Background/Scope

Lake Livingston Water Supply and Sewer Service Corporation (LLWSSSC) is a member-owned, non-profit water supply corporation. LLWSSSC currently provides water supply, treatment, and distribution to its customers by way of approximately 56 separate water systems to rural subdivisions located in Hardin, Liberty, Polk, San Jacinto, Trinity, Tyler, and Walker Counties in southeast Texas. Most of these water systems were installed in the 1960s and 1970s. The systems currently serve approximately 7,000 connections in some 115 subdivision areas. **Map 1** shows all of LLWSSSC's water service areas.

Since its formation in 1996, LLWSSSC has been undertaking the extremely challenging task of bringing the old water systems into compliance with the requirements of Texas Commission on Environmental Quality (TCEQ). In fact, TCEQ issued an agreed enforcement order in 2005, assessing a large administrative penalty and requiring corrective action to outstanding TCEQ rule violations. Complicating the compliance effort are factors such as the broad geographic dispersal of the water systems, a growing customer base, aging infrastructure, tightening water quality regulations, and rising energy costs.

On March 28, 2006, LLWSSSC authorized TRC Engineers, Inc. to perform a Regional Water Facility Plan. The purpose of the Facility Plan is to develop a long-term, cost-effective, and sustainable capital improvements program. The Facility Plan will focus especially on large-scale improvements involving regionalization of systems.

The last major planning effort undertaken by LLWSSSC was a 2001 Preliminary Engineering Report associated with an application to the USDA for funding of capital improvements. The report analyzed approximately 20 water systems that were deficient with respect to TCEQ criteria. USDA approved the report and funded the recommended improvements, the vast majority of which have since been completed.

The systems analyzed in this Facility Plan are all the LLWSSSC systems not analyzed in the USDA project, plus those that were that either have unresolved or new water quality problems or are seen as possible candidates for regionalization. This results in a total of approximately 44 systems analyzed herein.

Existing Connection Calculations

Reference is made to **Table 1**, which presents existing service connections and population for each water system included in this funding application. Existing population was derived by applying factors extracted from 2000 Census data combined with existing connection counts provided by LLWSSSC. Census blocks and block groups associated with the affected LLWSSSC service areas were identified, and occupancy rates for each area were taken from Census data. To determine the 2005 connection quantities for each area, monthly connection data for 2005 was analyzed,

and the highest monthly number of active connections was chosen. 2005 population was then calculated using the current connection values and the same capita per connection value that was calculated from the 2000 census data.

Table 2 presents historical pumpage and consumption data for each water system, provided by LLWSSSC.

Existing Water Quality

TRC collected from LLWSSSC the most recent water quality data for all LLWSSSC wells. The Texas Department of State Health Services' Laboratory Services Section had conducted the water quality analyses. The data is presented in **Appendix A.**

The "Inorganic Compounds" and "Radionuclide Contaminants" are considered primary constituents. According to the American Water Works Association, primary standards refer to substances that are thought to pose a threat to human health; secondary standards do not.

The only primary constituents having measured concentrations exceeding regulated limits are arsenic and radionuclides. The systems with excessive arsenic levels are Bass Bay, Forest Hills, Green Acres, and Natasha Heights. The systems with excessive radionuclide levels are Crystal Lakes, Indian Springs Lake Estates, and Paradise Acres.

It should be noted that the regulated maximum contaminant level for arsenic had been 0.05 mg/L, until 1/23/06 when it was lowered to 0.010 mg/L. Based on the aforementioned data, all four systems that exceed the new arsenic limit would have been in compliance with the old limit.

Existing Plant Facilities

Capacities of wells, ground storage tanks, high service pumps, and pressure tanks were evaluated based on TCEQ criteria.

For most of the systems involved in the USDA project, well flow rate and ground storage and pressure tank measurements were taken from project submittals, contract documents, and report files. For those USDA systems in which this information was not available, LLWSSSC provided information.

A TRC representative visited all of the plants not addressed in the USDA project. Well flow rates were read in person and ground storage and pressure tank dimensions were measured by hand. Digital photographs of each plant were taken.

Additionally, casing depth and diameter data for many of the newer public and private wells in the area were found on the TWDB website. This information will be useful for evaluating the feasibility of, and projecting construction costs of, wells proposed later in this Facility Plan.

