise of about 6 ft/yr during the December 2001 and December 2004 period. Well 12 had a static water level increase of about 6.4 feet based on data collected in December 2003 and December 2004. Differences in ranges between irrigation water levels and post-irrigation water levels were noted as about 25 and 12.4 feet for the 2003 and 2004 seasons, respectively; again, showing that static water level fluctuation was less during the high precipitation year of 2004.

Wells 13 and 14 are located in western Wharton County. Well 13 had a small static water level rise from December 2001 to December 2004. Static water level change between the irrigation season and post-irrigation season ranged from about 17 to 24 feet during this study. Static water levels also rose a small amount in Well 14 from December 2001 to December 2004. The seasonal differences between the irrigation and post-irrigation periods at the wells ranged from about 7 feet to 11 feet measured at the well within the 2001 to 2005 time period.

Well Pumping Rate Data

Pumping rate data were collected and are shown in *Table 3C.1*. The data show pumping rates for the wells and also show the speed of the pump engine when available. At each of the irrigation wells there was an internal combustion engine powered by natural gas and then a right-angle gear box with ratios of input revolutions per minute (rpm) from the engine to output rpm to the pump of 1:1, 2:3, or 3:4. At a 3:4 ratio, an engine speed of 1,150 rpm results in a pump operating speed of about 1,533 rpms. Farmers vary the engine speed through the irrigation season depending on the amount of water needed for the crop. The static water-level declines measured during the growing season result in deeper pumping lifts at the irrigation wells. A 20 foot increase in pumping lift can equate to about a 10 to 15 percent increase in the overall pumping lift and thus the amount of power that is required to operate the well pump. Review and analysis of the data were performed to compare changes in pumping rate that occurred when engines were operating at essentially the same speed each time the pumping rates were measured.

Data collected from Well 8 show that during the 2002 irrigation season, the pumping rate decreased to about 250 gpm from April to June as the pumping water level increased from about 84 to 107 feet.

Pumping rate data collected for Well 9 show that the pumping rate was about 300 to 500 gpm less during the July to August 2001 period compared to the end of September with the pump operating at the same speed at each pumping rate check. The data also show that the pumping level was about 4 to 5 feet deeper on July 13, July 26, and August 9, 2001, compared to September 28, 2001. The pumping rate measured on May 3, 2002, was about 150 gpm less compared to May 21, 2002, with the pump operating at the same speed at each pumping rate check. A water level decline of about 8 feet was observed between the May 3 and May 21, 2002, pumping levels.

The data also show that pumping lifts were greater during the middle of the irrigation season when water demand was higher and irrigation wells were operating for longer periods. The greater pumping lift correlates to higher pumping costs. Deeper pumping lifts were evident during mid-irrigation season for Well 8 during 2001, 2002, and 2004; Well 9 during 2001 and 2005; and Well 10, during 2003, as shown by the data in *Table 3C.1*.

In summary, the data reviewed show that the pumping rate can be about 200 to possibly 500 gpm less during the intensive irrigation months compared to the pumping rate at the beginning or end of the irrigation season. The amount of reduction in pumping rates during the primary irrigation months will vary depending on the performance characteristics of the well pump. Pumping levels normally are deeper during the mid-irrigation period than at the pre- and post-irrigation periods. The deeper pumping levels and lower well pumping rates are the result of the increase in interference drawdown between numerous wells pumping in an area for extended periods.

Study Conclusions

The following conclusions are based on review and analysis of the data collected from 2001 through the spring of 2005.

- 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 increased pumping lift.
- The increased pumping lift through the irrigation season can result in about 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 has been a small rise in the static water levels in wells from 2001 through the spring of 2005. The small rise in static water levels probably is the result of less groundwater pumping, particularly in 2004.

- The static water level fluctuations during the irrigation season normally are greater in the deeper wells that are pumped at higher rates and less in the shallower wells that normally do not have as high pumping rates or total pumped volume.

3.2.6 Subsidence Effects

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.

Land surface subsidence simulations given in Report 289, estimate a maximum of about 0.75 feet of subsidence in the southwestern part of Wharton County and the very eastern part of central Jackson County for the period from 1900 to 1975. Lesser amounts down to 0.25 feet and below are estimated to have occurred in the northern part of Jackson and Wharton Counties for the same time period. Data contained in Report 270 show that about 0.2 feet of subsidence occurred in the Town of Halletsville for the period from 1900 to 1973. Measured subsidence also shows a small area in the very southeastern part of Jackson County where about 1.5 feet of subsidence occurred from 1900 to 1975 based on data contained in TDWR Report 289, *Digital Models for Simulation of Groundwater Hydrology of the Chicot and Evangeline Aquifers Along the Gulf Coast of Texas* (May 1985).

Very limited releveling to quantify the amounts of subsidence that have occurred since 1970 has been performed within the Lavaca Region. Water level hydrographs show that the static water levels in wells are similar to the levels measured in the mid 1970s and in some instances the static water levels are slightly higher. Pumpage within LRWPA averaged about 234,900 ac-ft for the period 1908 through 1985. Since then, pumpage has decreaed somewhat. For the period from 1990 to 1997, pumpage averaged about 186,000 ac-ft/yr based on data available from TWDB. LRWPA pumpage averaged about 176,900 ac-ft/yr during the period 1998 through 2000. As discussed previously, the stabilization and slight rise in water levels in wells within the region reflects the stability and slight reduction in pumpage that has occurred within the last 15 years. With the combination of stable to reduced pumpages and stable or slightly elevated rises in static water levels, it is estimated that subsidence within the region has been very small since the mid 1970s, although releveling data have not been collected to verify this result. Releveling data from conventional surveying, or GPS surveying should be developed to evaluate any land surface elevation changes in the Lavaca Region.

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 3.1 percent, or 7,183 ac-ft of the groundwater used in LRWPA in 2000. Within LRWPA, Jackson County accounts for approximately 25.3 percent, or 1,816 ac-ft of the region's municipal groundwater usage; Lavaca County accounts for 42.8 percent, or 3,073 ac-ft; and Wharton County accounts for 31.9 percent, or 2,294 ac-ft. There are ten major municipal users scattered throughout LRWPA. The major municipal users in Jackson County are the Towns of Edna and Ganado and the County-Other category with approximately 44, 14, and 42 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 19, 5, 16, 19, and 41 percent of the county's municipal groundwater usage, respectively. The major municipal users in Wharton County are El Campo and County-Other with approximately 82 and 18 percent of the county's municipal groundwater usage, respectively.

3.2.8 Agricultural Groundwater Usage

Data concerning groundwater pumpage in LWRPA within Wharton County were obtained from TWDB. A graph of pumpage beginning in 1950 for LWRPA within Wharton County is attached as *Figure 3.7*. Pumpage in Wharton County within LWRPA has averaged more than 80,000 ac-ft/yr since 1967. From 1984 through 2000, pumpage within the region averaged about 102,000 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 3.2*. This figure also shows the eastern portion of Jackson County which immediately joins Wharton County to the southwest.

In 2000, groundwater pumped for agricultural practices, principally irrigation, accounted for approximately 96 percent or 200,134 ac-ft of the groundwater pumped in the Lavaca Region. Groundwater was pumped to irrigate approximately 59,653 ac in the region in 2000. Of those 59,653 ac, 2,785 were in Lavaca County, 23,803 were in Jackson County, and 33,065 were in Wharton County. In terms of the region's total agricultural groundwater pumpage, Jackson County accounted for about 42 percent; Lavaca County, 6 percent; and Wharton County, 52 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 LRWPA. The main crop is rice with small acreages of cotton, grain, sorghum, soybeans, and corn which are all irrigated.

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 ac in the northwestern part of Wharton County.

3.3 Identification of Surface Water Sources

LRWPA is located in the Lavaca, Colorado-Lavaca Coastal, and Lavaca-Guadalupe Coastal River Basins. Approximately 90 percent of 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 LRWPA. The remaining surface water 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.

3.3.1 Available Surface Water

Surface water availability was estimated using the TCEQ WAM for the river basins within LRWPA. The WAMs use the Water Rights Analysis Package (WRAP), developed at Texas A&M University, to simulate diversions under current and future conditions using historical rainfall and evaporation data. (The model does not increase diversion amounts over time, as will actually occur. Instead, the model simulates one set of monthly diversion targets attempted annually against a historical inflow dataset, which is typically 50 years long and varies each year.) DOR 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.

ROR 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 3.1* shows the permitted diversions within LRWPA. However, none of these permitted diversion rights in LRWPA are firm under DOR conditions. *Table 7A* in *Appendix 7* lists the individual water right appropriations of rivers and creeks in LRWPA. Data on the firm yields of the rights within the basin were provided by Bob Brandes, Ph.D., R. J. Brandes Co., Consultant for LNRA.

Table 3.1
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 LRWPA. It was developed as part of the Palmetto Bend Reclamation Project in 1968. Lake Texana has a firm yield of 79,000 ac-ft. Of this amount, 4,500 ac-ft of water is reserved for required releases for the bays and estuaries.

3.3.2 Previously Studied Potential Reservoir Sites

Water demand projections show that communities and entities within LRWPA do not need additional surface water supplies. However, there are communities and entities outside of the Lavaca Region that are experiencing supply needs that potentially can be satisfied by the development of the Palmetto Bend Reservoir. To that end, LRWPG has designated the Palmetto Bend Stage II reservoir site as URS. *Figure 3.12* shows the location of the proposed Palmetto Bend Stage II site.

3.4 Wholesale Water Providers

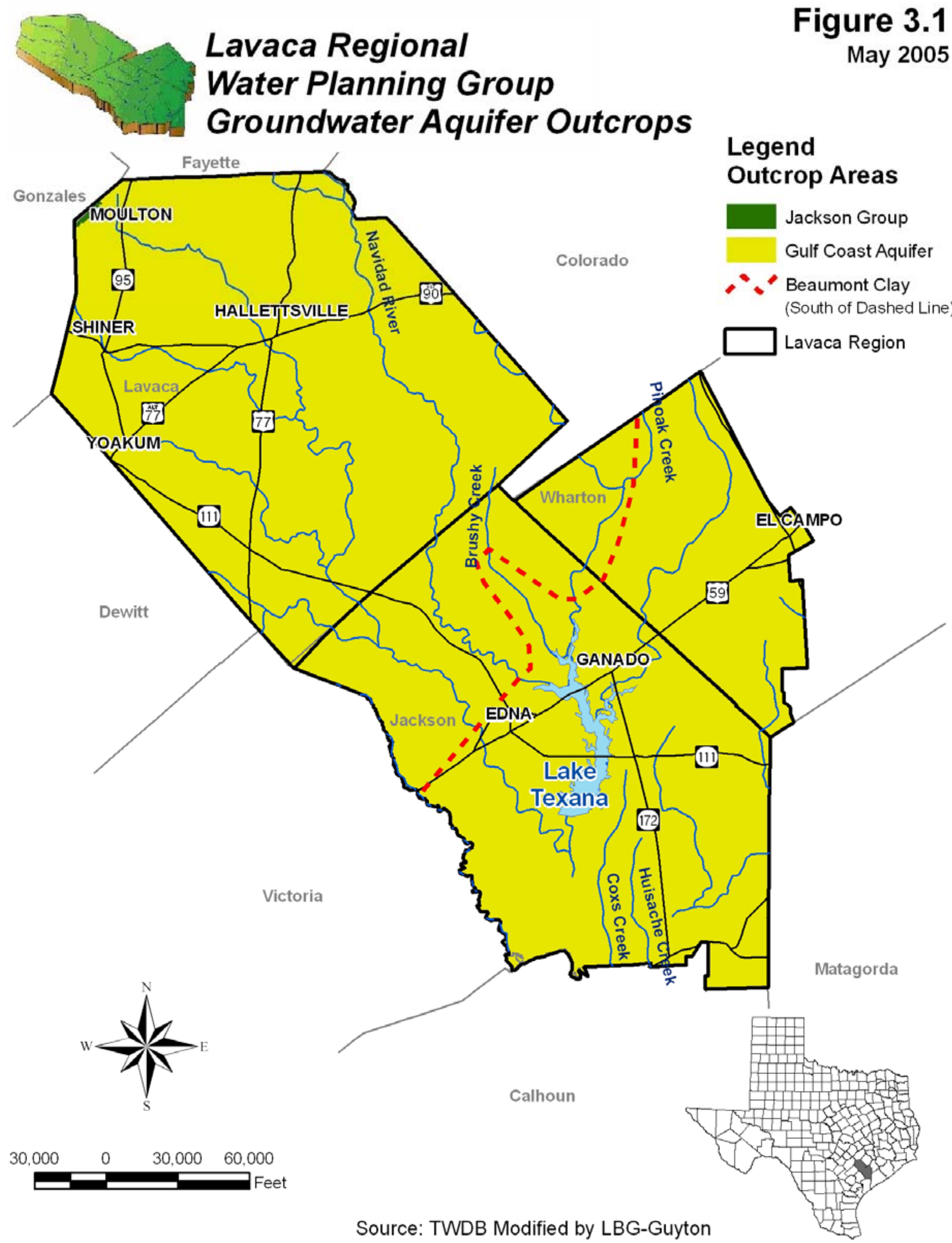
The only WWP in the LRWPA is the LNRA, who holds rights to the firm yield of Lake Texana. Approximately 42,000 ac-ft of this water is contracted for municipal use to Corpus Christi and its surrounding service area. Another 32,500 ac-ft is contracted for industrial use to Formosa Plastic Corporation, Inteplast Corporation, Central Power and Light Company, and Calhoun County Navigational District. The Inteplast Corporation contract is the only use of water from Lake Texana that is used within LRWPA. This contract is for 1,832 ac-ft/yr and is assigned to the Colorado-Lavaca Basin of Jackson County for manufacturing use. This contract exceeds the year 2000 manufacturing water use within the basin of 558 ac-ft.

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 the reservoir to meet pass through requirements as set forth in an agreement with TPWD. This agreement stipulates freshwater release rates for bay and estuary inflows that are based on historical mean and median 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. 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.

FIGURES

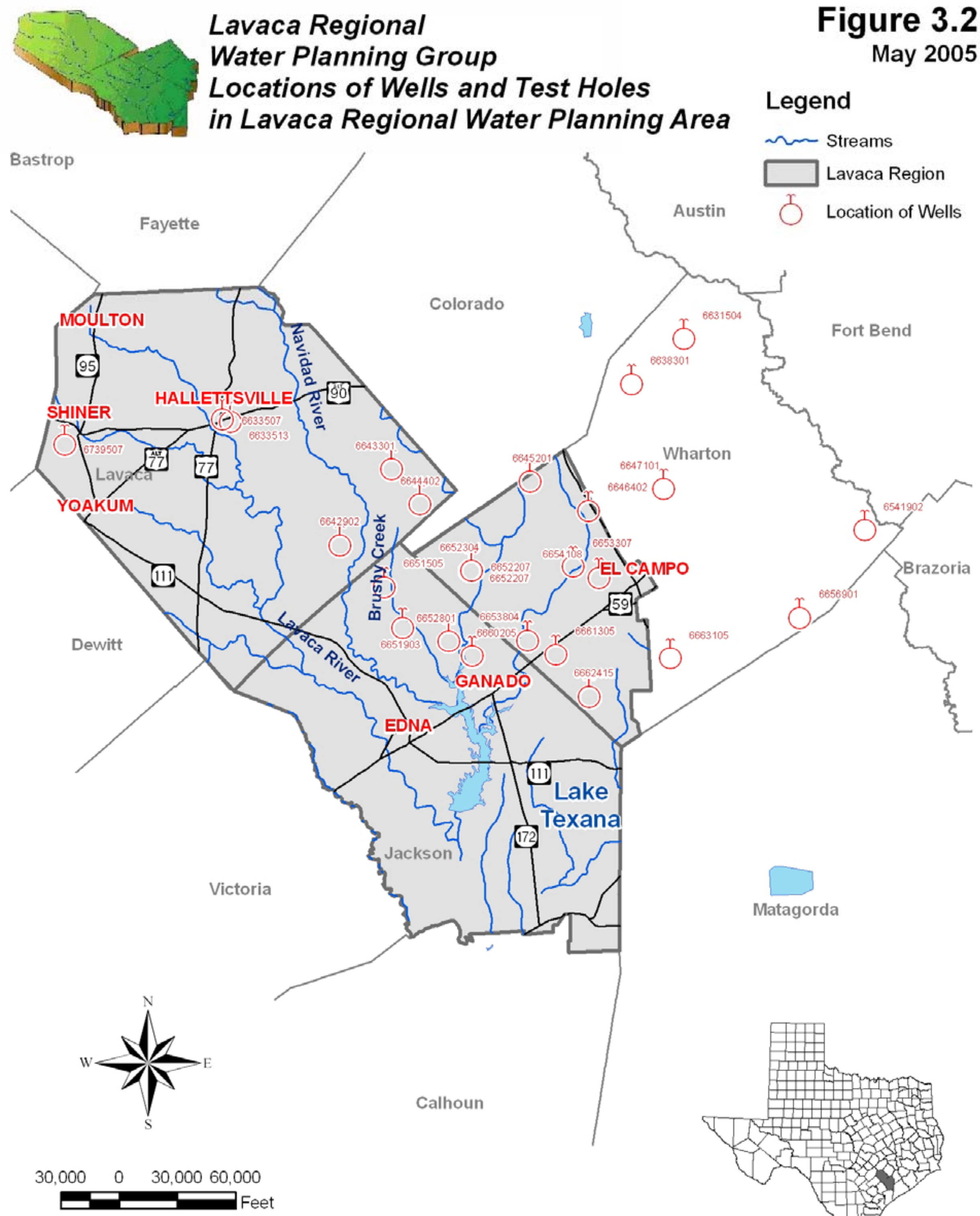
Figure 3.1
May 2005



Source: TWDB Modified by LBG-Guyton

Figure 3.2
May 2005

Lavaca Regional Water Planning Group Locations of Wells and Test Holes in Lavaca Regional Water Planning Area



