LAVACA-NAVIDAD RIVER AUTHORITY

WATER CONSERVATION PLAN

SEPTEMBER 2024

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PLAN OVERVIEW

1.0 INTRODUCTION

The Lavaca-Navidad River Authority (LNRA) is a conservation and reclamation district of the State of Texas, created in August 1959. LNRA is a body politic and corporate created and existing pursuant to Article XVI, Section 59 of the Texas Constitution and a series of acts formerly compiled as Article 8280-131, Vernon's Annotated Texas Civil Statutes (the "Act"), and is authorized and empowered under the Texas Constitution and the Act for the purposes of controlling, storing, preserving, and distributing the waters of the storm and flood waters and the waters of rivers and streams of Jackson County, Texas, for domestic, municipal, flood control, irrigation, agricultural, mining and recovery of minerals, hydroelectric power, navigation, recreation and pleasure, public parks, game preserves, and other useful purposes. LNRA is the only wholesale water provider in the Lavaca Basin. Protecting and improving the quality of the available water resources of the Lavaca River Basin for beneficial use by the public is also an important function of LNRA.

As shown in Figure 1, the boundaries of LNRA are coextensive with the boundaries of Jackson County, Texas

2.0 BASIN POPULATION

The Texas Water Development Board's (TWDB) 2021 Regional Water Plan Population Projections for 2020-2070 for Region P show an estimated population of 50,489 in year 2020 and an estimated population of 55,522 in year 2070. Population centers in the Lavaca River Basin include the Cities of Edna, Ganado, Hallettsville, Yoakum, Shiner, Schulenburg, and Moulton. See Table 1 showing population projections as collected as part of the Region P's efforts.

Although not located within the geographical boundary of the Lavaca River Basin, the City of Corpus Christi and Point Comfort are LNRA customers and receive water from Lake Texana. The City of Corpus Christi serves a seven (7) county area owned by the City.

3.0 CURRENT WATER USES

Lake Texana, has a conservation storage capacity of approximately 173,600 acre-feet, is the only major surface water reservoir in the Lavaca River Basin. The LNRA holds a water rights permit from the Texas Commission on Environmental Quality (TCEQ), which provides for a 74,500 acre-feet per year firm yield for Lake Texana and up to 12,000 acre-feet per year of interruptible water available for sale/use. In accordance with Certificates of Adjudication 16-2095E, the purposes for which this water is permitted are all beneficial uses. Other permit holders in the Lavaca River Basin have run-of-the-river rights and are permitted to divert up to approximately 63,000 acre-feet of stream flows annually for irrigation purposes. These rights are issued directly from TCEQ and are not administered through LNRA.

Historical records of water use in the Lavaca River Basin indicates the majority of water usage is for agricultural use, primarily irrigation. Irrigation water supplies within the Lavaca River Basin include groundwater, water rights permits from the Navidad and Lavaca Rivers, and water delivered from the Colorado River by the Lower Colorado River Authority's Garwood Irrigation District as irrigation water. Municipal and industrial water users in the Lavaca River Basin, not supplied by the LNRA, utilize groundwater as their primary water supply. See Table 2 showing projected water use in the Lavaca River Basin.

3.1 Municipal Water Use

Municipal water users include residences, commercial establishments, public offices, industries and institutions as defined by the rules of the TCEQ. As of 2019, the LNRA has raw water supply contracts with two municipal water customers, the City of Point Comfort (178 ac-ft/yr.) and the City of Corpus Christi (31,440 ac-ft/yr. Firm; 5,000 ac-ft/yr. Temporary; and 12,000 ac-ft/yr. interruptible).

The LNRA contracted with the City of Point Comfort in December 1994, to provide and deliver 168 acre-feet of raw water per year, which was amended in October 1996, for a total contracted diversion from Lake Texana of 178 acre-feet per year. In October 2001, Formosa Plastics Corporation changed the delivery point of 178 acre-feet per year from Formosa to the City of Point Comfort, giving the City a total of 356 acre-feet per year available for treatment. Deliveries of treated water to Point Comfort residences, businesses and industry began in February 1995. The City of Point Comfort assumed operations of the treatment plant on December14, 2012.