Existing Distribution Systems

Water loss for each system was calculated in **Table 2.** According to EPA, water loss greater than 10% is "excessive". The table shows that the vast majority of the systems experience either excessive or what is herein termed "severe" (over 30%) water loss. According to LLWSSSC, line breaks are the greatest cause of water loss in these systems, with flushing and water theft being other causes. Water loss was calculated using the following formula:

Water Loss = [(2003 Annual Water Pumped - 2003 Annual Water Consumed) +
(2004 Annual Water Pumped – 2004 Annual Water Consumed) +
(2005 Annual Water Pumped – 2005 Annual Water Consumed)] /
(2003 Annual Water Pumped + 2004 Annual Water Pumped +
2005 Annual Water Pumped)

TRC collected hand-drawn water system mapping information from LLWSSSC for each system not involved in the USDA project. This information included locations and sizes of water lines and gate and flush valves. TRC entered this information digitally into the digital background maps that TRC had previously purchased.

Simplified, steady-state (instantaneous) digital hydraulic models were performed using WaterCAD software for each distribution system. These simulations represent a snapshot in time and were used to evaluate pressures within each system under existing peak-hour demand conditions. No fire flows were modeled.

LLWSSSC's metering reading contractor and staff provided information as to the spatial distribution of active connections for each system, and this information was entered into the WaterCAD models.

From **Table 1** it was determined that an average capita-per-connection value of 2.4 is appropriate. From **Table 2** it was determined that the average water pumped per capita for 2005 was approximately 120 gallons per capita per day (gpcd). It was deemed prudent to use a somewhat higher value for modeling purposes; a value of 150 gpcd was selected. A peak-hour factor of 4 was also chosen. From these numbers, a value of 1.0 gpm/connection was generated for use in analysis of existing conditions. It should be noted that this is the same value specified by the USDA Rural Utilities Service for existing conditions analyses in projects they fund.

Most system minimum operating pressures were assumed to be 60 psi. If more than one supply point exists in an individual system, then the operating pressure of 60 psi

was assumed for the highest plant. It is understood that all systems analyzed herein have only one pressure plane, except for Pine Shadows, which has two pressure planes.

The majority of piping systems were assumed to be plastic material with a Hazen-Williams C factor of 140. The only exceptions were Crystal Lakes, Lake Livingston 1, 2, and 3, and Horseshoe Lake Estates. These systems are known to contain galvanized piping and thus a C factor of 120 was used.

After the demand, operating pressures, and C factors were entered into the WaterCAD model the system was then run to find any low pressure areas. If a system was found to have low pressure areas the area was noted and then the system was looked over for future modifications to increase the pressure to meet TCEQ criteria.

The distribution system maps are presented in the tabbed sections that follow. The clouded areas represent locations where the model determined that pressures fall below 35 psi during peak-hour conditions, which is unacceptable per TCEQ criteria.

Existing Conditions Summary

The baseline conditions analysis has confirmed, and provided a better understanding of, known problems in LLWSSSC's systems, and has also identified other problems that may not have been known. A summary of the existing deficiencies for each system is presented in **Table 3**.

Projected Growth

Projections of future growth and corresponding water demand are needed in order to size proposed improvements. The future planning milestones used in this Report are 2010, 2015, 2025, and 2035.

Whenever growth projections are made, the development capacity of the existing service areas must be considered, as projected growth cannot exceed capacity. For each service area, an attempt was made, by way of site visits and review of connection maps, to determine the approximate degree of existing development with respect to its capacity. This information was factored into the growth projections.

Reference is made to **Table 4** and **Figures 1 through 6**, which present the data discussed in the following paragraphs.

For this Facility Plan, LLWSSSC furnished data that facilitated LLWSSSC connection counts within each county for the years 1999 and 2005. Corresponding historical average annual growth rates were calculated.

On their website, TWDB lists "2006 Regional Water Plan Population Projections for 2000 - 2060 for Cities, Counties, and County-Other by County and Region in Texas." The projections were presented in 10-year increments (2010, 2020, etc.). It is understood that this information will be incorporated into the upcoming 2007 State Water Plan. Within these Projections, Year 2000 populations and projected future populations for LLWSSSC systems within each county, for the Counties themselves, and for the Cities of Livingston and Onalaska were presented. It is noteworthy that, for LLWSSSC's systems, TWDB projects future growth occurring at higher rates than those experienced between 1999 and 2005. **Figure 7** illustrates the historical and future LLWSSSC connections by county (based on the TWDB data).