Sources: TWDB, TCEQ

Figure 3.3 - Static Water Levels in West Wharton County

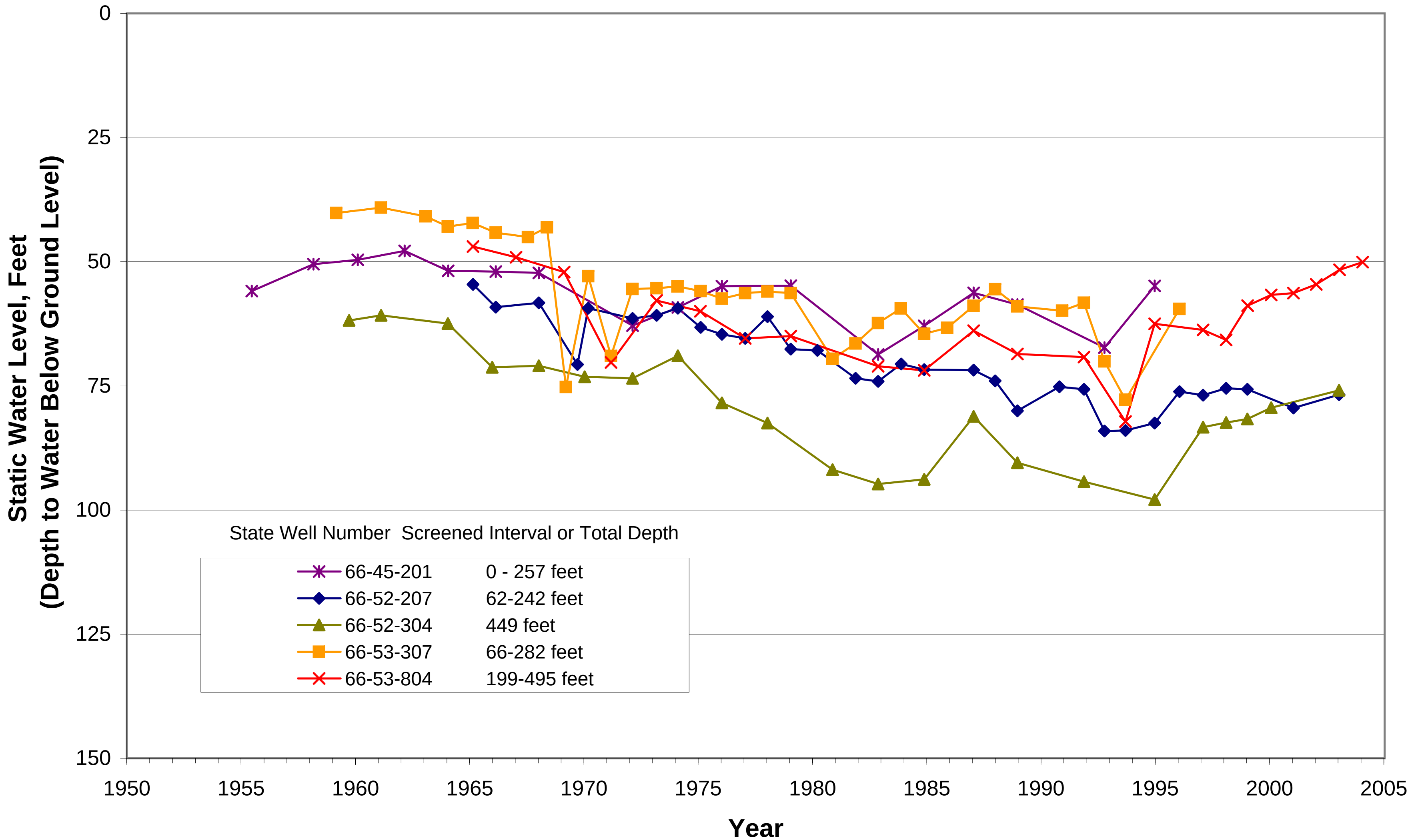


Figure 3.4 - Static Water Levels in Central Wharton County

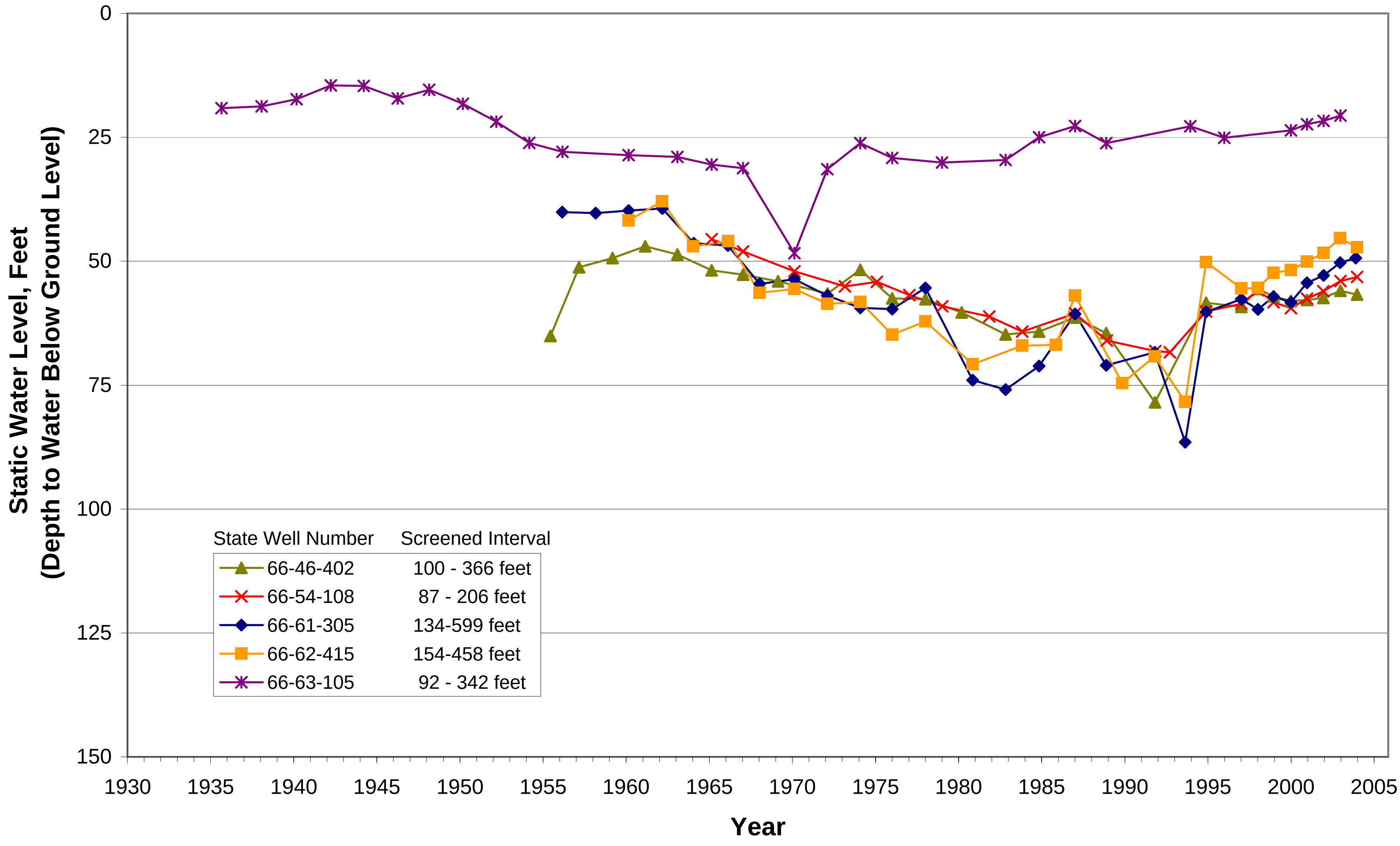
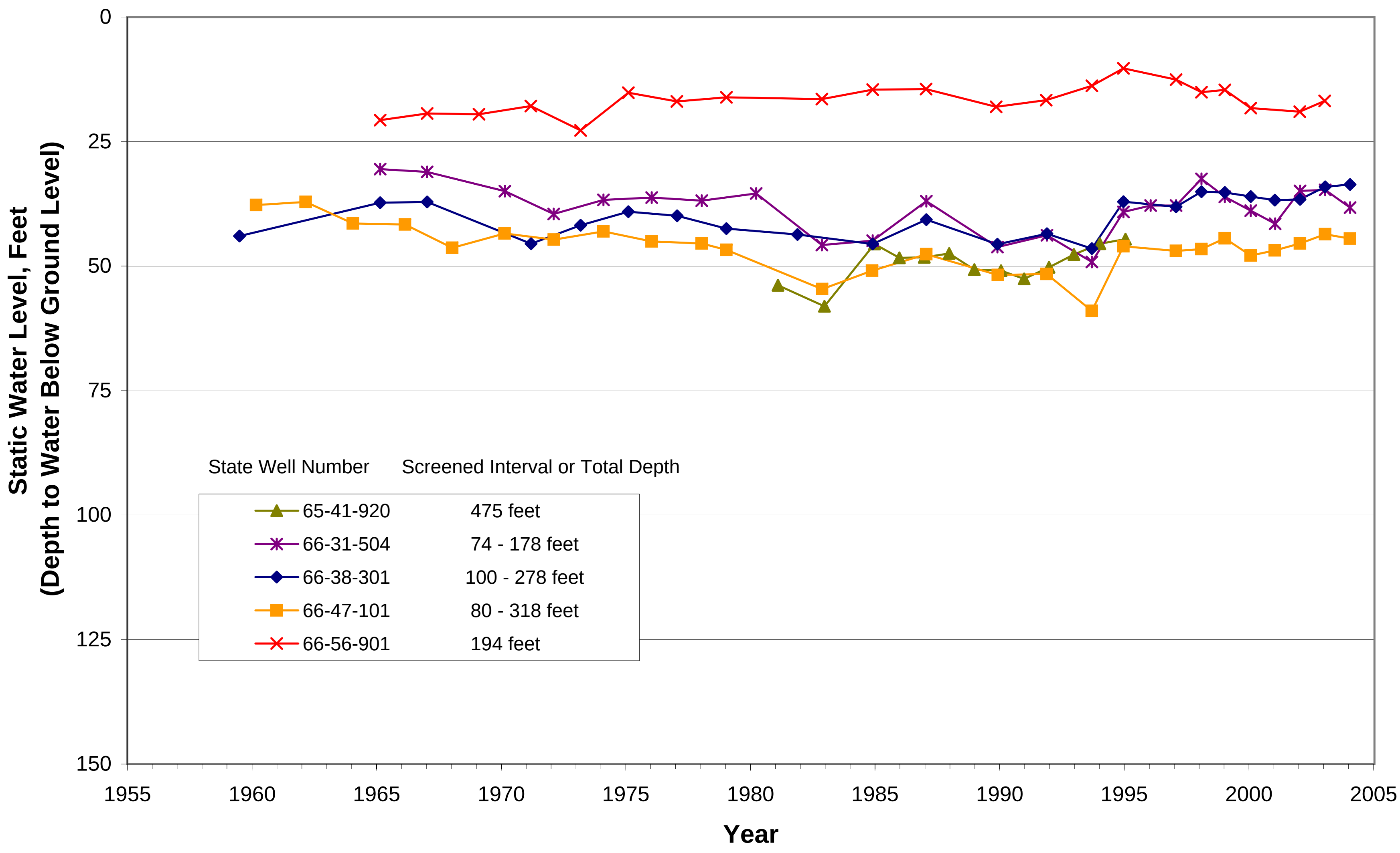


Figure 3.5 - Static Water Levels in East Wharton County



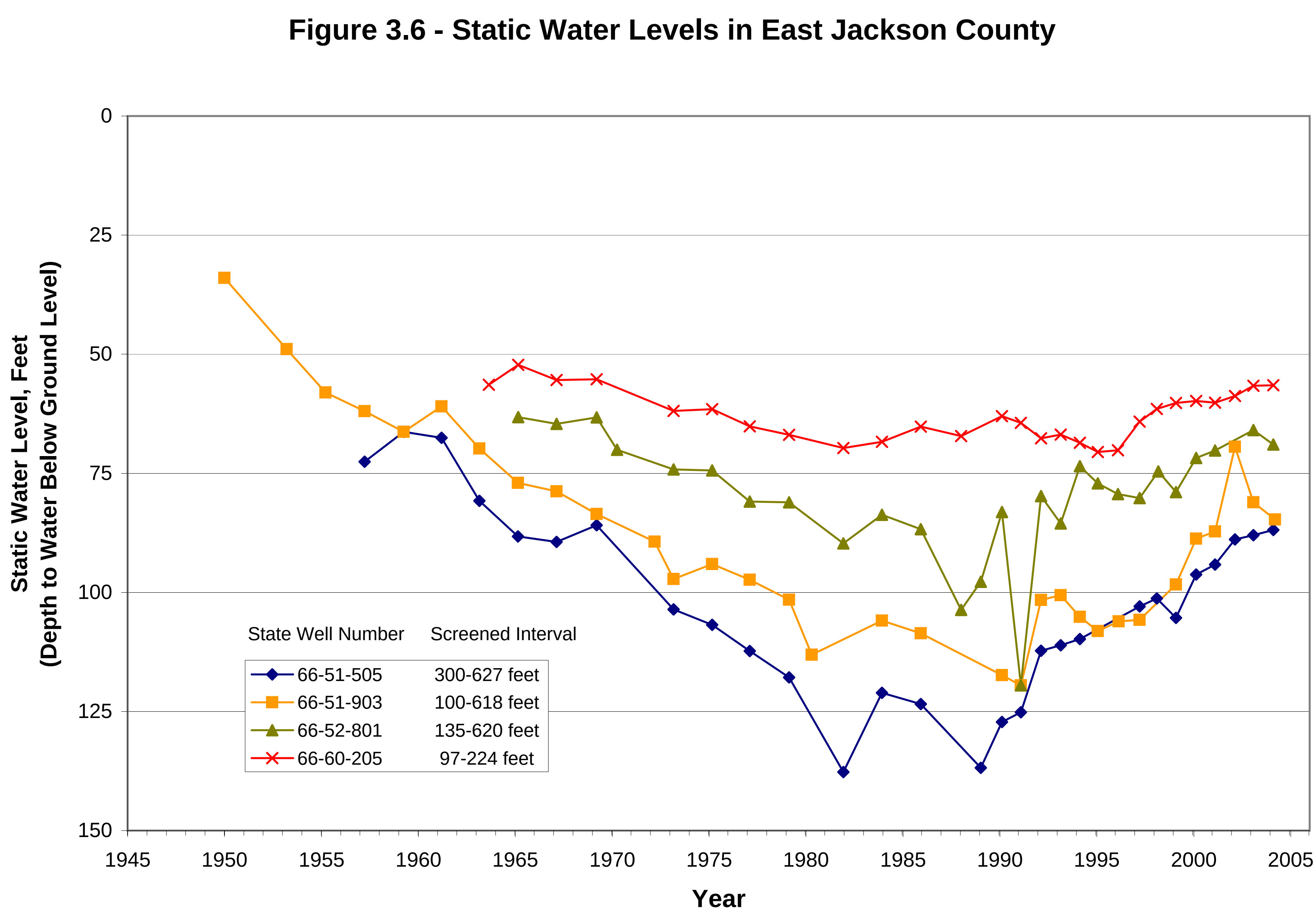
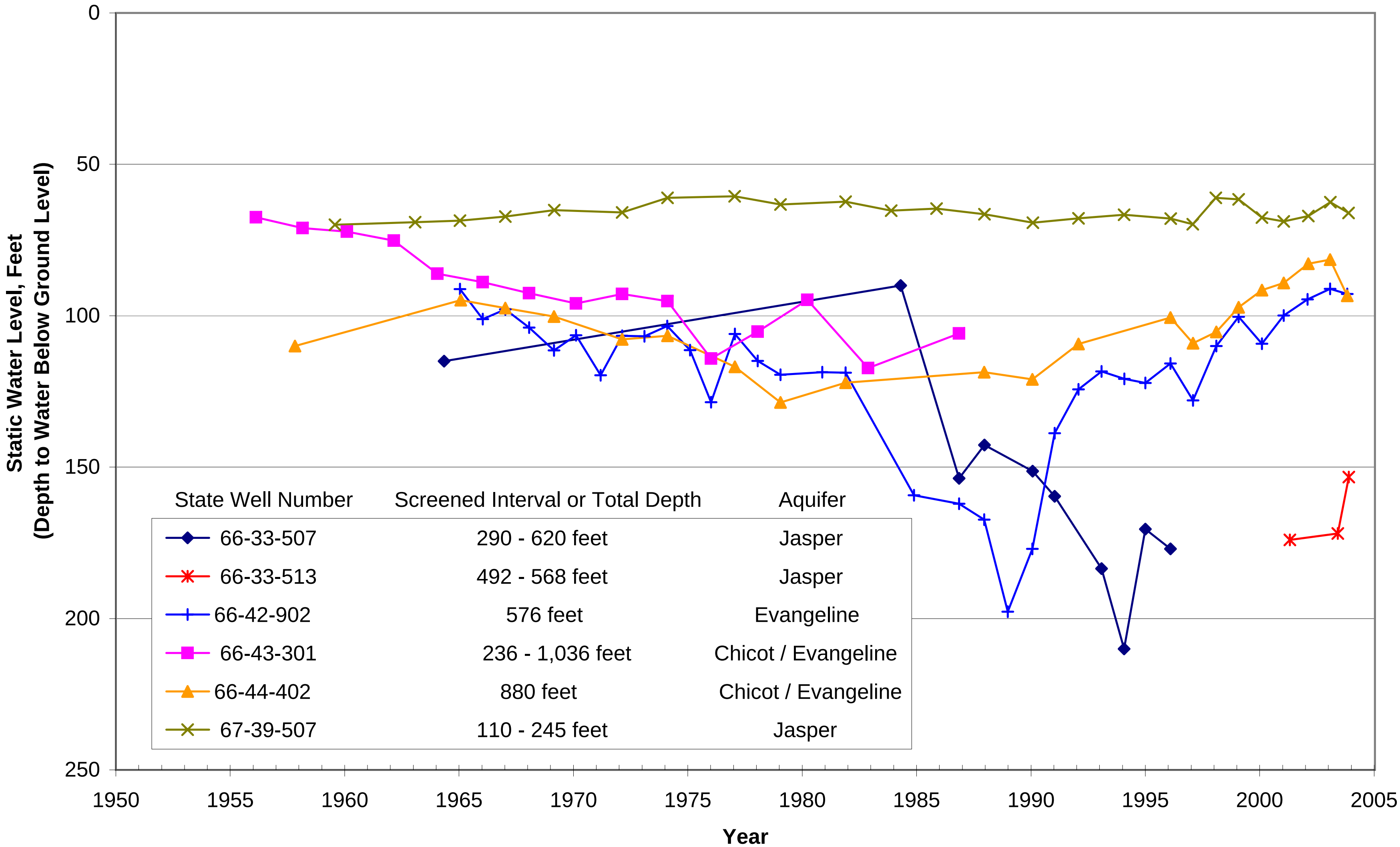


Figure 3.6 - Static Water Levels in East Jackson County
Static Water Level, Feet
(Depth to Water Below Ground Level)
0
25
50
75
100
125
150
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
State Well Number
Screened Interval
66-51-505
300-627 feet
66-51-903
100-618 feet
66-52-801
135-620 feet
66-60-205
97-224 feet