In December 1993, the LNRA contracted with the City of Corpus Christi (the "CCC") to provide and deliver 31,440 acre-feet per year of raw water on a permanent basis for their seven-county service area and 10,400 acre-feet per year on a temporary basis until such water is needed to supply demand in Jackson County. As part of the delivery system project, the LNRA constructed an intake pumping station near Edna, which it owns and operates, adjacent to Lake Texana. In July 2001, LNRA contracted with the CCC to provide up to 4,500 ac-ft/yr of water for use on an interruptible basis. In July 2003, the contract was amended to increase the interruptible water amount up to 12,000 ac-ft/yr. The CCC currently obtains raw water from Choke Canyon Reservoir, Lake Corpus Christi, and Lake Texana (firm and interruptible supplies). The CCC uses the interruptible supply from Lake Texana first when possible, in increments as available. This interruptible supply is available approximately 87% of the time. The CCC serves a significant industrial demand along its port area, and the scarcity of water available to the CCC in past years has driven these industries to a high level of conservation for them to continue to operate during periods of shortage. The CCC also encourages the use of reclaimed water but has not promoted this effort as aggressively as other cities because of return flow requirements to the Nueces River Estuary included in the Certificate of Adjudication issued for the construction of the Choke Canyon Dam and Reservoir. On January 7, 1999, the CCC finalized its purchase of 35,000 acre-feet/year of water from the Garwood Irrigation Company by obtaining a water right authorizing the CCC to divert the water from the Colorado River. In April, 2014 the CCC started construction

of a pumping plant at Bay City on the Colorado River along with a 41-mile pipeline (Mary Rhodes Phase II) from Bay City to the West Pump Station (WPS) at LNRA. They also constructed a 6,000 MG storage tank at the WPS. On May 25, 2016, the CCC started pumping water from the Colorado River to the WPS where it enters the West Delivery Pumping Plant which sends the water on to the CCC via the existing Mary Rhodes Phase I pipeline.

In 2018, LNRA recalled 5,400 acre-feet of water from CCC. In September 2020, LNRA recalled the remaining 5,400 acre-feet of water finalizing the recall provision made part of the 1994 agreement with the CCC. Currently LNRA is contracted with the CCC to provide and deliver 31,440 acre-feet per year of raw water on a permanent basis for their seven-county service area.

3.2 Industrial Water Use

Industrial water uses include chemical processing, manufacturing and steam electric power generation as defined by the rules of the TCEQ. Currently, LNRA has raw water supply contracts with three industrial water customers, Formosa Plastics Corporation (30,800 ac-ft/yr.), Inteplast Corporation (1,032 ac-ft/yr.), and Calhoun County Navigation District (594 ac-ft/yr.).

In May 1980, the LNRA contracted with Formosa Plastics Corporation to provide and deliver 5,000 acre-feet of water annually. The contract also called for the construction of a 15 mile, 36-inch pipeline and associated pumping plant. In April 1990, the LNRA again contracted with Formosa Plastics Corporation, for the construction of a 54-inch pipeline and together with the existing 36-inch pipeline, LNRA has the capacity to provide and deliver to Formosa Plastic Corporation 30,800 acre-feet of water annually. In July 2007, the contract was amended adding an additional 800 acre-feet of water bring the total volume to 30,800 acre-feet. Formosa Plastics was using approximately 80% percent of its contract allocation of 30,800 acre-feet per year. Formosa has implemented a highly successful program of water conservation through water reuse. Plant process water at Formosa Plastics is reused until the Total Dissolved Solids (TDS) concentration exceeds the plant process requirements. At this point, the process water is treated and discharged; and additional makeup water is introduced into the recycle stream. This has been highly successful for them, for instance, in 2017, Formosa used approximately 71.63% of its contract allocation of 30,800 acre-feet per year while increasing water use within the plant. In 2018, LNRA recalled 5,400 acre-feet of water from CCC and on January 11, 2018 sold this water to Formosa Plastics Corporation for use in their expansion plant in Jackson County. In September, 2020, LNRA contracted with Formosa for an additional 5,000 ac-ft/yr. Currently LNRA is contracted with Formosa Plastics Corporation to provide and deliver 46,200 acre-feet of water.

In October 1992, the LNRA contracted with Inteplast Corporation to provide and deliver 2000 acre-feet of water annually, which was reduced to 1,832 acre-feet annually in October 1994 and reduced a second time in July 2007 to the present volume of 1032 acre-feet. Inteplast Corporation also has a significant water reuse program. Like other industrial customers, process water is recycled and reused by Inteplast until the TDS concentration increases to an unacceptable level for process use and it becomes more cost effective to clean and discharge the waste stream.