The Livingston-Polk County Chamber of Commerce was also contacted. They referred us to 2005 – 2010 Polk County population growth projections, done by Experian/ Applied Geographic Solutions and apparently endorsed by the Texas Workforce Commission. The corresponding average annual growth rate is higher than that projected by TWDB for Polk County during the same time period.

The Deep East Texas Council of Governments was contacted but indicated that they had no other data useful to this exercise. The websites for Polk County, San Jacinto County, and City of Livingston were also researched, but no other data useful to this exercise were found.

It is assumed that future development will be of the same character as existing development (single-family residential), and that capita per connection numbers will remain the same. It is assumed that the spatial distribution of future growth throughout each service area will be proportional to the current distribution.

Per Chapter 290.44(d) of the TCEQ Rules, a value of 1.5 gpm/connection was used for the analysis of future distribution system conditions

The improvements recommended in this Facility Plan are sized based on the aforementioned TWDB and Texas Workforce Commission growth projections. The projected timetable by which existing plant components will become undersized is presented in **Table 3**.

It was noted that the existing actual unit water demand (48 gallons per capita per day) calculated at the bottom of **Table 2**, is slightly less than those calculated from TWDB's demand projections for 2000 and 2010, shown in **Table 5**. For the sake of being reasonably conservative, the projected future average water demands calculated by TWDB (and presented in **Table 5**) are adopted herein by reference.

Preliminary Design Criteria and Factors Affecting Cost Projections

1. Surface Water Treatment Plants

There are new regulatory requirements expected to be enacted soon which will affect the design of the new surface water treatment plants (SWTPs). The Stage II Disinfection Byproducts (DBP) Rule builds upon earlier rules that addressed disinfection byproducts, and involves tightened compliance monitoring requirements for two groups of DBPs, trihalomethanes and haloacetic acids. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) supplements existing regulations by targeting additional *Cryptosporidium* treatment requirements to higher risk systems. It also contains provisions to reduce risks from uncovered finished water reservoirs and to ensure that systems maintain microbial protection when they take steps to decrease the formation of DBPs that result from chemical water treatment. TCEQ currently projects that they will formally adopt these rules in December 2007.

Historical raw water quality data was acquired from Trinity River Authority (TRA). This data was taken from sample points on the Lake in the general areas of the potential raw water intakes for the two plants considered herein (the Trinity County-Area Plant and the Scenic Loop Plant). The data was submitted to water treatment equipment manufacturers. Treatment issues were also discussed with TRA and with another, smaller utility which treats water from the Lake (Waterwood M.U.D. No. 1). Of the information that was gathered, there was nothing that indicated that treating Lake water would be unfeasible.

Raw water intakes should extend to the deepest part of the river channel to help ensure continuity of supply during drought conditions.

It was determined that the Scenic Loop Plant should be sized to treat 1.5 million gallons per day (MGD) and the Trinity County-Area Plant should be sized to treat 1.25 MGD. These numbers were arrived at by multiplying the projected 2035 connection quantity by 0.6 gallons per minute per connection (per Chapter 290 of the TCEQ Rules) and dividing by 85%. The 0.6 gpm/conn factor is associated with Chapter 290, and the 85% factor is associated with Chapter 291, of the TCEQ Rules. Chapter 291 states that:

> "A retail public utility… that has reached 85% of its capacity… shall submit to the executive director a planning report that clearly explains how the retail public utility will provide the expected service demands to the remaining areas within the boundaries of its certificated area."

The intent herein was to size the SWTPs large enough such that no such report would be necessary until after 2035.

At this point it is anticipated that the most cost-effective treatment process for this application would be a conventional one involving coagulant chemical feed, two-stage mechanical flocculation, sedimentation with tube settlers, granular media filtration,

chemical pH adjustment, and primary and residual disinfection by the injection of some form of chlorine. This process is illustrated in **Figure 8**.

Cursory blending calculations were not performed in this Regional Plan because there are not any proposed scenarios involving pre-distribution blending of different known sources.