Figure 3.7 - Static Water Levels in Lavaca County



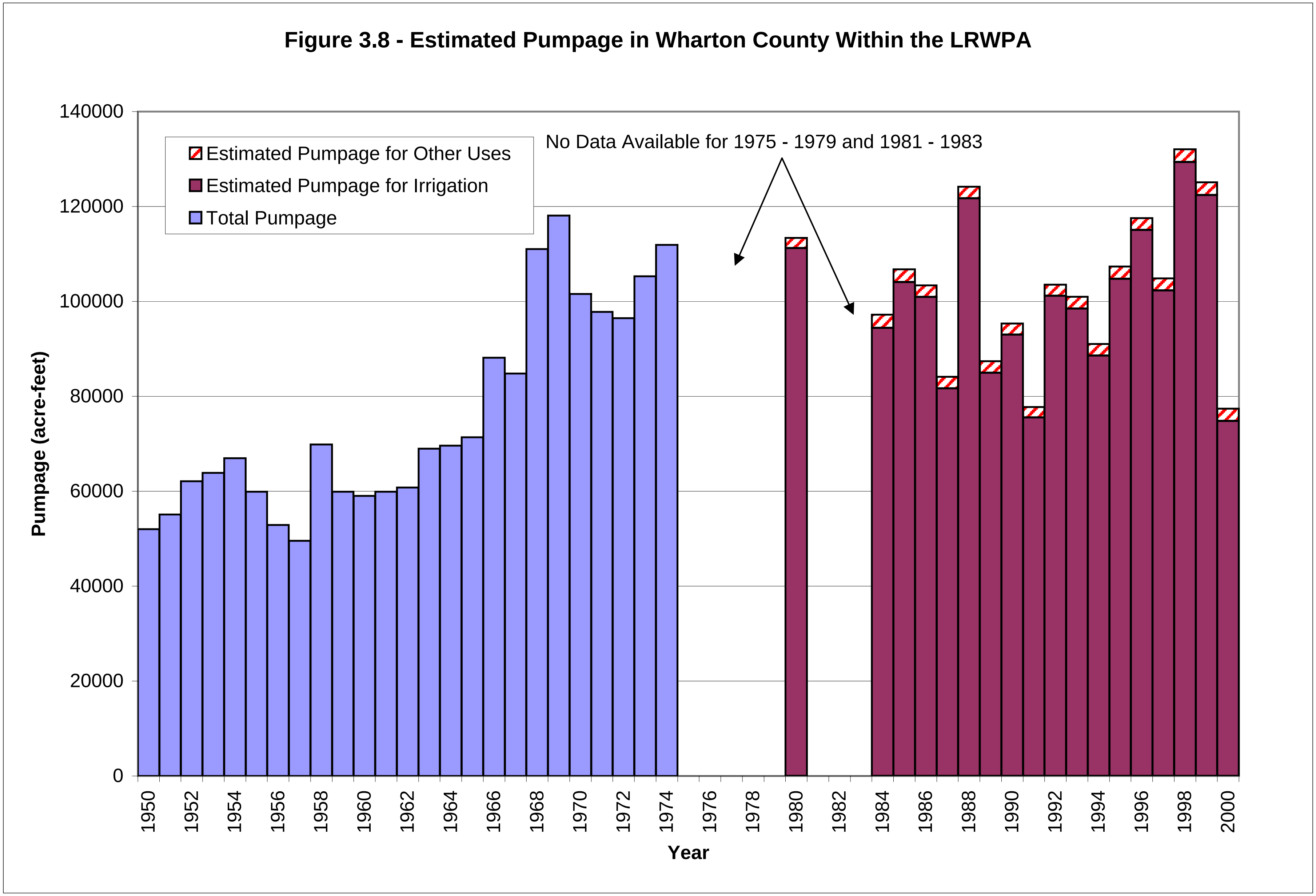


Figure 3.8 - Estimated Pumpage in Wharton County Within the LRWPA
Estimated Pumpage for Other Uses
Estimated Pumpage for Irrigation
Total Pumpage
No Data Available for 1975 - 1979 and 1981 - 1983
Pumpage (acre-feet)
0
20000
40000
60000
80000
100000
120000
140000
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
Year

Figure 3.9
Estimated Pumpage in Wharton County Within the Lavaca Regional Water Planning Area

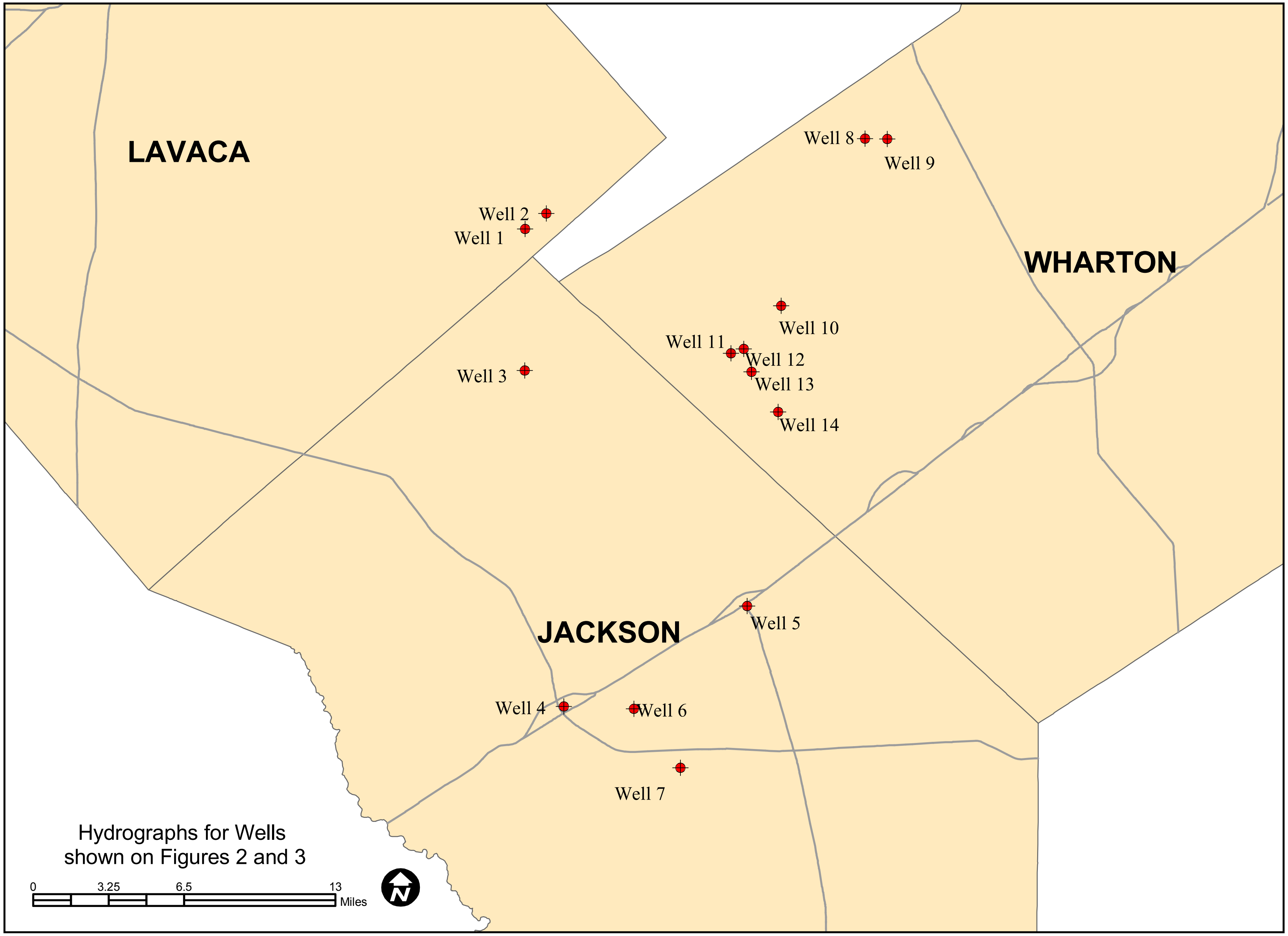


Figure 3.10
Static Water Level Hydrographs for Wells Monitored in Wharton County

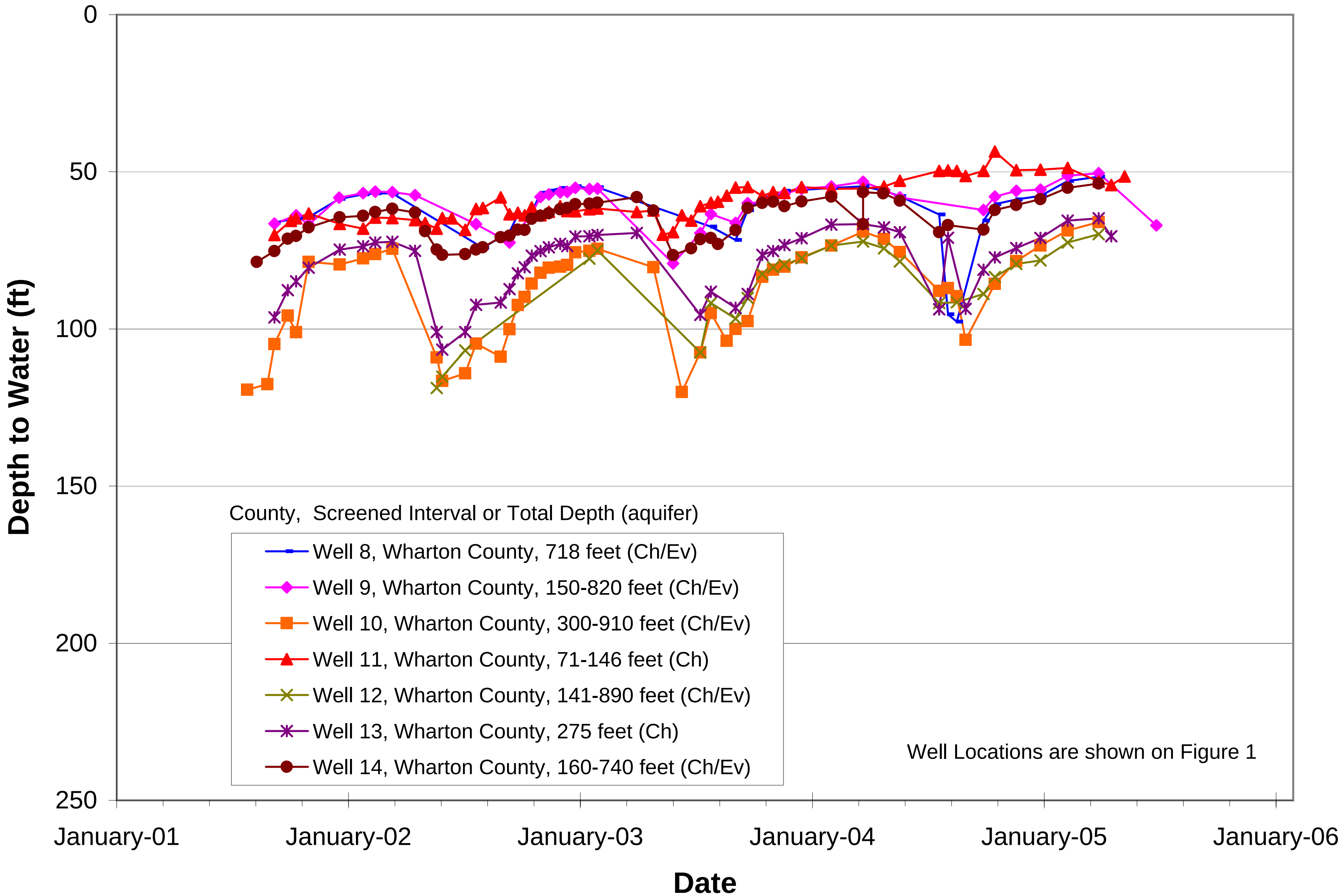
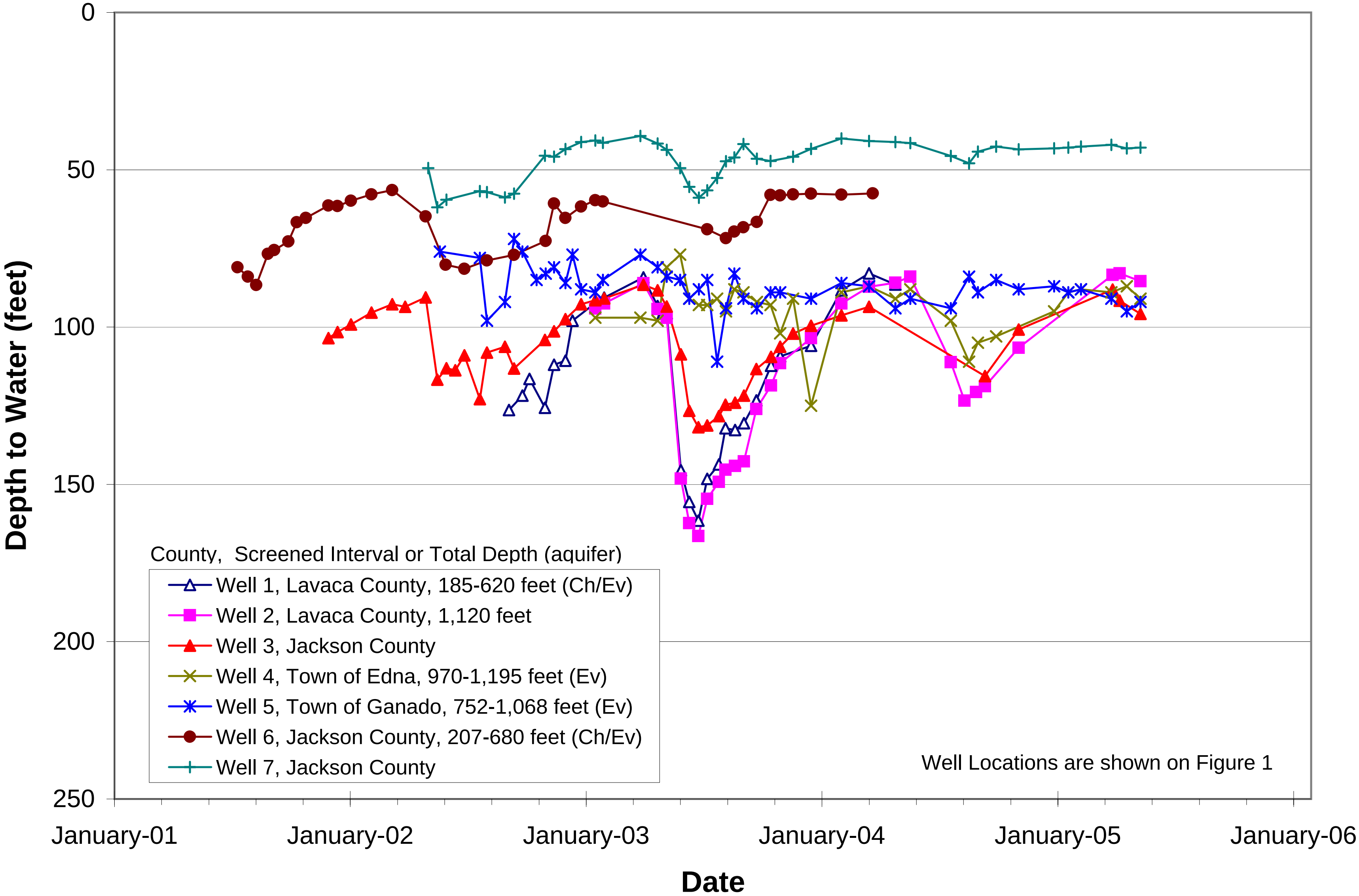


Figure 3.11
Static Water Level Hydrographs for Wells Monitored in Jackson and Lavaca Counties



Lavaca Regional
Water Planning Group
Palmetto Bend Stage II
Figure 3.12
May 2005
Legend
Streams
Lavaca Region
Fayette
Gonzales
Colorado
Lavaca River
Navidad River
Lavaca
Clarks Creek
Pinoak Creek
Brushy Creek
Wharton
Dewitt
Palmetto Bend
Stage II
Jackson
Lake
Texana
Victoria
Coxs Creek
Huisache Creek
Matagorda
Calhoun
N
W
E
S
32,000
0
32,000
64,000
Feet

Source: TWDB

CHAPTER 4

4. Identification, Evaluation, and Selection of Water Management Strategies Based on Needs

This chapter describes the analysis required within 31 TAC 357.7 (a) (4–7) regarding the identification of WUGs with needs and identification, evaluation, and selection of appropriate water management strategies for 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 report are:

- Review of the projected water shortages
- Description of the potentially available water management strategies
- Definition of the recommended management strategies
- Allocation of selected strategies to specific WUGs

In addition to the above, this report contains a description of socio-economic impacts of not meeting the identified needs. .

4.1 Identification of Needs

In *Chapter 2*, water demands were identified for all WUGs. In *Chapter 3*, water supplies available to 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. *Table 4A* in *Appendix 4A* lists all WUGs within LRWPA and their respective surplus or shortage.

Total water demands in LRWPA were 230,447 ac-ft/yr in the year 2000 and are projected to decrease to 206,908 ac-ft/yr in year 2060. The projected 2050 demand is 210,324 ac-ft/yr, which is approximately 14 percent less than the 2050 demand projected in the 2001 LRWPA RWP of 244,758 ac-ft/yr. As discussed in *Chapter 2*, the demand projections for municipal and irrigation have decreased in comparison to the 2001 RWP. Total water supplies available to the region were estimated at 209,431 ac-ft/yr for all planning periods between the years 2000 and 2060.

The sum of the projected shortages in *Table 4A* is 55,755 ac-ft/yr in year 2000, decreasing to 31,979 ac-ft/yr in year 2060. 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 which are preferred due to the lower expense of pumping surface water rather than groundwater. In addition, the Plan focuses on maximum rice production during dry years.

Lavaca County was found to experience no shortages through the year 2060. Shortages for irrigation are expected to occur in the Colorado-Lavaca River Basin of Jackson County from year 2000 through year 2060 planning periods. Irrigation in Wharton County will experience the greatest shortages in the planning area with a deficit 40,036 ac-ft/yr in year 2000 and

16,145 ac-ft/yr in year 2060. There are no municipal shortages anticipated for LRWPA through the year 2060.

4.2 Selection and Application of Water Management Strategies

The planning group 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. The converse of this assumption, however, is that the groundwater is available in the area and that municipal and industrial users have the necessary funding to drill their wells deeper and pay the increased costs of energy for pumping from greater depths. As a result, it was assumed that the municipalities and the industrial WUGs had the assurance that they would have sufficient supply. Furthermore, since the municipal and manufacturing usages within the planning region composed less than 4 percent of the total usage, this assumption would not cause the increased drawdown of the static and pumping water levels to the point that the remaining water would be unavailable for agricultural uses.