In May 1995, the LNRA contracted with the Calhoun County Navigation District (CCND) for the purchase of 410 acre-feet annually, which was amended to 594 acre-feet annually in August 1996.

CCND are not utilizing their contracted industrial water allocations and does not have a water delivery system constructed from Lake Texana. As a result, there is no existing water conservation plan for CCND and will only be required by LNRA when they begin taking their contract water.

In September 1996, the LNRA contracted with the Central Power and Light Company (CPL) for the purchase of 56 acre-feet of water annually. In February 2005, the contract was terminated with the sale of the plant and cancellation of the water supply contract by the new owner. LNRA therefore has 56 acre-feet of firm water available for sale and use.

Currently, there is no water demand for electric power generation water in the Lavaca River Basin.

3.3 Irrigation Water Use

The Lavaca River Basin is primarily a rural area, having a large agricultural base. Total irrigation water usage of the agricultural industry for year 2020 has been projected as 175,636 acre-feet and is assumed to carry throughout the planning horizon. Major irrigated crops include rice, cotton, corn, milo, soybeans and turf grass. The primary irrigated crop in the basin was rice, using approximately 224,500 acre-feet of water annually, with approximately 90% percent being produced from groundwater sources. Currently, irrigation use is primarily used for row crops, including corn, milo, turf grass and cotton.

3.4 Other Water Uses

Mining and livestock uses account for approximately 9115 acre-feet of water annually, accounting for approximately two percent of the annual water use in the Lavaca River Basin.

4.0 WATER USES BY LNRA CUSTOMERS

Except for 56 acre-feet of water which is available for sale and use, all the permitted water of Lake Texana is under contract. LNRA has water supply contracts with the City of Corpus Christi (31,440 acre-feet/year on a permanent basis), Formosa Plastics Corporation (46,200 acre-feet/year), Inteplast Corporation (1,032 acre-feet/year), the Calhoun County Navigation District (594 acre-feet/year), and the City of Point Comfort (178 acre-feet/year) totaling 74,444 acre-feet per year. The remaining 4,500 acre-feet per year yield is reserved to cover the mandated releases for bay and estuarine needs. However, in those years when a surplus of water exists and all bay and estuary requirements are satisfied, an additional diversion up to 4,500 acre-feet per year may be available for sale on an interruptible basis. As indicated above, LNRA and the City of Corpus Christi have entered into a contract wherein LNRA will sell and make available to Corpus Christi, up to 12,000 acre-feet of water per year, for use by the City of Corpus Christi on an interruptible basis. The CCC can also use 35,000 acre-feet per year from the Colorado River.

5.0 CURRENT WATER SUPPLY

The primary surface water supplies in the Lavaca River Basin are the Lavaca River, the Navidad River, and Lake Texana. Currently, Lake Texana, located on the Navidad River, is the main surface water supply for LNRA. Lake Texana was designed to ensure that a dependable water

supply existed to support water requirements inherent with industrial and urban growth in the coastal region. LNRA's water right permit also allows from a second impoundment on the Lavaca River. LNRA is currently pursuing an alternative off channel approach to the authorized on-channel impoundment on the Lavaca River to instead allow the water to be pumped into Lake Texana and/or future Off-Channel Reservoir.

To better manage the water resources of the area, the LNRA has developed an updated *Water Resource Management Plan* for Lake Texana and LNRA's water rights on the Lavaca River to establish policies and guidelines for water resource management. This Water Conservation Plan and LNRA's Drought Contingency Plan have been made a part of the LNRA's *Water Resource Management Plan* as an appendix.

Groundwater supplies in the Lavaca River Basin are produced from the Carrizo and Gulf Coast Aquifers. The Gulf Coast Aquifer is the predominant groundwater source in the LNRA area, supplying more than 95% percent of the total water usage in the region. The largest single use of groundwater in the area is for irrigation purposes.

Currently, the Lavaca River Basin water supply is adequate for a variety of consumptive uses; however, water conservation is necessary to extend the usability of the existing supply.