For the treatment capacities calculated herein, plant sites of approximately three acres would be necessary.

It is assumed that basins and tanks will be of steel construction, buildings will be of masonry construction, and paving and access roads will be concrete.

Itemized construction cost projections of these plants are presented in tabular form within the relevant sections of this Report. The unit prices within these projections were developed using cost data from recently constructed projects, consultation with equipment manufacturers, and analysis of recent inflationary trends.

In the Construction Cost Projection Tables, Construction Contingency was calculated as 10% of the cost of all construction items.

Further engineering planning and pre-design work will be necessary to 1) analyze the environmental and geotechnical characteristics of each site, to confirm suitability and guide structural design, 2) thoroughly compare the currently-anticipated process with other viable processes that are less common and/or emerging, and 3) quantify in greater detail major component sizes and dimensions, to establish the basis of design for the plant and to facilitate the generation of plans and specifications.

Regarding required staffing of the proposed SWTP's, reference is made to TCEQ Ch. 290.46(e)(6), which includes the following paragraphs:

> *"(A) Surface water systems that serve no more than 1,000 connections must employ at least one operator who holds a Class "B" or higher surface water license. Part-time operators may be used to meet the requirements of this subparagraph if the operator is completely familiar with the design and operation of the plant and spends at least four consecutive hours at the plant at least once every 14 days and the system also employs and operator who holds a Class "C" or higher surface water license. Effective January 1, 2007, the public water system must employ at least one operator who has completed the Surface Water Unit I course and the Surface Water Unit II course.*
>
> *(B) Surface water systems that serve more than 1,000 connections must employ at least two operators; one of the required operators must hold a Class "B" or higher surface water license and the other required operator must hold a Class "C" or higher surface water license. Each of the required operators must work at least 32 hours per month at the public water system's production, treatment, or*

distribution facilities. Effective January 1, 2007, the public water system must employ at least two operators who have completed the Surface Water Unit I course and the Surface Water Unit II course."

Based on the projected numbers of connections served, Paragraph A would apply to the proposed Trinity County-Area Plant, and Paragraph B would apply to the proposed Scenic Loop Plant.

2. Ground Water Plants

For those water systems which are smaller, farther from the Lake, and/or not experiencing water quality problems, groundwater plant improvements are proposed.

The Stage II Disinfection Byproducts (DBP) Rule builds upon earlier rules that addressed disinfection byproducts, and involves tightened compliance monitoring requirements for two groups of DBPs, trihalomethanes and haloacetic acids. TCEQ currently projects that they will formally adopt this rule in December 2007.

Another upcoming new rule to be considered is the Ground Water Rule (GWR), which will apply to public water systems that serve ground water. The purpose of the rule is to provide for increased protection against microbial pathogens in public water systems that use ground water sources. The rule involves four major components: periodic sanitary surveys, source water monitoring, corrective action for problematic systems, and compliance monitoring of treatment equipment virus removal efficacy. TCEQ currently projects that they will formally adopt this rule in December 2007.

In recent years there have been some Groundwater Conservation Districts formed in southeast Texas.

In November 2006 Lower Trinity Groundwater Conservation District (LTGCD) was formed. It covers Polk and San Jacinto Counties. According to its attorney, LTGCD is still presently in a very preliminary organizational state. At this time, LTGCD requests that LLWSSSC make them aware of new well drilling. LTGCD may in the future have some regulatory authority regarding minimum spacing between wells, permitting of groundwater extraction, and issuance of a pumpage fee (potentially as high as 5 cents per 1,000 gallons).

There are no wells proposed within Trinity, Tyler, and Walker Counties in the Regional Plan, and there is no GCD for Liberty County.

Criteria for ground water plant improvements are as follows:

- Test wells should be drilled and results analyzed prior to starting design of related ground water plant or water line improvements.

- New wells should be located at least 1,000 ft. from existing wells that draw from the same geologic strata. This would help reduce the risk of overlapping drawdowns of the aquifer, given the low pumping rates of the LLWSSSC wells. However, depending upon the aquifer characteristics in the particular area in question, it is possible that test drilling will indicate that some wells need to be spaced further apart . Discharge from new wells should be piped directly to the existing nearby ground storage tanks.