The primary evaluation criteria established by LRWPG was cost and the minimization of capital expenditures for providing water, since there is no readily available source of capital for agricultural water procurement and limited ability of agricultural operations to repay loans if loans were available. LRWPG concurred that the price of the water obtained had to be the overriding criteria. In this instance, if the cost of a project was beyond the ability of agriculture to pay for it, either through the need for environmental mitigation or the capital cost necessary to provide infrastructure, no further analysis was appropriate.

4.2.1 Potential Water Management Strategies

The management strategies considered for shortages in the 2001 RWP that have been carried through to the 2006 RWP are as follow:

- Conjunctive use of groundwater in Jackson and Wharton Counties
- Conversion of Ganado and Edna to surface water
- Reuse of municipal effluent
- Construction of the Palmetto Bend Phase II reservoir site on the Lavaca River

The individual strategies and their costs and environmental impacts are contained in *Appendix 4B*. *Table 4C.1* in *Appendix 4C* includes a list of the potential management strategies recommended for each shortage.

4.2.2 Strategy Evaluation and Selection

The ultimate factor considered by LRWPG when selecting management strategies 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. A maximum cost of $50 per ac-ft was set by LRWPG as a cost that would be reasonable for irrigators to pay for additional water. Management strategies with a unit cost greater than this were not considered, and costs previously developed for these measures in the 2001 RWP were not revised for this Plan.

Pumping of additional groundwater beyond the sustainable yield was the lowest cost alternative. Since there are no springs in the area with the higher water demands, this option also maintains the current status with regard to the environment by allowing the flooding of rice fields to continue and return flows to continue without diminishing. In addition, the area has seen static water levels in earlier years that are as low or lower than the levels predicted to occur if dry years coincide with maximum rice production. As a result of the lowering of many of the irrigation well pumps during that earlier period, it was assumed that no capital costs would be incurred since the wells have already been modified to meet the lower water table conditions. This is an important factor, since there are no municipal or manufacturing WUGs with shortages which would be a source of capital investment to help farmers implement on-farm water conservation measures in return for receiving a portion of the resulting water conserved.

Because of the extreme sensitivity of agricultural users to the cost of water, no previously proposed management strategies were further developed for the 2006 Lavaca RWP. Agricultural users cannot afford the cost of water from new reservoirs for firm yield, although the development of new reservoirs would result in some additional interruptible water that could potentially be used for agricultural purposes if it could be provided economically. For much of the region, groundwater is used as the primary source of irrigation water, so large-scale canal systems do not exist. The cost of building canals or pipelines would make widespread distribution of any interruptible water uneconomical. For the remaining water management strategies considered, planning level costs and data are contained in *Appendix 4B* for each potential strategy. The costs for those strategies have not been updated from the last planning cycle as none of the strategies were remotely within reasonable costs set by LRWPG.

It should be noted that the analysis of demand and supply was done assuming certain acreages were in agricultural production during the DOR conditions. The overpumping will occur only if peak agricultural production is combined with DOR hydrological conditions. It is possible that the acreages of rice grown would be reduced during record drought conditions to the extent that pumping of the aquifer beyond the sustainable yield amounts would not occur. As a result, even the costs for pumping at greater lifts for the water used would not materialize. For planning purposes, however, it is prudent to assume that these costs would be incurred during DOR conditions.

An analysis of the interruptible flows from Lake Texana was conducted as a part of this process. This analysis determined that there are approximately 12,000 ac-ft of interruptible flows in Lake Texana at least 80 percent of the time. Currently, all of this interruptible yield water is under contract to the City of Corpus Christi.

Planning level costs were estimated for the conversion of both Edna and Ganado to surface water to meet the municipal demand. Unit costs were based on information from the 2001 Plan updated per TWDB Exhibit B. On a planning level, the probable cost for the conversion to surface water is approximately $738 per ac-ft/yr. This estimate includes an intake structure, lift station pumping, conveyance lines, a Level 3 (conventional treatment) plant, ground storage, yearly operation and maintenance cost, energy costs, possible studies (feasibility, environmental, etc.), engineering and contingencies. The assumption was also made that the available water from Lake Texana would be the municipal portion allocated currently to the City of Corpus Christi, but recallable by Jackson County and made available to the regional treatment plant at the same cost that Corpus Christi is currently paying for the water. The proposed plant would be located at a suitable site south of Interstate Highway (IH) 59 and west of Lake Texana. It is assumed that only major conveyance lines would be needed to tie into the existing distribution systems of the two cities. By converting the municipal water demand to surface water, groundwater currently being used to meet this demand can be utilized for other demands. Since the conversion efforts noted above will result in only 2,000 ac-ft annually of groundwater reduction, the effects on groundwater pumpage, aquifer drawdown, and subsidence are expected to be negligible.

4.2.3 Strategy Allocation

The management strategy of exceeding firm groundwater supplies to meet short-term demands was applied to meet the irrigation shortages in both Jackson and Wharton Counties. This is shown in *Table 4C.2* in *Appendix C.*

4.3 Water Conservation

As noted above, there are no municipal WUGs with shortages. In addition, while water conservation by municipalities is encouraged, the significance of even a 20 percent reduction in municipal use, when applied to the 3 percent of total usage that municipal usage composes, results in a 0.6 percent savings overall. Further, most of the municipalities have standby well capacities so that they can provide the maximum daily demand with the largest well out of service. Since the anticipated growth in total population is only 10,000 persons, it is not anticipated that conservation savings will result in significant savings over the 50-year planning horizon. In fact, many of the cities are projected to experience a decrease in population over time. As a result, they have no incentive to conserve to delay implementation of costly expansions. There is no real driver to induce conservation for these WUGs.

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. There are no municipalities within the planning area that are in need of additional supplies that cannot be supported by groundwater. Neighboring regions with needs tend to have much larger needs than could be supported by savings in groundwater for irrigation purposes. As an example, if 20 percent of the total irrigation water used in Jackson County could be conserved by the canal and on-farm conservation practices outlined in the management strategies, the net effect is that the usage would be reduced to the sustainable yield of the aquifer and there would still not be any surplus to be marketed under DOR conditions. With total usage of approximately 100,000 ac-ft annually, the savings would only result in 20,000 ac-ft of available water annually even under the best of conditions. The needs of neighboring basins are such that much larger projects are needed to provide economical costs for new supplies.

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.

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. Unfortunately, the way in which agricultural operations in LRWPA are managed prevent such programs from having a powerful effect. 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.

4.4 Irrigation Return Flow Analysis

One of the areas of effort for the plan revision process has been determining the potential impact of return flows on instreamflows. A second point of concern is the potential reduction in in-streamflows from conservation of water, particularly in the rice growing areas. As we have noted earlier, approximately 95 percent of the total water used in LRWPA is used for irrigation purposes, and of that amount, in excess of 80 percent is used for growing rice. It is further noted that during extended periods of below normal rainfall, virtually all of the rice in LRWPA is grown using groundwater since the surface water irrigation rights are not firm rights.

4.4.1 Current WAM Contributions

The first area of investigation was to identify the sources of return flows in the current Lavaca Region Water Availability Model (WAM). WAM Run 3 has no return flows from municipal and manufacturing WUGs, but it was determined that there was some return flow from agriculture in the model. It is our understanding that the Lavaca WAM contains return flows from tracts irrigated with groundwater at 5 percent of the total water applied. For tracts irrigated with surface water, the total estimated return flow is 15 percent of the water applied. These represent annual return flow amounts. A review of the information developed in the water demand section of this report indicates that total water applied for rice production in lands irrigated by groundwater is approximately 4.15 ac-ft/ac based on total planted first-crop acres, and 6.51 ac-ft/ac for lands irrigated with surface water, again based on total first-crop acres. As a result, annual return flow contributions were estimated at 2.49 inches per acre (in/ac) for groundwater-irrigated lands, and 11.7 inches for surface water-irrigated lands.

4.4.2 Estimated Conservation Savings

One additional item of data that is important to this analysis is a report prepared by Dr. James Stansel concerning the impacts of various conservation measures. Those measures with the greatest impact upon rice grown with groundwater are precision leveling and multiple inlets. These measures, when implemented together, are anticipated to provide an annual savings of approximately 0.5 ac-ft/ac, or 6 in/ac. Again, this is an annual number; however, as noted above, there are some potential negative impacts on wildlife habitat associated with irrigation conservation.

In general, costs are prohibitive to the implementation of field improvements to reduce water usage. *Table 4.1* lists the costs published by Stansel, adjusted to the 2nd Quarter of 2002.

Table 4.1
Estimated Unit Cost of
Agricultural Conservation Improvements

Improvement	Improvement Cost per Acre
Land Leveling	$108.15
Multiple Inlets	$2.16
Reduced Levee Interval	$0.54
Irrigation Pipeline	$178.44

The LRWPA includes nearly 150,000 acres of land that could be irrigated for rice in any given year. As indicated by local farmers, approximately 25 percent, or roughly 37,500 of these acres have improvements such as irrigation pipelines and laser leveled fields in place. In any given year, approximately one-third of the available land is used for rice production, meaning that 12,500 acres of improved land are flooded for rice irrigation. From these estimates it was determined that approximately 6,250 acre-feet of water are conserved annually from conservation practices that are already in use, assuming one half-foot of conservation per improved acre.

4.4.3 Extent and Timing of Flows From Rice Culture

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 is being 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. *Figure 4D.1* in *Appendix 4D* is the map of the irrigated lands.

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.

Table 4D.1 presents the estimated flows from the tracts of land identified in the 2000 Irrigated Lands Inventory, both before and after conservation. These flows were then compared to the naturalized streamflows at the various control points to which they correspond. Thirty-six of the 38 control points shown 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 WAM Control Points DV215 and DV301, Sandy Creek at Control Points TDV901 and DV1001, and Pinoak Creek at Control Points DV1018, DV1021, and DV1023. Two other Points, DV503 in Lavaca County and DV501 in 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.

Table 4D.1 also lists which control points are expected to receive irrigation return flows in excess of the minimum naturalized flow for the months of June and July. These columns in the table show 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 is 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.

4.4.4 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.

CHAPTER 5

5. Impacts of Water Management Strategies on Key Parameters of Water Quality and Impacts of Moving Water From Rural and Agricultural Areas

5.1 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 regions defined by TWDB. RWPs prepared by each RWPG will be combined into a comprehensive state water plan. The planning effort is part of a consensus-based planning effort to include local concerns in the statewide planning effort.

This chapter presents the results of Task 5 of the project scope, which addresses impacts of water management strategies on key parameters of water quality and impacts of moving water from rural and agricultural areas.

5.2 Impacts of Water Management Strategies on Key Parameters of Water Quality

The potential impacts that water management strategies might have on water quality are discussed herein. The identified water quality parameters deemed important to the use of the water resources within the region as well as how they are impacted by the water management strategies are also discussed below.

Key water parameters identified within LRWPA are:

- Bacteria
- pH
- DO
- TDS
- TSS
- Chlorides
- Nutrients (nitrogen, phosphorus)
- Salinity

The water quality parameters and water management strategies selected by 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 LRWPG management strategies in place. For the Lavaca Region, the predominant water use is for agricultural purposes, with 96 percent of the water used for irrigation and livestock watering. The water for municipal and manufacturing use is less than 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.

Of the irrigation water, approximately 85 percent of that demand is for growing rice. As a result of the predominance of agricultural use of the water, the Lavaca Region is very price sensitive, and the review of 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. For the first plan, a value of $100 per acre foot (ac-ft) was selected as the upper limit of what the agricultural interests would be able to pay for irrigation water. This criteria has been retained in the current plan update because of the continuing economic pressure on agricultural users, although there was some sentiment in the Planning Group that this figure was too high. It was proposed that agriculture would be unable to pay for irrigation water at a cost even as low as $50 per ac-ft. Because of this reason, overpumping the Gulf Coast aquifer during DOR was determined to be the only reasonable strategy.

Water quality records were obtained from TWDB for wells completed in the Chicot, Evangeline, and Jasper aquifers in the Lavaca Region. Records available from TWDB include water quality data dating back to the 1930s through 2001. Of the key water parameters identified in the Lavaca Region, TWDB includes records for pH, TDS, and chloride for groundwater. Irrigation, domestic, municipal, manufacturing, and livestock supplies are the main uses for water in LRWP.

The most recent TWDB water chemistry available results are from 2001. Data from 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. Recent data indicate TDS 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 2001. The TDS content of the water generally is in the range of 300 to 700 mg/L, but can be as much as 1,200 mg/L at a few locations in southern Jackson County.

Analysis of 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 2001 TWDB water quality records do not indicate a change in the water quality. Available data for wells sampled in the 1980s and in 2001 have water quality constituents with similar values with only slight differences noted. Samples taken from wells in 2001 that are located near wells sampled in the 1980s also have similar reported values for the water quality constituents.

As discussed previously, a water supply strategy within the Lavaca Region includes pumping groundwater as needed to satisfy the regional water demands. This strategy includes pumping a larger quantity of groundwater in some years than estimated to be available on a sustainable basis and also pumping less groundwater than the estimated sustainable availability during years when precipitation is higher than normal and the demand for water for irrigation is lower.

For Lavaca County, the estimate of water demand is less than the estimate of overall groundwater availability. For Jackson County, the estimate of water demand is about 3,000 ac-ft/yr higher than the estimate of groundwater availability for the county which is about 87,876 ac-ft/yr. Thus, for these two counties the pumping of groundwater from the aquifers is less than or just about equal to the estimate of groundwater availability. Historical data show that in Jackson County groundwater pumping averaged about 66,000 ac-ft/yr from 1990 through 2000 and had been as high as 136,000 ac-ft/yr in 1980. Thus for the last several years, groundwater pumping has been less than the estimate of availability of 87,867 ac-ft/yr.

In Wharton County, it is estimated that groundwater pumping in some years could exceed the estimate of groundwater availability within the Lavaca Region in Wharton County. Estimated groundwater demand in 2010 is 116,388 ac-ft/yr. Pumpage for the last ten years in the Lavaca Region of Wharton County has ranged from about 78,000 ac-ft/yr to an estimated 132,000 ac-ft/yr. 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 515 mg/L for samples collected in 2001. The data show very little change in the overall mineralization of the water during a period of relatively intense irrigation and water use. It is estimated, based on the available data and stable TDS content of the groundwater, that the strategy of overpumping the aquifers during years when water demand is higher and precipitation is lower and pumping less groundwater from the aquifers during years when precipitation is higher and irrigation demand is lower should not have a significant effect on the quality of the groundwater. 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.

Another issue of concern is the application of conservation measures to minimize agricultural shortages as a first strategy. This works well as a strategy for all those farms which are family owned and operated, and for as long as matching grants are available through NRCS's 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 essure 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. 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. With this in mind, if one assumes that the region retains ownership of half of the water produced through conservation savings, then the cost of that water to the outside interest that is paying for the conservation is approximately $170 per ac-ft at the location of the existing usage. When transportation costs are added to this amount, the costs become significantly less competitive, particularly for the relatively small amounts of water available. As a result of the issues noted above, the only feasible management strategy is pumping additional groundwater during drought conditions. This strategy is somewhat self limiting in that surface water is cheaper to pump than groundwater because of the greater cost of pumping groundwater to the surface. As a result, when surface water is available, the farmers are going to use it because there is a cost advantage in doing so. As a result, extra groundwater will only be pumped during the driest years, and the groundwater pumpage will be reduced again as soon as surface water is available. Therefore, the extra pumpage is temporary and is not anticipated to have a long-term impact on aquifer levels in the region.

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

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 less 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 cropland 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, nearly all of the manufacturing water, and 80-plus percent of the irrigation water is derived from groundwater, the reduction of the return flows through conservation will have a negative impact on streamflows during the DOR. Municipal and manufacturing return flows are returned to the stream throughout the year, 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 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 would not be easily converted for other crops.

5.3 Impacts of Moving Water From Rural and Agricultural Areas

Currently, the water used in rural (livestock) and agricultural areas represents 95 percent of the total water used in the Lavaca Region. 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. As acreage has declined over a period of years, there has been a concomitant decline in infrastructure such as rice mills and railroad access. A major section of track in Wharton County has been removed and the right-of-way abandoned. 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 is primarily economic. *Chapter 9* contains the specific calculations of socio-economic impacts prepared by TWDB for the Lavaca Region.

CHAPTER 6

6. Water Conservation and Drought Management Plans

This chapter presents the minimum necessary requirements for conservation plans and drought contingency plans as well as the model conservation plans and drought contingency plans for the various water user categories. The model conservation plans and drought contingency plans were developed specifically for the Lavaca Region in accordance with and as described in *Texas Water Code 11.1271* and *11.1272*. It is recognized that the predominant water use in LRWPA is for irrigation purposes. The greatest impact in reducing water usage in the Lavaca Region will be from conservation in the irrigation of rice, which represents 88 percent of the total water used. However, the current rules for conservation plans and for drought contingency plans are geared more toward wholesale and retail water public water suppliers. The following sections discuss who is required to have plans and what the plans, if required, must contain.

6.1 Existing Water Conservation and Drought Management Plans in LRWPA

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. These documents are found in *Appendix 6A*.

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. Some plans also included the use of alternative water sources such as the use of non-potable wells to meet non-potable water demands. The amount of water saved for each drought response conditions varied by community. *Table 6.1* shows the ranges of expected water conservation for each stage of response.

Table 6.1
Range of Anticipated Savings From Drought Contingency Plans

Response Level	Shortage Condition	Lower Limit % Savings	Upper Limit % Savings
1	Mild	5	10
2	Moderate	10	20
3	Severe	15	30
4	Critical	20	40
5	Emergency	25	50
6	Water Allocation	Unspecified	Unspecified

Water conservation plans were also included with the drought contingency plans for the Cities of Shiner and Yoakum. These documents include the following recommendations for reducing municipal water demands:

- **Public Education –** distribution of conservation materials through mail distribution and published articles.
- **Plumbing Code –** setting plumbing standards for new construction and replacement in existing structures.
- **Retrofit Program –** encouraging the replacement of plumbing devices with water saving devices by informing the public on where to obtain these devices and encouraging the sale of such fixtures.
- **Water Rate Structure –** using a conservation water rate structure to discourage the excessive use of water.
- **Metering –** scheduling regular meter testing programs.
- **Water Conservation Landscaping –** encouraging the use of plants with low water demands through public education.
- **Leak Detection and Repair –** through electronic and traditional monitoring of water use and water system infrastructure.

6.1.1 Municipal Uses by Public Water Suppliers[1]

Water conservation plans for municipal water use by public water suppliers (i.e., documented Lavaca Regional Municipal WUGs) must include specific information. If the plans do not provide information for each requirement, the public water supplier shall include in the plans an explanation of why the requirement is not applicable. The required water conservation plan information for municipal uses by public drinking water suppliers is as follows:

- A utility profile including, but not limited to, information regarding population and customer data, water use data, water supply system data, and wastewater system data.
- Specification of conservation goals including, but not limited to, municipal per capita water use goals, the basis for the development of such goals, and a time frame for achieving the specified goals (until May 1, 2005).
- Specific, quantified 5- and 10-year targets for water savings to include goals for water loss programs and goals for municipal use in gallons per capita per day (gpcd). The goals established by a public water supplier under this subparagraph are not enforceable.