6.0 OVERVIEW

Consistent with TCEQ regulations, all LNRA water customers are required by their respective water sales contract to prepare and submit Water Conservation and Drought Contingency Plans to the TCEQ. The LNRA recommends that its customers develop plans consistent with the LNRA Water Conservation Plan and trigger conditions as established in the LNRA Drought Contingency Plan.

The LNRA Water Conservation Plan provides its customers and communities with essential water conservation information, regulations and services. The plan will be reviewed every five years or less and updated based upon developments in the Lavaca River Basin and the LNRA service area.

The following sections discuss water conservation programs for LNRA water customers, the operation of Lake Texana, the LNRA Water Management Plan, and the LNRA Drought Contingency Plan.

Table 1: Projection Region P Water User Group (WUG) Population
Source: Texas Water Development Board 2021 Regional Water Plan Population Projection for 2020-2070

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

Table 2: Projected Water Use for Region P

Region P Water User Group (WUG) Category Summary

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

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

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

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

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

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

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

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

WATER CONSERVATION PLAN

1.0 INTRODUCTION

The objective of the Water Conservation Plan is to produce a permanent reduction in the quantity of water required through the implementation of efficient water supply and water use practices, and not elimination of use.

2.0 WATER CONSERVATION GOALS

The Water Conservation Plan for the Lavaca River Basin is consistent with LNRA's goals for water conservation and resource management. LNRA will provide technical assistance for water conservation and drought management for both municipal and industrial water users in the Lavaca River Basin.

The LNRA has both municipal and industrial water conservation target goals for their wholesale customers where appropriate which include:

1. Per capita water use of 150 gpcd for the year 2025 for its service area and maintain this through 2029. The basis for this goal is the projected per capita water demands developed by the TWDB for the most current State Water Plan. The per capita water demands are the total projected municipal water use within LNRA service area divided by the population within the service area and do not represent per capita water demand for a specific entity.

2. Limiting unaccounted-for-water from the customer's water distribution systems to no more than 15 percent of the volume of water delivered for the year 2025 and maintains unaccounted-for-water at no more than 15% through the year 2029.

3. Limiting unaccounted-for-water from the LNRA's water delivery systems to no more than 10 percent of the volume of water delivered to their wholesale customers for the year 2025 and maintain unaccounted-for-water at no more than 10% through the year 2029.

4. Reducing industrial water consumption 20% through the implementation and increased use of wastewater reuse/recycle programs for the year 2025 and maintain such reduction through the year 2029.

5.

   LNRA will add 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 Chapter 288.

6. Assisting the Region P Regional Water Planning Group in completing/implementing the Lavaca Regional Water Plan.

7. Pass-through water conservation goals, including where appropriate, target per capita water use, maximum acceptable unaccounted-for-water and a time frame for achieving these goals and specific quantifiable 5-year and 10-year goals, will be required as a part of each wholesale water customer's contract with the LNRA upon modification or extension.

2.1 Water Conservation Methods

The LNRA does not own or control any of the internal distributions systems of its wholesale water customers; therefore, the LNRA cannot mandate customer conservation methods. Each wholesale customer employs Best Management Practices (BMPs) to ensure the maximum economic benefit will be realized for their business and/or individual retail water customers. The LNRA does lend its full support to its customers in their conservation plans and has included the methods listed in those plans for achieving conservation goals.

Methods to be employed for achieving the customer's stated water conservation goals include leak detection and repair programs, plumbing and landscape ordinances, public education programs, cost-based water rate structures, and reuse/recycling of wastewater and greywater.

2.2 Unaccounted-for-Water

Measures to determine and control unaccounted-for-water should include:

1. Metering water from fire hydrants used for construction purposes on a temporary basis.

2. The Fire Department should report to the Water Department estimated flow times from fire hydrants either during fires or as part of the hydrants testing program.

3. Water Department crews should provide timely responses to leaks and estimate the volume of water lost.

4. Water Department crews should estimate the volume of water discharged as part of a main-flushing program.

5. When retail water accounts are closed, water service is currently turned off at the meter. If it is anticipated that the building will be vacant for an extended period or if there is evidence of unauthorized water use, the meter should be removed.