[1] Information in this subsection was obtained from the *Texas Administrative Code*, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.2

- Metering device(s) within an accuracy of plus or minus 5.0 percent in order to measure and account for the amount of water diverted from the source of supply.

- A program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement.

- Measures to determine and control unaccounted-for uses of water (for example: periodic visual inspections along distribution lines, or annual or monthly audits of the water system to determine illegal connections and abandoned services, etc.).

- A program of continuing public education and information regarding water conservation.

- A water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water.

- A reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin in order to optimize available water supplies.

- A means of implementation and enforcement which should be shown by either of the following:

    1. A copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the water supplier, or

    2. A description of the authority by which the water supplier will implement and enforce the conservation plan.

- Documentation of coordination with LRWPG for the service area of the public water supplier to ensure consistency with the appropriate, approved Lavaca RWP.

Water conservation plans for municipal uses by public drinking water suppliers serving a current population of 5,000 or more and/or a projected population of 5,000 or more within the next 10 years subsequent to the effective date of the plan must also include the following information:

- A program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system to control unaccounted-for uses of water.

- A record management system to record water pumped, water deliveries, water sales, and water losses that allows for the desegregation of water sales and uses into residential, commercial, public and institutional, and industrial users.

- A requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with the provisions of this chapter.

If the conservation goals cannot be achieved through the minimum conservation plan requirements, the water supplier can implement water conservation strategies to help achieve their goals. TCEQ can also require the water supplier to implement a conservation best management practices (BMP) strategy to achieve the goals set in the conservation plan. Some of the water conservation BMPs are listed below, and a more detailed list can be found in the *Water Conservation Best Management Practices Guide, Report 362,* TWDB, November 2004.

- Conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates.
- Adoption of ordinances, plumbing codes, and/or rules requiring water-conserving plumbing fixtures to be installed in new structures and existing structures undergoing substantial modification or addition.
- A program encouraging the replacement or retrofit of existing structures built prior to 1991 with water conserving plumbing fixtures.
- Reuse and/or recycling of wastewater and/or graywater.
- A program for pressure control and/or reduction in the distribution system and/or for customer connections.
- A program and/or ordinance(s) for landscape water management.
- A method for monitoring the effectiveness and efficiency of the water conservation plan.
- Any other water conservation practice, method, or technique which the water supplier shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

A water conservation plan prepared in accordance with *31 TAC §363.15* (relating to the Required Water Conservation Plan) of the TWDB, and substantially meeting the requirements of this section and other applicable commission rules, may be submitted to meet application requirements in accordance with a memorandum of understanding between the commission and TWDB.

Beginning May 1, 2005, a public water supplier for municipal use shall review and update its water conservation plan, as appropriate, based on an assessment of previous 5- and 10-year targets and any other new or updated information. The public water supplier for municipal use shall review and update the next revision of its water conservation plan no later than May 1, 2009, and every five years after that date to coincide with LRWPG's RWP update.

6.1.2 Industrial or Mining[2]

Water conservation plans for industrial or mining uses of water must provide the information as outlined below. If the plan does not provide information for each requirement, the industrial or mining water user shall include in the plan an explanation of why the requirement is not applicable. Water conservation plans for industrial or mining uses of water should include at a minimum the following information.

- A description of the use of the water in the production process, including how the water is diverted and transported from the source(s) of supply, how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and, therefore, unavailable for reuse, discharge, or other means of disposal.
- Until May 1, 2005, specification of conservation goals, the basis for the development of such goals, and a time frame for achieving the specified goals.
- Beginning May 1, 2005, specific, quantified 5- and 10-year targets for water savings and the basis for the development of such goals. The goals established by industrial or mining water users under this paragraph are not enforceable.
- A description of the device(s) and/or method(s) within an accuracy of plus or minus 5.0 percent to be used in order to measure and account for the amount of water diverted from the source of supply.
- Leak-detection, repair, and accounting for water loss in the water distribution system.
- Application of state-of-the-art equipment and/or process modifications to improve water use efficiency.
- Any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

Beginning May 1, 2005, an industrial or mining water user shall review and update its water conservation plan, as appropriate, based on an assessment of previous 5- and 10-year targets and any other new or updated information. The industrial or mining water user shall review and update the next revision of its water conservation plan no later than May 1, 2009, and every five years after that date to coincide with LRWPG RWP update.

[2] Information in this subsection was obtained from the *Texas Administrative Code*, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.3

6.1.3 Agriculture[3]

A water conservation plan for agricultural use of water must provide information in response to the following subsections. If the plan does not provide information for each requirement, the agricultural water user must include in the plan an explanation of why the requirement is not applicable.

- For an individual agricultural user other than irrigation:
- A description of the use of the water in the production process, including how the water is diverted and transported from the source(s) of supply, how the water is utilized in the production process, and the estimated quantity of water consumed in the production process and, therefore, unavailable for reuse, discharge, or other means of disposal.
- Until May 1, 2005, specification of conservation goals, the basis for the development of such goals, and a time frame for achieving the specified goals.
- Beginning May 1, 2005, specific, quantified 5- and 10-year targets for water savings and the basis for the development of such goals. The goals established by agricultural water users under this subparagraph are not enforceable.
- A description of the device(s) and/or method(s) within an accuracy of plus or minus 5.0 percent to be used in order to measure and account for the amount of water diverted from the source of supply.
- Leak-detection, repair, and accounting for water loss in the water distribution system.
- Application of state-of-the-art equipment and/or process modifications to improve water use efficiency.
- Any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

For an individual irrigation user:

- A description of the irrigation production process which shall include, but is not limited to, the type of crops and acreage of each crop to be irrigated, monthly irrigation diversions, any seasonal or annual crop rotation, and soil types of the land to be irrigated.
- A description of the irrigation method or system and equipment including pumps, flow rates, plans, and/or sketches of the system layout.

[3] Information in this subsection was obtained from the Texas Administrative Code, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.4

- A description of the device(s) and/or methods within an accuracy of plus or minus 5.0 percent to be used in order to measure and account for the amount of water diverted from the source of supply.

- Until May 1, 2005, specification of conservation goals including, where appropriate, quantitative goals for irrigation water use efficiency and a pollution abatement and prevention plan.

- Beginning May 1, 2005, specific, quantified 5- and 10-year targets for water savings including, where appropriate, quantitative goals for irrigation water use efficiency and a pollution abatement and prevention plan. The goals established by an individual irrigation water user under this subparagraph are not enforceable.

- Water-conserving irrigation equipment and application system or method including, but not limited to, surge irrigation, low pressure sprinkler, drip irrigation, and nonleaking pipe.

- Leak-detection, repair, and water-loss control.

- Scheduling the timing and/or measuring the amount of water applied (e.g., soil moisture monitoring).

- Land improvements for retaining or reducing runoff and increasing the infiltration of rain and irrigation water including, but not limited to, land leveling, furrow diking, terracing, and weed control.

- Tailwater recovery and reuse.

- Any other water conservation practice, method, or technique which the user shows to be appropriate for preventing waste and achieving conservation.

For a system providing agricultural water to more than one user:

- A system inventory for the suppliers:

    - Structural facilities including the supplier’s water storage, conveyance, and delivery structures.

    - Management practices, including the supplier’s operating rules and regulations, water pricing policy, and a description of practices and/or devices used to account for water deliveries.

    - A user profile including square miles of the service area, the number of customers taking delivery of water by the system, the types of crops, the types of irrigation systems, the types of drainage systems, and total acreage under irrigation, both historical and projected.

- Until May 1, 2005, specification of water conservation goals, including maximum allowable losses for the storage and distribution system.
- Beginning May 1, 2005, specific, quantified 5- and 10-year targets for water savings including maximum allowable losses for the storage and distribution system. The goals established by a system providing agricultural water to more than one user under this subparagraph are not enforceable.
- A description of the practice(s) and/or device(s) which will be utilized to measure and account for the amount of water diverted from the source(s) of supply.
- A monitoring and record management program of water deliveries, sales, and losses.
- A leak-detection, repair, and water loss control program.
- A program to assist customers in the development of on-farm water conservation and pollution prevention plans and/or measures.
- A requirement in every wholesale water supply contract entered into or renewed after official adoption of the plan (by either ordinance, resolution, or tariff), and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements in this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with applicable provisions of this chapter.
- Official adoption of the water conservation plan and goals, by ordinance, rule, resolution, or tariff, indicating that the plan reflects official policy of the supplier.
- Any other water conservation practice, method, or technique which the supplier shows to be appropriate for achieving conservation.
- Documentation of coordination with RWPGs in order to ensure consistency with appropriate approved regional water plans.

A water conservation plan prepared in accordance with the rules of the U.S. Department of Agriculture's NRCS, TSSWCB, or other federal or state agencies and substantially meeting the requirements of this section and other applicable commission rules may be submitted to meet application requirements in accordance with a memorandum of understanding between the commission and that agency.

Beginning May 1, 2005, an agricultural water user shall review and update its water conservation plan, as appropriate, based on an assessment of previous 5- and 10-year targets and any other new or updated information. An agricultural water user shall review and update the next revision of its water conservation plan no later than May 1, 2009, and every five years after that date to coincide with LRWPG RWP update.

6.1.4 Wholesale Water Providers[4]

A water conservation plan for a WWP must provide information in response to each of the following paragraphs. If the plan does not provide information for each requirement, WWP shall include in the plan an explanation of why the requirement is not applicable. All water conservation plans for WWPs must include the following elements:

- A description of the wholesaler's service area, including population and customer data, water use data, water supply system data, and wastewater data.
- Until May 1, 2005, specification of conservation goals including, where appropriate, target per capita water use goals for the wholesaler's service area, maximum acceptable unaccounted-for water, the basis for the development of these goals, and a time frame for achieving these goals.
- Beginning May 1, 2005, specific, quantified 5- and 10-year targets for water savings including, where appropriate, target goals for municipal use in gpcd for the wholesaler's service area, maximum acceptable unaccounted-for water, and the basis for the development of these goals. The goals established by wholesale water suppliers under this subparagraph are not enforceable.
- A description as to which practice(s) and/or device(s) will be utilized to measure and account for the amount of water diverted from the source(s) of supply.
- A monitoring and record management program for determining water deliveries, sales, and losses.
- A program of metering and leak detection and repair for the wholesaler's water storage, delivery, and distribution system.
- A requirement in every water supply contract entered into or renewed after official adoption of the water conservation plan, and including any contract extension, that each successive wholesale customer develop and implement a water conservation plan or water conservation measures using the applicable elements of this chapter. If the customer intends to resell the water, the contract between the initial supplier and customer must provide that the contract for the resale of the water must have water conservation requirements so that each successive customer in the resale of the water will be required to implement water conservation measures in accordance with applicable provisions of this chapter.

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[4] Information in this subsection was obtained from the *Texas Administrative Code*, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.5

- A reservoir systems operations plan, if applicable, providing for the coordinated operation of reservoirs owned by the applicant within a common watershed or river basin. The reservoir systems operations plans shall include optimization of water supplies as one of the significant goals of the plan.

- A means for implementation and enforcement, which shall be evidenced by a copy of the ordinance, rule, resolution, or tariff, indicating official adoption of the water conservation plan by the water supplier; and a description of the authority by which the water supplier will implement and enforce the conservation plan.

- Documentation of coordination with RWPGs for the service area of the wholesale water supplier in order to ensure consistency with the Lavaca Regional Water Plan.

Additional Conservation Strategies

Any combination of the following strategies shall be selected by WWP, in addition to the minimum requirements of paragraph (1) of this section, if they are necessary in order to achieve the stated water conservation goals of the plan. The commission may require by commission order that any of the following strategies be implemented by WWP if the commission determines that the strategies are necessary in order for the conservation plan to be achieved:

- Conservation-oriented water rates and water rate structures such as uniform or increasing block rate schedules, and/or seasonal rates, but not flat rate or decreasing block rates.

- A program to assist agricultural customers in the development of conservation pollution prevention and abatement plans.

- A program for reuse and/or recycling of wastewater and/or graywater.

- Any other water conservation practice, method, or technique which the wholesaler shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

Review and update requirements. Beginning May 1, 2005, WWP shall review and update its water conservation plan, as appropriate, based on an assessment of previous 5- and 10-year targets and any other new or updated information. WWP shall review and update the next revision of its water conservation plan no later than May 1, 2009, and every five years after that date to coincide with the Lavaca Regional Water Planning Group's RWP update.

6.1.5 Other Water Uses[5]

A water conservation plan for any other purpose or use not covered in this subchapter shall provide information where applicable about those practices, techniques, and technologies that will be used to reduce the consumption of water, prevent or reduce the loss or waste of water,

[5] Information in this subsection was obtained from the *Texas Administrative Code*, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.6

maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water.

Model water conservation plans specifically for the Lavaca Region were developed for each water use category and are located at the end of this chapter.

6.2 Drought Contingency Plan[6]

Drought contingency plans can be required by the TCEQ/TWDB for certain applicants and water rights' holders.

- The commission shall by commission rule require wholesale and retail public water suppliers and irrigation districts to develop drought contingency plans consistent with the appropriate approved regional water plan to be implemented during periods of water shortages and drought.

- The wholesale and retail public water suppliers and irrigation districts shall provide an opportunity for public input during preparation of their drought contingency plans and before submission of the plans to the commission.

Beginning in May 2005, the following are additional requirements in the drought contingency plan:

- Specific, quantified targets for water use reductions are to be achieved during periods of water shortages and drought. The entity preparing the plan shall establish the targets.

- The commission and the board by joint rule shall identify quantified target goals for drought contingency plans that wholesale and retail public water suppliers, irrigation districts, and other entities may use as guidelines in preparing drought contingency plans. Goals established under this subsection are not enforceable requirements.

The commission and the board jointly shall develop model drought contingency programs for different types of water suppliers that suggest BMPs for accomplishing the highest practicable levels of water use reductions achievable during periods of water shortages and drought for each specific type of water supplier.

6.2.1 Municipal Uses by Public Water Suppliers[7]

Drought contingency plans for retail public water suppliers, where applicable, and for public water suppliers, must include the following minimum elements.

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[6] Model drought contingency plans specifically for Lavaca Region were developed for each water use category and are located at the end of this chapter.

[7] Information in this subsection was obtained from the *Texas Administrative Code*, TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.20

- Preparation of the plan shall include provisions to actively inform the public and affirmatively provide opportunity for public input. Such acts may include, but are not limited to, having a public meeting at a time and location convenient to the public and providing written notice to the public concerning the proposed plan and meeting.

- Provisions shall be made for a program of continuing public education and information regarding the drought contingency plan.

- The drought contingency plan must document coordination with RWPGs for the service area of the retail public water supplier to ensure consistency with the appropriate approved regional water plans.

- The drought contingency plan must include a description of the information to be monitored by the water supplier and specific criteria for the initiation and termination of drought response stages, accompanied by an explanation of the rationale or basis for such triggering criteria.

- The drought contingency plan must include drought or emergency response stages providing for the implementation of measures in response to at least the following situations:

    - Reduction in available water supply up to a repeat of DOR.
    - Water production or distribution system limitations.
    - Supply source contamination.
    - System outage due to the failure or damage of major water system components (e.g., pumps).

- The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this subparagraph are not enforceable.

- The drought contingency plan must include the specific water supply or water demand management measures to be implemented during each stage of the plan including, but not limited to, the following:

    - Curtailment of nonessential water uses.
    - Utilization of alternative water sources and/or alternative delivery mechanisms with the prior approval of the executive director as appropriate (e.g., interconnection with another water system, temporary use of a non-municipal water supply, use of reclaimed water for non-potable purposes, etc.).

- The drought contingency plan must include the procedures to be followed for the initiation or termination of each drought response stage, including procedures for notification of the public.

- The drought contingency plan must include procedures for granting variances to the plan.

- The drought contingency plan must include procedures for the enforcement of mandatory water use restrictions, including specification of penalties (e.g., fines, water rate surcharges, discontinuation of service) for violations of such restrictions.

Privately owned water utilities shall prepare a drought contingency plan in accordance with this section and incorporate such plan into their tariff.

Any water supplier that receives all or a portion of its water supply from another water supplier shall consult with that supplier and shall include in the drought contingency plan appropriate provisions for responding to reductions in that water supply. A wholesale or retail water supplier shall notify the executive director within five business days of the implementation of any mandatory provisions of the drought contingency plan.

The retail public water supplier shall review and update, as appropriate, the drought contingency plan, at least every five years, based on new or updated information, such as the adoption or revision of the Lavaca Regional Water Plan.

6.2.2 Irrigation Uses[8]

A drought contingency plan for an irrigation use, where applicable, must include the following minimum elements. Drought contingency plans for irrigation water suppliers must include policies and procedures for the equitable and efficient allocation of water on a pro rata basis during times of shortage in accordance with *Texas Water Code, §11.039*. Drought contingency plans for irrigation water suppliers should include at a minimum the following information:

- Preparation of the plan shall include provisions to actively inform and to affirmatively provide opportunity for users of water from the irrigation system to provide input into the preparation of the plan and to remain informed of the plan. Such acts may include, but are not limited to, having a public meeting at a time and location convenient to the water users and providing written notice to the water users concerning the proposed plan and meeting.

- The drought contingency plan must document coordination with the RWPGs to ensure consistency with the appropriate approved regional water plans.

[8] Information in this subsection was obtained from the *Texas Administrative Code*, specifically TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.21

- The drought contingency plan must include water supply criteria and other considerations for determining when to initiate or terminate water allocation procedures, accompanied by an explanation of the rationale or basis for such triggering criteria.

- The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this subparagraph are not enforceable.

- The drought contingency plan must include methods for determining the allocation of irrigation supplies to individual users.

- The drought contingency plan must include a description of the information to be monitored by the water supplier and the procedures to be followed for the initiation or termination of water allocation policies.

- The drought contingency plan must include procedures for use in accounting during the implementation of water allocation policies.

- The drought contingency plan must include policies and procedures, if any, for the transfer of water allocations among individual users within the water supply system or to users outside the water supply system.

- The drought contingency plan must include procedures for the enforcement of water allocation policies, including specification of penalties for violations of such policies and for wasteful or excessive use of water.

- Wholesale water customers. Any irrigation water supplier that receives all or a portion of its water supply from another water supplier shall consult with that supplier, and shall include in the drought contingency plan appropriate provisions for responding to reductions in that water supply.

- Protection of public water supplies. Any irrigation water supplier that also provides or delivers water to a public water supplier(s) shall consult with that public water supplier(s) and shall include in the plan, mutually agreeable and appropriate provisions to ensure an uninterrupted supply of water necessary for essential uses relating to public health and safety. Nothing in this provision shall be construed as requiring the irrigation water supplier to transfer irrigation water supplies to non-irrigation use on a compulsory basis or without just compensation.

Irrigation water users shall review and update, as appropriate, the drought contingency plan at least every five years, based on new or updated information such as adoption or revision of the Lavaca RWP.

6.2.3 Wholesale Water Providers[9]

A drought contingency plan for a WWP should include at a minimum the following information:

- Preparation of the plan shall include provisions to actively inform the public, to affirmatively provide opportunity for user input in the preparation of the plan and for informing wholesale customers about the plan. Such acts may include, but are not limited to, having a public meeting at a time and location convenient to the public and providing written notice to the public concerning the proposed plan and meeting.

- The drought contingency plan must document coordination with LRWPG for the service area of WWP to ensure consistency with the Lavaca Regional Water Plan.

- The drought contingency plan must include a description of the information to be monitored by the water supplier and specific criteria for the initiation and termination of drought response stages, accompanied by an explanation of the rationale or basis for such triggering criteria.

- The drought contingency plan must include a minimum of three drought or emergency response stages providing for the implementation of measures in response to water supply conditions during a repeat of DOR.

- The drought contingency plan must include the procedures to be followed for the initiation or termination of drought response stages, including procedures for notification of wholesale customers regarding the initiation or termination of drought response stages.

- The drought contingency plan must include specific, quantified targets for water use reductions to be achieved during periods of water shortage and drought. The entity preparing the plan shall establish the targets. The goals established by the entity under this paragraph are not enforceable.

- The drought contingency plan must include the specific water supply or water demand management measures to be implemented during each stage of the plan including, but not limited to, the following:

    - Pro rata curtailment of water deliveries to or diversions by wholesale water customers as provided in *Texas Water Code §11.039*
    - Utilization of alternative water sources with the prior approval of the executive director as appropriate (e.g., interconnection with another water system, temporary use of a non-municipal water supply, use of reclaimed water for non-potable purposes, etc.).

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[9] Information in this subsection was obtained from the *Texas Administrative Code*, specifically TAC Title 30 Part 1 Chapter 288 Subchapter A Rule 288.22

- The drought contingency plan must include a provision in every wholesale water contract entered into or renewed after adoption of the plan, including contract extensions, that in case of a shortage of water resulting from drought, the water to be distributed shall be divided in accordance with *Texas Water Code, §11.039.* The drought contingency plan must include procedures for granting variances to the plan.

- The drought contingency plan must include procedures for the enforcement of any mandatory water use restrictions, including specification of penalties (e.g., liquidated damages, water rate surcharges, discontinuation of service) for violations of such restrictions.

WWP shall notify the executive director within five business days of the implementation of any mandatory provisions of the drought contingency plan. WWP shall review and update, as appropriate, the drought contingency plan at least every five years, based on new or updated information such as adoption or revision of the Lavaca RWP.

Model Water Conservation Plan Template

Municipal Uses

Model Water Conservation Plan Template – Municipal Uses
Introduction and Background

Brief introduction describing WUG, its provided services, and general information.

1. Purpose

Purpose is to identify and establish principles, practices, and standards to effectively conserve and efficiently use available water supplies and water distribution system capacity.

Possibly provide historical annual average residential water demands and the goals for reductions in municipal demand included in the plan.

2. Location

General location of WUG and its service area

3. Customer Data

Population and Service Area Data

- Provide CCN certificate (if applicable) from TCEQ and service area map.
- Provide service area size in square miles.
- Provide current population of service area.
- Provide current population served by utility (water, wastewater, etc.).
- Provide population served by utility for previous five years.
- Provide projected population for service area for 2010, 2020, 2030, 2040, 2050.
- Provide source/method of calculating current and projected populations.

Active Connections

- Provide current number of active connections by user type and whether they are metered or not-metered (Metered Residential, Not-metered Residential, Metered Commercial, Not-metered Commercial, Metered Industrial, Not-metered Industrial, Metered Public, Not-metered Public, Metered Other, Not-metered Other).
- Provide net number of new connections/year for most recent three years by user type.

High Volume Customers

- Provide annual water use for five highest volume retail and wholesale customers indicating if treated or raw water delivery.

4. Water Use Data

Water Accounting Data

- Provide amount of water use monthly for previous five years in 1,000 gallons and indicate whether the water is raw water diverted or treated water distributed.
- Provide source/method of obtaining monthly water use for previous five years.
- Provide amount of water in 1,000 gallons delivered as recorded by user type (residential, commercial, industrial, wholesale, other).
- Provide previous five year records for unaccounted for water use.
- Provide previous five year records for annual peak-to-average daily use ratio.
- Provide municipal per capita water use for previous five years.
- Provide seasonal water use for previous five years (gpd).

Projected Water Demands

- Provide total water demand estimates for utility's planning horizon indicating data sources/methods for determining water demand.

- Discuss conservation measures already implemented, if any, including impacts of measures and methods of determination of impacts.

5. Water Supply System

Water Supply Sources

- Provide current water supply sources and amounts available for surface water, groundwater, contracts, and other.

Treatment and Distribution System

- Provide design daily system capacity.
- Provide storage capacity (elevated and ground).
- Provide description of water system including number of treatment plants, wells, storage tanks along with sketch of system.

- Provide estimates of time before additional facilities for supply, storage, and pumping will be needed without conservation measures.

6. Wastewater Utility System

Wastewater System Data

- Provide design capacity of wastewater treatment plant.
- Provide description of wastewater system in service area including TCEQ name, number of treatment plants, operator, owner, receiving stream of discharge if applicable.
- Provide sketch of plant and discharge point locations

Wastewater Data for Service Area

- Provide percent of water service area served by wastewater system.
- Provide monthly volume treated for previous three years.
- Provide quality information on treatment plant effluent for reuse applications.
- Determine ratio between treated water pumped and wastewater flow.

7. Utility Operating Data

Water and wastewater rates/ rate structure for all classes – provide list of rates

(Rates should be cost-based so that they do not promote the excessive use of water)

Other relevant data

8. Water Conservation Goals

Goals for municipal utilities established to maintain/reduce consumption measured in:

- Gallons per capita per day used
- Unaccounted for water uses
- Peak day to average day ratio
- Increase in reuse or recycling of water

TCEQ/TWDB will assess conservation goals based on whether the following is addressed:

- Identification of a water/wastewater problem
- Completion of utility profile

- Selection of goals based on technical potential to save water as in utility profile
- Performance of cost-benefit analysis of strategies

Complete following (in gpcd) to quantify conservation goals for utility's service area:

Estimation for reducing per capita water use:

- Reduction in unaccounted-for uses
- Reduction in indoor water use due to water-conserving plumbing fixtures
- Reduction in seasonal use
- Reduction in water use due to public education program

Planning goal (Specific quantified five and ten year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita day)

A schedule for implementing the plan to achieve the applicant's targets and goals

Needed reduction in per capita to meet planning goal

9. Water Conservation Plan Elements – Other Programs/BMPs That Should be Part of the Conservation Plan

Supplier:

A method for tracking the implementation and effectiveness of the plan

Metering Program

- A master meter(s) to measure and account for the amount of water diverted from the source of supply
- A program for universal metering of both customer and public uses of water, for meter testing and repair, and for periodic meter replacement)

Measures to Determine and Control Unaccounted for Water

- Measures to determine and control unaccounted-for uses of water (e.g., periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.)

Leak Detection and Repair (a program for leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water)

Reservoir System Operating Plan

Customer:

Education Programs

- Media Campaign
- School Programs
- Public Exhibitions

Water Rate Structure

Examples of programs/BMPs that could be considered in achieving the conservation goals:

Supplier:

- Plumbing and Landscape Ordinances
- Toilet Replacement/Rebates
- Clothes Washer Replacement/Rebates
- Hot-on-demand Rebate – circulating pumps installed to reduce water waste while waiting for the water to get warm
- Refrigerated Air Conditioning Cash Rebate
- Rain Barrel Rebate
- Rainwater Harvesting Program
- Efficient Irrigation Rebate

Customer:

- Reuse and Recycling of Wastewater and Graywater

10. Regional Water Planning and Coordination

11. Authority and Adoption

- Means of implementation and enforcement

Model Water Conservation Plan Template
Industrial and Mining Uses

Model Water Conservation Plan Template – Industrial and Mining Uses
Introduction and Background

Brief introduction describing WUG, its provided services, and general information.

1. Purpose

Purpose is to identify and establish principles, practices, and standards to effectively conserve and efficiently use available water supplies and water distribution system capacity.

Possibly provide historical annual average Industrial or Mining water demands and the goals for industrial or mining water demand reduction included in the plan. (The water conservation plan 5- and 10-year targets should be discussed in *Section 1.4 – Water Conservation Plan Goals*).

2. Location

General location of WUG and its service area

3. Water Use Data

Water Accounting Data

- Description of the use of the water in the production process, including how the water is diverted and transported from the source(s) of supply, how the water is utilized in the production process, and estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal.

Projected Water Demands

- Provide total water demand estimates for utility's planning horizon indicating data sources/methods for determining water demand.

- Discuss conservation measures already implemented, if any, including impacts of measures and methods of determination of impacts.

4. Water Conservation Goals

Planning goal (Specific quantified five and ten year targets for water savings to include goals for water loss programs and goals for industrial and mining uses).

A schedule for implementing the plan to achieve the applicant's targets and goals.

Needed reduction in gallons per day (gpd) to meet planning goal.

5. Water Conservation Plan Elements –Other Programs/BMPs that should be part of the conservation plan

A method for tracking the implementation and effectiveness of the plan

Metering Program

- A master meter(s) (accurate to within plus or minus 5 percent) to measure and account for the amount of water diverted from the supply source

Measures to Determine and Control Unaccounted for Water

- Measures to determine and control unaccounted-for uses of water (e.g., periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.)

Leak Detection and Repair (a program for leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water)

List any application of state-of-the-art equipment and/or process modifications to improve water use efficiency

Examples of programs/BMPs that could be considered in achieving the conservation goals:

- Industrial Water Audit
- Industrial Water Waste Reduction
- Industrial Submetering
- Cooling Towers
- Cooling Systems (other than cooling towers)
- Industrial Alternative Sources and Reuse of Process Water
- Rinsing/Cleaning
- Water Treatment
- Boiler and Steam Systems
- Refrigeration (including chilled water)
- Once through Cooling
- Management and Employee Programs

- Industrial Landscape
- Industrial Site Specific Conservation

6. Regional Water Planning and Coordination

Beginning May 1, 2005, an industrial or mining water user shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The industrial or mining water user shall review and update the plan with the next revision of this water conservation plan coinciding with the Lavaca regional water planning process.

Model Water Conservation Plan Template

Agricultural Uses

Model Water Conservation Plan Template – Agricultural Uses
Introduction and Background

Brief introduction describing WUG, its provided services, and general information

1. Purpose

Purpose is to identify and establish principles, practices, and standards to effectively conserve and efficiently use available water supplies and water distribution system capacity.

Possibly provide historical annual average agricultural water demands and the goals for reduction in agricultural water demand included in the plan.

2. Location and General Information

General location of WUG and its service area

System Providing Agricultural Water to More Than One User

- System Inventory for the Suppliers facilities including water storage, conveyance, and delivery structures. Also discuss the operating practices and rules as well as water pricing policy. Accounting practices for the water should be briefly discussed.

- User profile including square miles of the service area, the number of customers taking delivery of water by the system, the types of crops, the types of irrigation systems, the types of drainage systems, and total acreage under irrigation, both historical and projected.

3. Water Use Data

Water Accounting Data

Agricultural User Other than Irrigation

- Description of the use of the water in the production process, including how the water diverted and transported from the source(s) of supply, how the water is utilized in the production process, and estimated quantity of water consumed in the production process and therefore unavailable for reuse, discharge, or other means of disposal.

Individual Irrigation User

- Description of the irrigation production process, including type of crops to be irrigated, monthly irrigation diversions, any seasonal or annual crop rotation, and soil types of the land to be irrigated.

- A description of the irrigation method or delivery system and equipment including pumps, flow rates, plans, and/or schematics of the system layout.

All Agricultural Users

Projected Water Demands

- Provide total water demand estimates for utility's planning horizon indicating data sources/methods for determining water demand
- Discuss conservation measures already implemented, if any, including impacts of measures and methods for determination of impacts.

4. Water Conservation Goals

All Agricultural Users

- Planning goal (Specific, quantified five-year and ten-year targets for water savings including, where appropriate, quantitative goals for irrigation/agricultural water use efficiency and a pollution abatement and prevention plan. The targets established by a water user under this section are not enforceable.

5. Water Conservation Plan Elements –Other Programs/BMPs That Should be Part of the Conservation Plan

All Agricultural Users

- A method for tracking the implementation and effectiveness of the plan
- Metering Program
    - A master meter(s) or other **device/method** (accurate to within +/- 5 percent) to measure and account for the amount of water diverted from the source of supply.
- Measures to Determine and Control Unaccounted for Water
    - Measures to determine and control unaccounted-for uses of water (e.g., periodic visual inspections along distribution lines and canals; annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.)
- Leak Detection and Repair (a program for leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control unaccounted-for uses of water)

Agricultural User Other than Irrigation

- List any application of state-of-the-art equipment and/or process modifications to improve water use efficiency

- Any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

Individual Irrigation User

- Water-conserving irrigation equipment and application system or method including surge irrigation, low-pressure sprinkler, lining of on-farm irrigation ditches, and non-leaking pipe are a few examples of equipment to aid in conservation. List all conservation measures utilized to conserve water.

- Scheduling the timing and/or measuring the amount of water applied (e.g., soil moisture monitoring, etc.)

- Land improvements for retaining or reducing runoff, and increasing the infiltration of rain and irrigation water including, but not limited to, land leveling, furrow diking, terracing, and weed control

- Tailwater recovery and reuse

- Any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

System Providing Agricultural Water to More Than One User

- Monitoring and record management program of water deliveries, sales, and loses.

- A program to assist customers in the development of on-farm water conservation and pollution prevention plans and/or measures.

- Any other water conservation practice, method, or technique which the user shows to be appropriate for achieving the stated goal or goals of the water conservation plan. Lining of district irrigation canals and replacement of canals with pipelines are a few examples of measures to aid in conservation.

- The customers of the agricultural water provider should also develop a water conservation plan or implement water conservation measures.

6. Regional Water Planning and Coordination

System Providing Agricultural Water to more than one User

- Beginning May 1, 2005, an agricultural water user shall review and update its water conservation plan, as appropriate, based on an assessment of previous five-year and ten-year targets and any other new or updated information. The industrial or mining water user shall review and update the plan with the next revision of this water conservation plan coinciding with the regional water planning process.

7. Adoption of Plan

Official adoption of the water conservation plan and goals, by ordinance, rule, resolution, or tariff, indicating that the plan reflects official policy.

A review and update of this plan should occur in conjunction with the regional water planning groups update of the Lavaca Regional Water Plan as well as modify the five and ten-year targets modified as necessary.

Model Water Conservation Plan Template

Wholesale Water Providers

Model Water Conservation Plan Template – Wholesale Water Providers
Introduction and Background

Brief introduction describing WWP, its provided services, and general information.

1. Purpose

Purpose is to identify and establish principles, practices, and standards to effectively conserve and efficiently use available water supplies and water distribution system capacity.

Possibly provide historical annual average residential water demands and the goals for reduction in water demands included in the plan.

2. Location

General location of WWP and its service area

3. Customer Data

Population and Service Area Data

- Provide CCN certificate from TCEQ and service area map
- Provide service area size in square miles
- Provide current population of service area
- Provide current population served by utility (water, wastewater, etc.)
- Provide population served by utility for previous five years
- Provide projected population for service area for 2010, 2020, 2030, 2040, 2050
- Provide source/method of calculating current and projected populations

Active Connections

- Provide current number of active connections by user type and whether they are metered or not-metered (Metered Residential, Not-metered Residential, Metered Commercial, Not-metered Commercial, Metered Industrial, Not-metered Industrial, Metered Public, Not-metered Public, Metered Other, Not-metered Other)
- Provide net number of new connections/year for most recent three years by user type

High Volume Customers

- Provide annual water use for five highest volume retail and wholesale customers indicating if treated or raw water delivery

4. Water Use Data

Water Accounting Data

- Provide amount of water use monthly for previous five years in 1,000 gallons and indicate whether the water is raw water diverted or treated water distributed
- Provide source/method of obtaining monthly water use for previous five years
- Provide amount of water in 1,000 gallons delivered as recorded by user type (residential, commercial, industrial, wholesale, other)
- Provide previous five year records for unaccounted for water use
- Provide previous five year records for annual peak-to-average daily use ratio
- Provide municipal per capita water use for previous five years
- Provide seasonal water use for previous five years (gpd)

Projected Water Demands

- Provide total water demand estimates for utility's planning horizon indicating data sources/methods for determining water demand
- Discuss conservation measures already implemented, if any, including impacts of measures and methods of determination of impacts.

5. Water Supply System

Water Supply Sources

- Provide current water supply sources and amounts available for surface water, groundwater, contracts, and other

Treatment and Distribution System

- Provide design daily system capacity
- Provide storage capacity (elevated and ground)

- Provide description of water system including number of treatment plants, wells, storage tanks along with sketch of system

- Provide estimates of time before additional facilities for supply, storage, and pumping will be needed without conservation measures.

6. Wastewater Utility System

Wastewater System Data

- Provide design capacity of wastewater treatment plant

- Provide description of wastewater system in service area including TCEQ name, number of treatment plants, operator, owner, receiving stream of discharge if applicable.

- Provide sketch of plant and discharge point locations

Wastewater Data for Service Area

- Provide percent of water service area served by wastewater system
- Provide monthly volume treated for previous three years
- Provide quality information on treatment plant effluent for reuse applications
- Determine ratio between treated water pumped and wastewater flow

7. Utility Operating Data

Water and wastewater rates/ rate structure for all classes – provide list of rates

(Rates should be cost-based so that they do not promote the excessive use of water)

Other relevant data

8. Water Conservation Goals

Goals for WWPs established to maintain/reduce consumption measured in

- Gallons per capita per day used
- Unaccounted for water uses
- Peak day to average day ratio
- Increase in reuse or recycling of water

TCEQ/TWDB will assess conservation goals based on whether the following is addressed:

- Identification of a water/wastewater problem
- Completion of utility profile
- Selection of goals based on technical potential to save water as in utility profile
- Performance of cost-benefit analysis of strategies

Complete following (in gpcd) to quantify conservation goals for WWP's service area:

- Estimation for reducing per capita water use:
    - Reduction in unaccounted-for uses
    - Reduction in indoor water use due to water-conserving plumbing fixtures
    - Reduction in seasonal use
    - Reduction in water use due to public education program
- Planning goal (Specific quantified five and ten year targets for water savings to include goals for water loss programs and goals for municipal use, in gallons per capita day)
- A schedule for implementing the plan to achieve the applicant's targets and goals
- Needed reduction in per capita to meet planning goal

9. Water Conservation Plan Elements – Other Programs/BMPs That Should be Part of the Conservation Plan

Supplier:

- A method for tracking the implementation and effectiveness of the plan
- Metering Program
    - A master meter(s) to measure and account for the amount of water diverted from the source of supply
- Measures to Determine and Control Unaccounted for Water
    - Measures to determine and control unaccounted-for uses of water (e.g., periodic visual inspections along distribution lines; annual or

monthly audit of the water system to determine illegal connections, abandoned services, etc.)