2.3 Plumbing and Landscape Ordinances

Plumbing and landscape ordinances that promote water conservation should be implemented. Examples include:

1. Requiring water saving plumbing fixtures for all new construction.

2. Requiring the use of drip irrigation systems in certain circumstances, such as any irrigation system designed to irrigate vegetation located within the following areas - in the right-of-way (ROW) between the curb and sidewalk; within five feet of the paved surface of the ROW where there is no sidewalk; narrow strips of vegetation less than five feet wide between the sidewalk or curb and the parking lot; narrow strips of vegetation less than five feet wide within a parking lot; any median or traffic island which is less than five feet wide.

3. Requiring the use of Xeriscaping and drought tolerant plant species in commercial development landscaping.

2.4 Leak Detection and Repairs

Aggressive leak detection and repair programs should be implemented for all water distribution systems. Citizens as well as city employees from other departments should be encouraged to promptly report any leaks. City personnel such as meter readers, solid waste collectors, and street maintenance workers, as well as those from other utility departments (Wastewater, Gas, and Stormwater) that routinely travel throughout a city make the most effective leak detectors. A 24-hour, 365-day dispatching service should be provided to assure rapid response, as well as work crews that are devoted exclusively to repairing leaks. Crews normally assigned to construction of new water mains can, in emergency situations, augment these crews. The leak repair crews should be on duty for two daily eight-hour shifts. The remaining eight hours should have a crew that is on pager call to respond. The city's goal should be to respond to any leak within four hours of it being reported. In order to maintain the integrity of the distribution system, the city should also budget for water main replacement. The operating budget should provide for replacing lines that have a high leak incidence or are the very oldest lines. The capital improvements budget should provide for system replacements and upgrades associated with other improvements such as major street reconstruction projects.

2.5 Education Programs

Educational programs should be implemented to inform retail water customers of the need to conserve water and the available methods for attaining this goal. The three basic components of an educational program are media campaigns, school programs, and public exhibitions. Media campaigns include local TV and radio stations advertisements; handouts mailed to provide information on water conservation issues, such as Xeriscape and simple water conserving tips; printed newspaper and billboard advertisements. Establish a telephone Water Hotline to encourage public access to water conservation information. Customers can utilize a dedicated telephone line to request water conservation kits and other information. Establish school programs to teach children water conservation concepts through various school-related activities. School programs target young water consumers who will hopefully retain a water-use ethic into their adult life. Children also have direct contact with their parents and may have a better opportunity to influence their behavior than traditional advertising campaigns. The City of Corpus Christi currently has the following school programs implemented – "Major Rivers Educational Program", "Water Conservation Fair; Xeriscape – A Water Wise Educational Program", "Toilet Training – It's Not Just for Kids", "Learning to be Water Wise", "The Water Source Book", water-conservation school book covers, and the "Teacher Outreach – Super Saturday workshop". Public Water Conservation

Exhibitions should include information booths set up by the city's water conservation department at various public events throughout the year. Staff distributes practical literature on learning to read water meters, xeriscape planning, rainwater harvesting, and other water conservation issues; toilet retrofit kits and low-flow showerheads; and, promotional items such as stickers, beach balls, etc. at these events. Other exhibitions could include the establishment of an educational garden and learning center that teaches the seven principles of Xeriscape and beneficial horticulture practices.

2.6 Conservation-Oriented Water Rate Structures

Conservation-oriented water rate structures should be implemented by the LNRA's wholesale customers for serving their retail customers. There are many ways to design this type of rate structure; however, a common rate scheme has a two-part approach consisting of:

1. A monthly minimum customer charge based on customer class and meter size; and

2. A volume charge based on water usage above the minimum base amount.

2.7 Reclaimed Wastewater Programs

Reclaimed wastewater programs can be established for both municipal and industrial discharges. Municipal water and wastewater treatment plants as well as industrial process plants are well suited to incorporate reclaimed water technology. Currently, two of the LNRA's industrial wholesale customers, Formosa Plastics and Inteplast Corporation, have implemented major water reuse/recycle programs. Formosa Plastics is meeting approximately 30 percent of its current demand with reclaimed process water. The City of Corpus Christi has prepared a long-range plan for reusing effluent from its six wastewater treatment plants within their treatment processes as well as to irrigate the plants' on-site landscaping. This reclaimed water is also used to irrigate golf courses, ballpark complexes, the city landfill, etc. During drought conditions, the City has made reclaimed wastewater effluent available to other water users free of charge. Distribution sites at the treatment plants are established to allow homeowners the opportunity for obtaining treated wastewater for private use. Training and instructions are provided to ensure safe use and handling of the treated wastewater. Few owners take advantage of this service, however, primarily due to the cost of transporting the effluent. It must be noted, however, that the widespread reuse of effluent in the CCC service area is subject to the return flow limitations in the existing Nueces River watershed, so the majority of the reuse must take place with water obtained from the LNRA.