- Leak Detection and Repair (a program for leak detection, repair, and water loss accounting for the water storage, delivery, and distribution system in order to control unaccounted-for uses of water)

- Reservoir System Operating Plan

    - Water Rate Structure (should be conservation oriented)

- Program to assist agricultural customers in the development of conservation pollution prevention and abatement plans.

- Program for Reuse and Recycling of Wastewater and Greywater (if not feasible explain why)

- Any other conservation measure which the WWP shows to be appropriate for achieving the stated goal or goals of the water conservation plan.

10. Regional Water Planning and Coordination

11. Authority and Adoption

Means of implementation and enforcement

Model Drought Contingency Plan Template

Utility/Water Supplier

Model Drought Contingency Plan Template (Utility / Water Supplier)
Brief Introduction and Background

Include information such as

- Name of Utility
- Address, City, Zip Code
- CCN#
- PWS #s

Section 1 Declaration of Policy, Purpose, and Intent

In cases of extreme drought, periods of abnormally high usage, system contamination, or extended reduction in ability to supply water due to equipment failure, temporary restrictions may be instituted to limit nonessential water usage. The purpose of the Drought Contingency Plan (Plan) is to encourage customer conservation in order to maintain supply, storage, or pressure or to comply with the requirements of a court, government agency or other authority.

Water uses regulated or prohibited under this Drought Contingency 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 6* of this plan.

(**Please note:** Water restriction is not a legitimate alternative if a water system does not meet the Texas Commission on Environmental Quality (TCEQ) capacity requirements under normal conditions **or** if the utility fails to take all immediate and necessary steps to replace or repair malfunctioning equipment.)

Section 2 Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the _____________ (name of utility/water supplier) by means of __________________ (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; see below for examples)

- *Scheduling and providing public notice of a public meeting to accept input on the Plan*

  The meeting took place at:

  Date: ________________

  Time: _____________

  Location: __________________________

- *Mailed survey with summary of results (attach survey and results)*
- *Bill insert inviting comment (attach bill insert)*
- *Other method* ____

Section 3 Public Education

_______________________________ (*name of utility/name of 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.

Drought plan information will be provided by:

(Check at least one of the following)

- ❑ *Public meeting*
- ❑ *Press releases*
- ❑ *Utility bill inserts*
- ❑ *Other* ____

Section 4 Coordination with Regional Water Planning Groups

The service area of the _______________________________ (*name of your utility/water supplier*) is located within the Lavaca Region. _____________________________ (*name of your utility/water supplier*) has mailed a copy of this Plan to the Lavaca Regional Water Planning Group.

Section 5 Notice Requirements

Written notice will be provided to each customer **prior to implementation or termination of each stage of the water restriction program**. Mailed notice must be given to each customer 72 hours prior to the start of water restriction. If notice is hand delivered, the utility cannot enforce the provisions of the plan for 24 hours after notice is provided. The written notice to customers will contain the following information:

the date restrictions will begin,

the circumstances that triggered the restrictions,

the stages of response and explanation of the restrictions to be implemented, and,

an explanation of the consequences for violations.

The utility must notify the TCEQ by telephone at (512) 239-4691, or electronic mail at *watermon@tceq.state.tx.us* prior to implementing Stage III and must notify in writing the Public Drinking Water Section at MC - 155, P.O. Box 13087, Austin, Texas 78711-3087 within five (5) working days of implementation including a copy of the utility's restriction notice. The utility must file a status report of its restriction program with the TCEQ at the initiation and termination of mandatory water use restrictions (i.e., Stages III and IV).

Section 6 Violations

First violation - The customer will be notified by written notice of their specific violation.

Subsequent violations:

After written notice, the utility may install a flow restricting device in the line to limit the amount of water which will pass through the meter in a 24-hour period. The utility may charge the customer for the actual cost of installing and removing the flow restricting device, not to exceed $50.00.

After written notice, the utility may discontinue service at the meter for a period of seven (7) days, or until the end of the calendar month, whichever is LESS. The normal reconnect fee of the utility will apply for restoration of service.

Section 7 Exemptions or Variances

The utility may grant any customer an exemption or variance from the drought contingency plan for good cause **upon written request**. A customer who is refused an exemption or variance may appeal such action of the utility in writing to the Texas Commission on Environmental Quality. The utility will treat all customers equally concerning exemptions and variances, and shall not discriminate in granting exemptions and variances. No exemption or variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

Section 8 Response Stages

Unless there is an immediate and extreme reduction in water production, or other absolute necessity to declare an emergency or severe condition, the utility will initially declare Stage I restrictions. If, after a reasonable period of time, demand is not reduced enough to alleviate outages, reduce the risk of outages, or comply with restrictions required by a court, government agency or other authority, Stage II may be implemented with Stage III to follow if necessary.

STAGE I - CUSTOMER AWARENESS

Stage I will begin:

Every April 1st, the utility will mail a public announcement to its customers. No notice to TCEQ required.

Stage I will end:

Every September 30th, the utility will mail a public announcement to its customers. No notice to TCEQ required.

Utility Measures:

This announcement will be designed to increase customer awareness of water conservation and encourage the most efficient use of water. A copy of the current public announcement on water conservation awareness shall be kept on file available for inspection by the TCEQ.

Voluntary Water Use Restrictions:

Water customers are requested to voluntarily limit the use of water for nonessential purposes and to practice water conservation.

STAGE II - VOLUNTARY WATER CONSERVATION:

Target: Achieve a ______ percent reduction in __________ (example: total water use, daily water demand, etc.)

The water utility will implement Stage II when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Well level reaches ___________ ft. mean sea level (msl)
- ☐ Overnight recovery rate reaches ___________ ft.
- ☐ Reservoir elevation reaches ___________ ft. (msl)
- ☐ Stream flow reaches ___________ cfs at USGS gage # __________
- ☐ Wholesale supplier's drought Stage II ____________________________________
- ☐ Annual water use equals _______ % of well permit/Water Right/purchased water contract amount
- ☐ Other ____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

☐ Drinking water treatment as % of capacity __________ %

☐ Total daily demand as % of pumping capacity __________ %

☐ Total daily demand as % of storage capacity __________ %

☐ Pump hours per day __________ hrs.

☐ Production or distribution limitations

☐ Other ____

Upon initiation and termination of Stage II, the utility will mail a public announcement to its customers. No notice to TCEQ required.

Requirements for Termination:

Stage II of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage II, Stage I becomes operative.

Utility Measures:

Visually inspect lines and repair leaks on a daily basis. Monthly review of customer use records and follow-up on any that have unusually high usage.

Describe additional measures, if any, to be implemented directly by the utility 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.

The second water source for ____________________________ (*name of utility*) is: (check one)

☐ Other well
☐ Inter-connection with other system
☐ Purchased water
☐ Other
____

Voluntary Water Use Restrictions:

Restricted Hours: Outside watering is allowed daily, but only during periods specifically described in the customer notice; between 10:00 p.m. and 5:00 a.m. for example;

Restricted Days/Hours: Water customers are requested to voluntarily limit the irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems. Customers are requested to limit outdoor water use to **Mondays for water customers with a street address ending with the numbers 1, 2, or 3, Wednesdays for water customers with a street address ending with the numbers 4, 5, or 6, and Fridays for water customers with a street address ending with the numbers 7, 8, 9, or 0.** Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system; or

Other uses that waste water such as water running down the gutter.

STAGE III - MANDATORY WATER USE RESTRICTIONS:

Target: Achieve a ______ percent reduction in __________ (example: total water use, daily water demand, etc.)

The water utility will implement Stage III when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Well level reaches __________ ft. (msl)
- ☐ Overnight recovery rate reaches __________ ft.
- ☐ Reservoir elevation reaches __________ ft. (msl)
- ☐ Stream flow reaches __________ cfs at USGS gage # _________
- ☐ Wholesale supplier's drought Stage III ______________________________
- ☐ Annual water use equals _______ % of well permit/Water Right/purchased water contract amount
- ☐ Other ____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Drinking water treatment as % of capacity __________ %
- ☐ Total daily demand as % of pumping capacity __________ %
- ☐ Total daily demand as % of storage capacity __________ %
- ☐ Pump hours per day __________ hrs.
- ☐ Production or distribution limitations

☐ Other ____

Upon initiation and termination of Stage III, the utility will mail a public announcement to its customers. Notice to TCEQ required.

Requirements for Termination:

Stage III of the Plan may end when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage III, Stage II becomes operative.

Utility Measures:

Visually inspect lines and repair leaks on a regular basis. Flushing is prohibited except for dead end mains.

Describe additional measures, if any, to be implemented directly by the utility to manage limited water supplies and/or reduce water demand. Examples include: activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes; offering low-flow fixtures and water restrictors.

Mandatory Water Use Restrictions:

The following water use restrictions shall apply to all customers.

1. Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems **shall be limited to Mondays for water customers with a street address ending with the numbers 1, 2, or 3, Wednesdays for water customers with a street address ending with the numbers 4, 5, or 6, and Fridays for water customers with a street address ending with the numbers 7, 8, 9, or 0.** Irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet-filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

2. 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 rinses. 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 are contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

3. Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or "jacuzzi" type pool 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.

4. 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.

5. Use of water from hydrants or flush valves shall be limited to maintaining public health, safety, and welfare.

6. Use of water for the irrigation of golf courses, parks, and green belt area is prohibited except by hand-held hose and only on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight.

7. The following uses of water are defined as nonessential and are prohibited:

    a. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;

    b. use of water to wash down buildings or structures for purposes other than immediate fire protection;

    c. use of water for dust control;

    d. flushing gutters or permitting water to run or accumulate in any gutter or street;

    e. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and

    f. any waste of water.

STAGE IV - CRITICAL WATER USE RESTRICTIONS:

Target: Achieve a ______ percent reduction in __________ (example: total water use, daily water demand, etc.)

The water utility will implement Stage IV when any one of the selected triggers is reached:

Supply-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Well level reaches ___________ ft. (msl)
- ☐ Overnight recovery rate reaches ___________ ft.

- ☐ Reservoir elevation reaches ___________ ft. (msl)
- ☐ Stream flow reaches ___________ cfs at USGS gage # __________
- ☐ Wholesale supplier's drought Stage IV ____________________________________
- ☐ Annual water use equals _______ % of well permit/Water Right/purchased water contract amount
- ☐ Supply contamination
- ☐ Other ____

Demand- or Capacity-Based Triggers: (check at least one and fill in the appropriate value)

- ☐ Drinking water treatment as % of capacity ___________ %
- ☐ Total daily demand as % of pumping capacity ___________ %
- ☐ Total daily demand as % of storage capacity ___________ %
- ☐ Pump hours per day ___________ hrs.
- ☐ Production or distribution limitations
- ☐ System outage
- ☐ Other ____

Upon initiation and termination of Stage IV, the utility will mail a public announcement to its customers. Notice to TCEQ required.

Requirements for Termination:

Stage IV of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of three (3) consecutive days. Upon termination of Stage IV, Stage III becomes operative.

Operational Measures:

The utility shall visually inspect lines and repair leaks on a daily basis. Flushing is prohibited except for dead end mains and only between the hours of 9:00 p.m. and 3:00 a.m. Emergency interconnects or alternative supply arrangements shall be initiated. All meters shall be read as often as necessary to insure compliance with this program for the benefit of all the customers. *Describe additional measures, if any, to be implemented directly to manage limited water supplies and/or reduce water demand.*

Mandatory Water Use Restrictions: (all outdoor use of water is prohibited)

1. Irrigation of landscaped areas is absolutely prohibited.

2. Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

SYSTEM OUTAGE or SUPPLY CONTAMINATION

Notify TCEQ Regional Office immediately.

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. 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

Model Drought Contingency Plan Template

Irrigation Uses

Model Drought Contingency Plan Template (Irrigation Uses)

DROUGHT CONTINGENCY PLAN
FOR
(Name of irrigation district)
(Date)

Section 1: 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 2: 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 3: 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 4: 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 5: Application

The provisions for 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 6: Initiation of Water Allocation

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. Geologic 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).

Section 7: 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 8: 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 9: 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 users 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 10: 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 11: 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 12: 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 13: 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 14: 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 Directors

Model Drought Contingency Plan Template

Wholesale Water Providers

Model Drought Contingency Plan Template (**Wholesale Public Water Suppliers**)

DROUGHT CONTINGENCY PLAN
FOR THE
(Name of wholesale water supplier)
(Date)

Section 1: 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 water supplier) adopts the following Drought Contingency Plan (the Plan).

Section 2: Public Involvement

Opportunity for the public and wholesale water customers to provide input into the preparation of the Plan was provided by ______________ (name of 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 3: Wholesale Water Customer Education

The _____________ (name of 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 4: Coordination with Regional Water Planning Groups

The water service area of the _______________ (name of water supplier) is located within the ________________ (name of regional water planning area or areas) and the ______________ (name of water supplier) has provided a copy of the Plan to the _____________ (name of regional water planning group or groups).

Section 5: 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 6: Application

The provisions of this Plan shall apply to all customers utilizing water provided by the __________________ (name of supplier). The terms "person" and "customer" as used in the plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section 7: Triggering 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).

(a) Stage 1 - Mild Water Shortage Conditions

Requirements for initiation – The _____________ (name of 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. Geologic 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 Stage1 in the same manner as the notification of initiation of Stage 1 of the Plan.

(b) Stage 2 - Moderate Water Shortage Conditions

Requirements for initiation – The _____________ (name of 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 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.

(c) Stage 3 - Severe Water Shortage Conditions

Requirements for initiation – The _____________ (name of water supplier) will recognize that a severe water shortage condition exists when______________(describe triggering criteria).

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 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.

(d) Stage 4 – Emergency Water Shortage Conditions

Requirements for initiation - The _____________ (name of water supplier) will recognize that an emergency water shortage condition exists when______________(describe triggering criteria).

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 water supplier) will notify its wholesale customers and the media of the termination of stage 4.

Section 8: 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 - 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 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 - 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 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 - 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 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 – 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 9: 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 10: 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 11: 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 12: Severability

It is hereby declared to be the intention of the ________________ (governing body of 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 the water supplier) without the incorporation into this Plan of any such unconstitutional phrase, clause, sentence, paragraph, or section.

EXAMPLE ORDINANCE FOR ADOPTION OF A DROUGHT CONTINGENCY PLAN ORDINANCE NO. __________

AN ORDINANCE OF THE CITY OF ____________________, TEXAS, ADOPTING A DROUGHT CONTINGENCY PLAN; ESTABLISHING CRITERIA FOR THE INITIATION AND TERMINATION OF DROUGHT RESPONSE STAGES; ESTABLISHING RESTRICTIONS ON CERTAIN WATER USES; ESTABLISHING PENALTIES FOR THE VIOLATION OF AND PROVISIONS FOR ENFORCEMENT OF THESE RESTRICTIONS; ESTABLISHING PROCEDURES FOR GRANTING VARIANCES; AND PROVIDING SEVERABILITY AND AN EFFECTIVE DATE. WHEREAS, the City of _________________, Texas recognizes that the amount of water available to the City and its water utility customers is limited and subject to depletion during periods of extended drought; WHEREAS, the City 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 citizens of_____________, Texas, the ________________ (governing body) 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 ORDAINED BY THE CITY OF ____________, TEXAS:

SECTION 1. That the City of ____________, Texas 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 City.

SECTION 2. That all ordinances that are in conflict with the provisions of this ordinance be, and the same are hereby, repealed and all other ordinances of the City not in conflict with the provisions of this ordinance shall remain in full force and effect.

SECTION 3. Should any paragraph, sentence, subdivision, clause, phrase, or section of this ordinance be adjudged or held to be unconstitutional, illegal or invalid, the same shall not affect the validity of this ordinance as a whole or any part or provision thereof, other than the part so declared to be invalid, illegal or unconstitutional. SECTION 4. This ordinance shall take effect immediately from and after its passage and the publication of the caption, as the law in such cases provides. DULY PASSED BY THE CITY OF _______________, TEXAS, on the ___________ day of ______________, 20__.

APPROVED:

____

MAYOR

ATTESTED TO:

____

CITY SECRETARY

APPROVED AS TO FORM:

____

CITY ATTORNEY

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

CHAPTER 7

7. Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

LRWPG balanced meeting water needs with good stewardship of the water, agricultural, and natural resources within the region. However, 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 resulting strategies were found to be both beneficial from a cost-benefit perspective and helpful for maintaining in-stream flows during dry periods of the year.

Conjunctive use of groundwater along with surface water supplies was found to meet the needs of rice growers whose business is sensitive to the cost of irrigation water. The increased drawdown that will be experienced will increase the cost of producing rice in the area, but this effect will only be temporary. The additional groundwater that is estimated to be pumped will only occur if the DOR climate conditions occur during a cycle when maximum demand for rice is expected. In addition, the farmers who have a choice will use surface water when it is available in nearly all instances, since the cost of pumping surface water is less than the cost of pumping groundwater. Once DOR conditions end, interruptible surface water will be more readily available and surface water will then be used in place of groundwater wherever possible. This strategy would allow the groundwater levels in LRWPA to return to normal when the area is no longer experiencing DOR conditions. It is further noted that pumpage for agricultural irrigation during DOR will be all groundwater. No flow will be diverted from surface streams for irrigation during the drought conditions, and any return flows from irrigated agriculture would be a net benefit for in-stream flows that would, otherwise, be dry.

7.1 Water Resources Within the Lavaca Regional Water Planning Area

Water resources available by basin within LRWPA are discussed in further detail below. *Appendix 7A* includes a listing of current water rights' 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.

7.1.1 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.

7.1.2 Colorado-Lavaca Coastal River Basin

The sustainable yield of the portion of the Gulf Coast aquifer located in the Colorado-Lavaca River Basins of southern Jackson and Wharton Counties was found to be insufficient to meet the demands of irrigators under DOR conditions. Conjunctive use of groundwater and surface water supplies was recommended as a water management strategy to avoid shortages in irrigation categories in this region. 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 only contract surface water supply used within LRWPA is a 1,832 ac-ft/yr manufacturing contract within the Colorado-Lavaca River Basin. This water is supplied from Lake Texana and represents the only firm yield water supply allocated within this basin and the entire region that does not originate from the Gulf Coast aquifer.