3.0 WATER MEASUREMENT AND ACCOUNTING

LNRA deliveries are made through the LNRA East and West Water Delivery Systems; the East System consists of a 36-inch pipeline and a 54-inch pipeline with the related pumping and metering facilities. Deliveries to the City of Corpus Christi are made from the West Water Delivery System. The West System consists of a 64-inch pipeline with the related pumping and metering facilities. The same procedures are employed to maintain an accounting and leak detection program for water delivered to both the East and West Systems.

The LNRA meters water deliveries at the point of diversion near the Lake Texana spillway, and at the delivery points (Formosa Plastics Corporation, Formosa Plastics Corporation Expansion Plant, Inteplast Incorporated, and the Cities of Point Comfort and Corpus Christi) by time of travel flow meters. These flow meters vary in size from 14 inch to 64 inch. A manifold system for the 36-inch and 54-inch pipelines provides the connection between the two pipelines. The manifold system is supplied from Lake Texana by four vertical pumps located at the East Water Delivery System stilling well. Three pumps are powered by a 300 horsepower electric motor, and one pump by a 150 horsepower electric motor that together are capable of providing 28,000 gallons/minute to LNRA customers.

The West Water Delivery System consists of a single 64 inch, 102-mile pipeline originating at Lake Texana and terminating at the City of Corpus Christi's O.N. Stevens Water Treatment Plant. The conveyance system includes an intake pump station owned by LNRA and two intermediate booster pump stations located at Bloomington and Woodsboro. The intake pump station is currently fitted with six vertical turbine pumps powered by 2 - 820 Hp and 4 - 1250 Hp electric motors. LNRA also owns a chemical injection facility capable of dosing the system for bio-growth, including algae and fresh water mussels. The booster pump stations are fitted with 4 horizontal pumps powered by 4 - 1000 Hp electric motors. The combined capacity of the current system is 55,000 gpm. The ultimate capacity of the delivery system is designed at 72,000 gpm.

The Mary Rhodes Phase II (MRP II) delivery system consists of a single 54 inch, 41-mile pipeline originating at the Bay City Pump Station and terminating at a 6,000-gallon storage tank at LNRA. The conveyance system includes an intake structure, river pump station, sedimentation basins, and a booster pump station. The MRP II system ties in to the Mary Rhodes Phase I pipeline at the existing West Delivery Pump Station at LNRA. The MRP II project is a recommended water management strategy identified in the State Water Plan and the Region N Water Plan for meeting the water needs of the Coastal Bend Region. Corpus Christi takes a long-term approach to water planning and has an excellent record of maximizing the use of its existing water supplies and implementing conservation measures.

4.0 MONITORING AND RECORDS MANAGEMENT

The East Delivery systems flow meters are monitored by radio telemetry which consists of a master control station PLC and remote station PLC's located at each point of delivery. These remote station PLC's transmit data to the master control station PLC, which is interfaced with the LNRA computer system for storage of water delivery records. The master PLC is used to assimilate the transmitted information and control the operation of the water delivery system based on predetermined set points for maintaining the water levels in the receiving ponds. The computer system is comprised of one computer workstation which utilizes a Windows operating system and runs SCADA/database software which handles the reporting.

The West Delivery System is operated in much the same way. First flow meters measure the water. Then the information is stored in PLC's for local processing/control and also stored in a database at the main headquarters for records. This system in not based on radio's but a TCP/IP infrastructure. Overall there are 7 workstations in the West Delivery system and 3 servers. Two

servers are for SCADA and one for records/data. All workstations and servers use a Windows based operating system.

Operation and documentation of water deliveries are monitored using computer programs, which generate both daily and monthly water delivery reports. Daily reports include the water quantity initiated at the point of diversion, and the quantity of water distributed to each delivery point. Additionally, the daily reports provide percent meter error information for the day, month, and year. The maximum acceptable unaccounted-for water determined by metering equipment is based on the accuracy of the equipment, which is plus or minus two percent. LNRA calibrates meters on a monthly basis to insure accountability of water. Monthly reports include the amount of water delivered to each delivery point during the month and the year to date totals. Appendix B includes examples of LNRA water delivery accounting reports.