7.1.3 Lavaca River Basin

As in the Colorado-Lavaca River Basin, groundwater resources were found to be inadequate to meet the demands of irrigation WUGs. Conjunctive use of groundwater and surface water supplies was recommended to relieve these shortages. This use of groundwater in excess of the sustainable yield would not be continued for an extended period of time.

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.

7.1.4 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.

7.1.5 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.

7.2 Agricultural Resources Within the Lavaca Regional Water Planning Area

LRWPA currently has nearly 53,149 ac of irrigated agricultural acreage that require nearly 220,000 ac-ft of water for irrigation. This demand is expected to decrease to approximately 195,000 ac-ft by 2060. The majority of this water is used for growing rice and represents, by far, the greatest water demand in the area. Because of this and the strong dependency of rice production on water supplies, this anticipated reduction in irrigation demand will significantly impact water demands for the region over the next 60 years.

Due to the strong dependency of rice production on water supplies and the sensitivity of agriculture to increased costs in water, LRWPG focused on economical and practical strategies for meeting water demands under DOR conditions. The least costly management strategy reviewed by the group, and the only strategy that would be economically feasible for agricultural usage, was temporary pumpage of groundwater in excess of reliable supplies to meet demands during drought conditions.

This temporary pumpage is vital for sustaining the rice industry in times of droughts. As discussed in *Chapter 5*, the specifics of rice farming make it difficult to convert land used for the growth of rice to the production of alternative crops that require less water. Furthermore, any reduction in rice growth brought about by limited water resources could have a significant impact on the infrastructure required by the industry and, in turn, the cost of producing the rice acreage that remains.

7.3 Natural Resources Within the Lavaca Regional Water Planning Area

The water management strategy recommended for LRWPA in this plan is intended to be a realistic option for meeting the projected water needs of the region while still responsibly protecting natural resources. Temporary overpumping of groundwater does not involve the issues regarding the interbasin transfer of water nor the inundation of land required for reservoir storage.

This strategy may hold some positive environmental benefit during droughts. This was examined in *Chapter 4* by estimating the return flows from rice fields during the months of June and July. As streamflows are typically low during this period, WAM for LRWPA reported that DOR conditions may cause streams to dry up in worst-case scenarios. The majority of irrigation is currently from groundwater sources, and all irrigation would be performed using groundwater in DOR, as no surface irrigation rights are firm in these 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 8

8. Unique Stream Segments, Reservoir Sites, and Legislative Recommendations

LRWPG has made the following recommendations regarding unique ecological stream segments (USS) and URSs. 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

LRWPG designated the Palmetto Bend Phase II reservoir site on the Lavaca River as URS. This site is currently permitted and awaiting funding in order for the project to move forward. The water supply created by the Palmetto Bend Phase II reservoir site was evaluated as one of the management strategies for the region's agricultural shortages.

No designation of USSs was made as LRWPG desired to have additional information on the potential impacts of such designation. Group members are still considering this designation process. *Appendix 8A* includes information from TPWD concerning USSs within LRWPA.

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 eight policy resolutions. These policy recommendations and rationales for the proposals are detailed below.

8.2.1 Environmental Issues

LRWPG has developed a water plan to address projected water demands within LRWPA. The development of the Palmetto Bend Stage II reservoir has been identified as a feasible water development strategy to address increasing demands for freshwater. 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 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.

8.2.4 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. It is noted that the Lavaca Regional Plan does allow short-term overpumping for temporary periods during drought conditions, but on a long-term basis, the aquifer will not be pumped beyond the sustainable yield.

8.2.5 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.

8.2.6 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 these 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 group supports the further efforts of these districts as a tool in protecting water resources in the Lavaca Regional Water Planning Area.

8.2.7 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.

8.2.8 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.

CHAPTER 9

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. The purpose of the report is to identify the funding needed to implement the water management strategies recommended in RWPs. The primary objectives of this chapter/report are:

- Determine the number of political subdivisions with identified needs that will be unable to finance their water infrastructure needs
- Determine the impacts upon the economy and social aspects of the region if these demands are not met by management strategies
- 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

LRWPA is somewhat unique in that there are no shortages for either the municipal or manufacturing user groups. The only user groups with shortages were irrigation users in Jackson and Wharton Counties. The socioeconomic impacts associated with a failure to meet the water demands of irrigated agriculture in Jackson County were estimated in the report, *Socioeconomic Impacts of Unmet Water Needs in Lavaca Regional Water Planning Area*, which is summarized below in *Section 9.2* and found in its entirety in *Appendix 9A*. It should be noted here that the impacts presented in this report are based on a shortage of just under 56,000 acre-feet annually of irrigation water. This amount of water represents approximately 34 percent of the total demand for these user groups in Jackson and Wharton Counties.

Irrigated agriculture has experienced a moderate decline from the high usage periods of the 1970s and early 1980s. Demand for irrigation water was higher during those times and many irrigation wells were deepened to accommodate the lowering water table and increased lift needed to bring water to the surface. The projected additional pumping lifts anticipated as a result of increased groundwater pumpage during DOR are still within the pumping levels that were experienced during those times of greater usage. As a result, it is anticipated that capital costs have already been incurred and would not be incurred again.

Even though the municipal WUGs in the planning area had no shortages, there was still a need to survey the water systems to determine if they had facilities that would reach the end of their usable life and have to be replaced in the near future. A survey was sent to all municipal WUGs with potential infrastructure needs, and the results of those surveys are summarized in *Section 9.3* of this chapter. The needs of agriculture within the LRWPA were also estimated in *Section 9.4* of this Chapter.

LRWPG reviewed the current role of the state in financing water supply projects and made recommendations for program increases and new initiatives in *Section 9.5* of this chapter.

9.2 Socioeconomic Impacts of Unmet Water Needs

TWDB prepared the report, *Socioeconomic Impacts of Unmet Water Needs in Lavaca Regional Water Planning Area*, along with corresponding reports for each of the other 15 regional water planning areas. The socioeconomic impacts within Jackson, Lavaca, and Wharton Counties were summarized in the report for LRWPA.

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 LRWPA, this portion of the report predicts what would occur if, in any given year, 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 2000 data using IMPLAN PRO™ distributed by the IMPLAN Group. This information is shown in *Table 9.1*. Additional information concerning baseline economic data can be found in *Appendix 9A.*

Impacts were only estimated for the portion of the Jackson and Wharton Counties irrigation WUGs that experienced the shortage. The portion of the irrigation demand that could be met with available firm supplies was assumed to experience no impact from the drought condition. Additionally, output elasticities were chosen to correlate the magnitude of the shortage as a percentage of the total demand to the resulting economic impact. 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 30 percent were expected to result in a 0.25 percent reduction in output for every 1 percent of unmet need. For shortages of between 30 and 50 percent and shortages greater than 50 percent, output elasticities were selected to show a 0.50 percent and a 1.0 percent reduction in output for each 1 percent increase in the WUG shortage, respectively.

Table 9.1
Year 2000 Economic Baseline for LRWPA

	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Irrigation	$6.97	$0.07	$6.90	358	$4.56	$0.44
% of Total	< 1%	< 1%	1%	2%	1%	1%
Livestock	$72.61	$14.44	$58.17	1,855	$33.01	$1.46
% of Total	5%	5%	5%	11%	5%	3%
Manufacturing	$521.13	$17.17	$503.96	3,929	$158.60	$3.93
% of Total	37%	6%	45%	22%	25%	8%
Mining	$44.20	$13.66	$30.53	87	$20.38	$2.39
% of Total	3%	5%	3%	0%	3%	5%
Steam Electric	$10.03	$2.77	$7.26	27	$7.17	$1.28
% of Total	1%	1%	1%	< 1%	1%	3%
Municipal	$745.07	$236.06	$509.02	11,230	$416.83	$37.36
% of Total	53%	83%	46%	64%	65%	80%
Total	**$1,400.01**	**$284.17**	**$1,115.84**	**17,488**	**$640.54**	**$46.98**
% of Total	100%	100%	100%	100%	100%	100%

Note: Figures are rounded; monetary figures are reported in millions of dollars.
Source: Generated using IMPLAN models and data from MIG, Inc.

The anticipated economic impacts associated with the water shortages calculated for Jackson County are shown in *Table 9.2*. Additional information concerning the economic impacts of unmet water needs can be found in *Appendix 9A.*

Table 9.2
Annual Economic Impacts of Unmet Water Needs for Irrigation in LRWPA

Year	Sales ($ millions)	Regional Income ($ millions)	Jobs	Business Taxes ($ millions)
2010	$4.71	$3.25	125	$0.36
2020	$4.35	$3.00	115	$0.33
2030	$3.61	$2.49	95	$0.28
2040	$2.94	$2.03	80	$0.23
2050	$2.33	$1.61	60	$0.18
2060	$1.57	$1.08	40	$0.12

Notes. Costs are shown in year 2000 dollars.
* Source: Based on economic impact models developed by the TWDB, Office of Water Planning.

The second component of the socioeconomic analysis is the social impact module. This portion of the study utilizes the economic data generated by the economic module to determine how changes in a region's economy due to water shortages could affect demographic factors such as population and school enrollment. However, no significant social changes were estimated by TWDB methodology due to the small magnitude of unmet water needs to total demands and the small economic impact described above.

9.3 Summary of Survey Responses

A survey was created and sent to the municipal WUGs within LRWPA in order to determine the anticipated infrastructure improvements over the next 60 years. This survey provided information regarding future water demands by decade for each municipality and TCEQ reported well capacity of the public water system. The water supply representatives were asked to assess the capabilities of their current systems and determine if additional infrastructure would be required to meet future demands. Additionally, the survey also allowed the representative to list anticipated well replacements that were scheduled in upcoming years. An example of this survey is shown in *Appendix 9B.*

One response was received from the City of Shiner that indicated the need for the addition of a new well in the future. As shown in the completed survey in *Appendix 9C*, the cost of this improvement was estimated to be $600,000. This expense was not noted in the *2002 LRWPG IFR* and was added to the anticipated cost of $19,631,000 for improvements to the City of Yoakum water system already included in the previous report. The resulting total anticipated capital cost of municipal improvements specified in the current and 2002 surveys was determined to be just over $20.2 million. It should be noted that these costs are only for the two municipalities that provided estimated costs on their completed survey forms. The need for several other improvements were indicated in the 2002 IFR but were not assigned a cost by the municipal water supply.

9.4 Potential Agricultural Improvements

As agricultural water use is the greatest water demand in LRWPA, consideration was also given to the potential cost of on-farm improvements to enhance water conservation. The cost of implementing such practices was recognized as a substantial amount that would require farmers to seek assistance to defray the cost of improvements. Currently, programs such as EQIP allow for matching funds for conservation improvements on an as-available basis. However, funding is limited, and farmers are often unable to afford the matching share for this program. For this reason, it is important to consider the cost of agricultural conservation practices for the development of future financial assistance programs that will assist agriculturally dominated regions such as LRWPA.

The anticipated costs of agricultural conservation improvements were estimated from the 1995-2000 planted rice acreage as reported by the National Agricultural Statistics Service (NASS) and several assumptions guided by past experience, the report *Potential Rice Irrigation Conservation Measures* prepared by James W. Stansel for the Region H Water Planning Group, and input from L. G. Raun, Jr., a rice farmer and member of LRWPG.

Table 9.3 was prepared using the average 1995-2000 planted rice acreage for LRWPA as presented in *Chapter 2*. It was assumed that this planted acreage was approximately one-third of the total rice acreage in the region as crops are generally grown on a 3-year rotation. Additionally, it was assumed that 25 percent of LRWPA's rice acreage had already received conservation improvements. Costs were taken from the report by Stansel and adjusted to 2nd Quarter 2002 with the cost-indices provided by the *Engineering News Record* (ENR). Costs for the replacement of irrigation ditches with pipeline were compiled assuming 20 feet of pipeline would be required per acre of rice. The total costs for agricultural improvements in LRWPA were found to total nearly $37 million.

Table 9.3
Estimated Cost of Agricultural Conservation Improvements for LRWPA

Improvement	Total Rice Acreage Requiring Improvements	Improvement Cost per Acre	Total Improvement Cost
Land Leveling	111,663	$108.15	$12,076,200
Multiple Inlets	111,663	$2.16	$241,500
Reduced Levee Interval	111,663	$0.54	$60,400
Irrigation Pipeline	111,663	$178.44	$24,152,300
		Total Cost	**$36,500,000**

9.5 Policy Recommendations

SB 2 of the 77th Texas Legislature directed each RWPG, to propose roles for the state to take in financing the recommended water supply projects. In the *2002 LRWPA IFR*, two recommendations was made to the Legislature regarding policies and programs that directly or indirectly funded water projects and water infrastructure. These recommendations are included below with current policy recommendations.

9.5.1 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. Detailed discussions of each program or policy are provided in the following sections.

As previously recommended, 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.

The State Revolving Fund (SRF) Programs 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. LRWPG recommends increased funding of this program in future decades.

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.

USDA's Rural Utilities Service offers water and waste disposal loans and grants to rural areas and towns of up to 10,000 people. Certain communities within Texas are specifically targeted for these grants. The LRWPG supports the continued and increased funding of this program at the federal level as well as the state Rural Water Assistance Fund at the state level.

As previously recommended, 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 provide research grants for the study of current and upcoming desalination technologies available to wholesale and retail water suppliers and continue to fund appropriate demonstration facilities and subsidize the use of these facilities to develop a customer base.

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. The LRWPG supports provision of increased research grants to study and better develop efficient irrigation practices and to develop of varieties of crops that require less water to grow and provide increased first-crop yields.

9.5.2 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 to individual irrigators.

EQIP, available through USDA, provides some limited funding to natural resources issues, including water quantity and availability. In 2005, Texas was allocated over $90 million in EQIP funds for projects including irrigation supply, brush control, water and air quality from livestock operations, wildlife, and invasive species. This amount has increased from nearly $79 million in 2004. 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.

9.5.3 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." TWDB has concluded desalination site assessments and is preparing to assist in the pilot studies of three demonstration facilities along the Texas Gulf Coast.

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 seawater 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.

CHAPTER 10

10. Public Participation

10.1 Introduction

LRWPG's 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, LRWPG has made a commitment to an open planning process and has actively solicited public input and involvement in developing the elements of RWP. This has been accomplished by pursuing several avenues to gain public involvement.

The first line of public involvement occurs through the membership of 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 LRWPA. 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 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. Several meetings were held with interested agricultural representatives to develop revisions to the irrigation demands. These meetings were developed as workshop sessions. All planning group meetings are open to members of the public in order to welcome public participation in the planning process. In addition, three of these meetings, corresponding with the development of the scope of work, population and water demands, and the draft plan public hearing were more widely advertised to the public. Presentation materials tailored to the particular interest groups were prepared for each of the events noted above.

Following the development of the 2006 Draft Regional Water Plan for LRWPA, four meetings were held to present the draft plan to the public and receive comments. Two public meetings were held in Hallettsville and El Campo followed by two public hearings in Edna.

Members of 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 2006 Planning Cycle in early 2003. 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 February 5, 2003, Meeting

LRWPG began the planning process by choosing a representative for LNRA, electing officers, and appointing a liaison to Region L. Draft population and demand projections were reviewed at this time. The group also reviewed the status of the TWDB Desalination Demonstration Project.

10.2.2 May 5, 2003, Meeting

In the first publicly advertised meeting, LRWPG reviewed and discussed agricultural demand data. Various alternative demand scenarios were discussed and input was received from attendees.

10.2.3 June 9, 2003, Meeting

Discussion was continued concerning agricultural demands, and the group decided to approve a methodology utilizing a 5-year average of past irrigated acreage to determine water demands.

10.2.4 September 29, 2003, Meeting

LRWPG moved to accept the resignation of one member of the group and the appointment of a new member. The group decided to approve the final water demand projections for irrigation with a minor revision.

10.2.5 November 3, 2003, Meeting

LRWPG moved to approve the population figures for the region and elect a member to the group.

10.2.6 March 22, 2004, Meeting

In a publicly advertised meeting, LRWPG reelected group officers along with other business pertinent to the planning process. Potential water management strategies were examined as well as policy issues and recommended control points for the Lavaca WAM.

10.2.7 January 31, 2005, Meeting

LRWPG moved to reelect the existing officers and discussed appointing new members. The group discussed several points including future TWDB planning initiatives, 2005 freshwater inflows to Matagorda Bay, USSs and URSs, and the Central Gulf Coast GAM results. The group reviewed the draft *Chapters 1* and *6*. The results of the preliminary irrigation return flow and water level monitoring initiatives were also reviewed.

10.2.8 February 28, 2005, Meeting

LRWPG appointed new voting members and approved the revised *Chapters 1, 2,* and *6* of the 2006 RWP. The group also reviewed the draft *Chapter 3* and the associated surplus and shortage analysis. Potential management strategies and policy recommendations were also reviewed, and a presentation was made concerning preliminary results of the impacts of irrigation return flows and agricultural conservation.

10.2.9 March 29, 2005, Meeting

LRWPG approved *Chapter 3* following minor revisions and proceeded to review *Chapters 4, 5*, and *8*. The final surpluses and shortages for all WUGs were also approved at this time.

10.2.10 April 25, 2005, Meeting

LRWPG moved to approve Plan *Chapters 4, 5*, and *8*. At this time, the Group also received presentations on *Chapters 7, 9,* and *10* and the anticipated format of the Executive Summary.

10.2.11 May 23, 2005, Meeting

LRWPG moved to approve Plan *Chapters 7, 9*, and *10.* The Executive Summary to the Plan was also approved at this time. The Draft Plan was approved for submittal to TWDB pending corrections recommended during discussion of the already approved chapters. Plans were also made for the distribution of copies of the Draft Plan to public locations in preparation for the public meeting and public hearing scheduled in June.

10.2.12 June 21, 2005, Public Meeting

A public meeting to present the Draft Plan was held in Hallettsville at the Lavaca County Courthouse. The LRWPG received comments from the audience.

10.2.13 June 23, 2005, Public Meeting

A public meeting to present the Draft Plan was held in El Campo at the El Campo Chamber of Commerce. There were no public comments from the audience.

10.2.14 June 29, 2005, Public Hearing

A public hearing to present the Draft Plan was held in Edna at the Jackson County Services Building. One public comment was taken form the audience.

10.2.15 August 17, 2005, Public Hearing

A public hearing to present the Draft Plan was held in Edna at the Jackson County Services Building. No public comments were received at the meeting.

10.3 Public Information Sources

TWDB hosts a website that contains information provided to them, as well as the listing of the LRWPG members. The address for that website is www.twdb.state.tx.us. Additionally, LNRA also maintains a website that contains the names and telephone numbers of all of the LRWPG members. That website address is http://lnra.org.