5.0 DELIVERY SYSTEM AUDITING AND LEAK DETECTION

Leak detection of the LNRA water delivery system is monitored by three methods. The first method is by accounting for the amount of water passing the point of diversion against the amount of water being delivered to each delivery point. The second method is to monitor the system when there is no demand for water at the points of delivery to determine if there are losses in the system. The control center computer will also indicate if there is an improper valve closure in the system. The third method is periodic visual inspections of the entire distribution system.

Repairs and down times are minimized for the distribution system by implementation of proper maintenance programs. When minor repairs are necessary, trained on-site personnel accomplish the task with minimum interruption of service. When major equipment repairs require the assistance of outside experts, appropriate actions are taken to ensure minimal customer service disruption.

The East Water Delivery System is protected against power loss by six diesel-powered generators. These generators provide emergency power when standard operating power service has been disrupted. Two inline generators are located at the LNRA pump station that can supply sufficient power for operation of the three existing pumps. As an additional security measure, generators are located at the three distribution points and at the LNRA pipeline control building. These generators ensure continuous power for minimal customer service disruption.

The West Water Delivery System is not protected against primary power loss, however, auxiliary generators are in place to ensure proper operation of the control system to ensure valve closure and control system integrity.

6.0 RESERVOIR SYSTEM OPERATION PLAN

LNRA operates Lake Texana on the Navidad River for municipal and industrial water supply purposes, recreation, fish and wildlife benefits. Since Lake Texana is the only reservoir in the Lavaca River Basin and is operated by the LNRA, the LNRA does not have nor need a reservoir system operation plan.

After extensive biologic and hydrologic studies, the LNRA, Texas Parks and Wildlife Department (TPWD), and the Texas Water Development Board (TWDB) signed an agreement on May 20, 1992 concerning the quantity of water released from Lake Texana to estuaries and Lavaca Bay below the Palmetto Bend Dam. On December 16, 1994, the Texas Natural Resource Conservation Commission (TNRCC), predecessor agency of the TCEQ, amended Certificate of Adjudication No. 16-2095 to incorporate the agreed upon release schedule. Generally, the agreement requires that releases of inflows be made from Lake Texana under normal and abundant water supply conditions to ensure the productivity of estuaries and Lavaca Bay downstream from Lake Texana. Specifically, the agreement and permit requirements are as follows: All inflows into the reservoir up to the historical monthly median flow are released during the months of January through March, July, and November through December; inflows up to the historical average flow are released during the months April through June and August through September; however, if the reservoir contains less than 78.18% of the water storage capacity, only inflows up to the average median daily flow for the historical drought period (5 cubic feet per second) will be released. The agreement is beneficial for Lavaca Bay and provides a reliable water supply from Lake Texana. Appendix A contains a copy of Certificate of Adjudication: 16-2095B.

7.0 CONSERVATION-ORIENTED RATES

The LNRA has two different customer classes. All customers purchasing water from Lake Texana on a firm-yield basis are charged the same base rate. All customers purchasing water from Lake Texana for use on an interruptible basis are charged the same rate which is one-half of the base rate charged all customers using firm yield water.

8.0 CUSTOMER CONSERVATION STRATEGIES

LNRA water customers are required by their water sales contract to prepare and submit Water Conservation and Drought Contingency Plans to the TCEQ. The LNRA recommends that its customers develop plans consistent with the LNRA Water Conservation Plan and trigger conditions as established in the LNRA Drought Contingency Plan.

LNRA also recommends that their customers and the M&I users in the Lavaca River Basin address the eight aspects of water conservation discussed herein, including public information and education, conservation oriented plumbing codes, water conservation retrofit programs, universal metering and meter repair/replacement, water conserving landscaping, leak detection and water audits, and means of implementation and enforcement.

8.1. Public Information and Education

A committee should be appointed by each water supply entity to engage in an ongoing education program. The committee may be responsible for the following:

1. Provide qualified individuals to speak at institutions, organizations, and groups throughout the area at regular intervals;
2. Conduct or sponsor exhibits on conservation, water saving devices, and other methods to promote water conservation and efficiency;

3. Provide and distribute brochures and other materials to area citizens. Materials are available from the Texas Agricultural Extension Service and TWDB;
4. Work in cooperation with builders, developers, and governmental agencies to provide exhibits of xeriscape landscaping;
5. Work in cooperation with schools to establish an education program, and provide conservation videos, brochures, and teaching aids; and
6. Develop welcome packages for new citizens to educate and provide the benefits of conservation and availability of native, water efficient plants, trees, shrubs, and grasses.

8.2 Conservation Oriented Plumbing Code

A conservation oriented plumbing code is recommended to encourage the use of water-conserving plumbing fixtures for residential and commercial construction. Senate Bill 815 enacted by the 73rd Texas Legislature directs the Texas Senate Board of Plumbing Examiners to adopt the Southern Standard Plumbing Code, the Uniform Plumbing Code, and the National Standard Plumbing Code. Questions concerning State of Texas plumbing codes can be answered by the Texas State Board of Plumbing Examiners in Austin, Texas.

The 72nd Texas legislature passed legislation requiring that plumbing fixtures sold in Texas after January 1, 1992 meet the following standards:

(a) Shower Heads: No more that 2.75 gallons per minute at 80 pounds per square inch of pressure.
(b) Lavatory/Sink Faucets and Aerators: No more than 2.2 gallons per minute at 60 pounds per square inch of pressure.
(c) Wall Mounted, Flushometer Toilets: No more than 2.0 gallons per flush.
(d) All Other Toilets: No more than 1.6 gallons per flush.
(e) Urinals: No more than 1.0 gallon per flush.
(f) Drinking Water Fountains: Must be self closing.

The above standards are enforced through requirements placed directly on the manufacturers, importers, and suppliers of new fixtures in Texas and do not necessarily require the amendment of existing plumbing codes. However, LNRA encourages that the above standards be used in city, district, and other entity plumbing codes. Furthermore, LNRA suggests the following requirements be incorporated into city, district, and other entity plumbing codes:

(a) Hot Water Pipes: Hot water lines not in or under a concrete slab should be insulated.
(b) Pressure Reduction Valves: Pressure reduction valves may be installed where system pressures exceed 80 pounds per square inch.
(c) Swimming Pools: Swimming pools should have recirculating filtration equipment.
(d) Automatic Dishwashers: Automatic dishwashers installed in residential dwellings should be a design that uses a maximum of six gallons of water per cycle.
(e) Automatic Clotheswashers: Automatic clotheswashers installed in residential dwellings should be a design that uses a maximum of 14 gallons of water per cycle.

8.3 Water Conservation Retrofit Program

Retrofit of existing plumbing fixtures can be accomplished through the voluntary efforts of individual consumers for their homes and businesses. Adoption of a water conservation plumbing code can provide a gradual upgrading of plumbing fixtures in existing structures. Many water conserving plumbing devices are available at local hardware stores and can be installed by the consumer. The TWDB provides a list of Water Saving Device Sources to the public. Additional information on retrofitting can be provided through public education.

8.4 Universal Metering and Meter Repair/Replacement

Service connections to water supply utilities and customers should be metered. LNRA recommends the following schedule for testing meters:

1. Production or master meters, test once per year;

2. Meters larger than 1', test once every three years; and

3. Meters 1' or less, test once every 10 years.

8.5 Water Conserving Landscaping

Water conserving landscaping can be initiated through public information and education. Well-designed and properly maintained demonstration landscapes located in highly visible areas should be created to promote the xeriscape concept.

8.6 System Auditing and Leak Detection Program

Leak detection and water audits may be accomplished through the voluntary efforts of each water supplier. Technical assistance may be requested from the TWDB.

8.7 Water Reuse and Recycling

LNRA encourages reusing and recycling water whenever it is found to be fiscally, environmentally, and institutionally practical and prudent.

8.8 Means of Implementation and Enforcement

The Water Conservation Plan should be implemented by water supply utilities. The following methods are suggested:

1. Encourage service tap applicants to utilize water conserving plumbing fixtures. Water utility staff should insure that water saving plumbing devices is being installed in new buildings.

2. Adopt a rate structure that will encourage retrofitting of old plumbing fixtures that are using large amounts of water.

3. Require the water rate structure as a condition for receiving service.