- Properties acquired by LLWSSSC for new wells should be large enough to contain the entire 150 ft. sanitary control radius around the well that TCEQ requires. This would eliminate the need for acquiring sanitary control easements from landowners.

- New ground storage tanks will be constructed of either galvanized bolted steel or painted welded steel. These options will be analyzed and compared during the pre-design phase, to facilitate a selection.

- New controls will be of a similar nature as those currently found in LLWSSSC's systems (i.e. Turner Controls, etc… no SCADA except for new elevated storage tanks or standpipes).

- All plant components have been priced as if they are brand new. However, LLWSSSC may decide to salvage certain components from plants that will be abandoned and reinstall them where needed. This applies to high service pumps, chlorinators, air compressors, pressure tanks, forced-draft aerators, and even bolted steel ground storage tanks.

- New buildings will be of masonry construction.

- New or improved access roads will have a driving surface of crushed base material.

Cursory blending calculations were not performed in this Regional Plan because there are not any proposed scenarios involving pre-distribution blending of different known sources.

Itemized construction cost projections of these plants are presented in tabular form within the relevant sections of this Report. The unit prices within these projections were developed using cost data from recently constructed projects and analysis of recent inflationary trends.

In the Construction Cost Projection Tables, some of the line item costs under the "Misc." heading were calculated as percentages of other cost items in the table. Such items associated with ground water plants are as follows:

Plant piping: 30% of the cost of the following items: service pumps, well pumps, chlorinators, forced draft aerators, groundwater treatment, backwash pond, and all costs under the "Storage" heading.

Electrical: 25% of the cost of the following items: service pumps, well pumps, forced draft aerator, groundwater treatment, air compressor, aux. generator, and buildings.

Controls: 25% of the cost of the following items: service pumps, well pumps, chlorinators, forced draft aerators, groundwater treatment, storage tank (bolted), pressure tank, air compressor, and elevated storage/standpipe.

Site work: 15% of the cost of the following items: well base cost, backwash pond, storage tank (bolted), pressure tank, elevated storage/standpipe, and buildings.

Further engineering planning and pre-design work will be necessary to analyze the environmental and geotechnical characteristics of each site, to confirm suitability and guide structural design.

3. Pipelines

It is recommended that new pipelines be PVC and be installed by open cut except in special circumstances. Where lines will cross roads owned by TxDOT or railroads, it is anticipated that the PVC water lines will be inserted through steel casing pipes bored under the road. It is anticipated herein that county roads can be crossed by open cut and point repair of paving.

It is also recommended that directional bores be performed at creek crossings. These bores involve the use of HDPE pipe, which unlike PVC are butt-fused to allow jointless deflections. This method can facilitate boring operations extending several hundred feet long, having considerable vertical deflection, and requiring only minor pits on each end during construction.

"Service connections" as described herein involve the tap to the new main, new service line and fittings, and disconnecting the old service line and reconnecting the new service line to the inlet side of the existing meter. It is assumed herein that LLWSSSC will pay for any portion of service lines that are within private property, as such work cannot be funded through TWDB's Drinking Water SRF program.

It is assumed herein that all lines to be installed along TxDOT roads will be installed within existing TxDOT rights-of-way, as opposed to within new easements that LLWSSSC would have to acquire. This is based on an assumption that there is sufficient room within the existing rights-of-way for the new pipeline to be installed (in TRC's experience, this is true in the vast majority of cases). The advantage to installing lines within TxDOT right-of-way is that TxDOT usually approves the request within a month and does not charge any encroachment fee; acquiring easements on adjoining private property is often a time-consuming process and usually involves compensating the property owners on the order of 50% of the value of the affected property (usually a 15 ft. – wide strip). The disadvantage to installing the line within TxDOT right-of-way is, if and when TxDOT ever widens the road, installs drainage improvements, etc., the cost of any necessary water line relocations would be borne by LLWSSSC, whereas if the line had been installed within LLWSSSC's easement, TxDOT would pay for any necessary water line relocations.

Criteria for new pipeline installation are generally as follows:

- Install where necessary to achieve/maintain pressures throughout each system of at least 35 psi, per TCEQ requirements. (by 2010)
- Install where necessary to replace pipes known to be uncovered. (by 2010)
- Install where necessary to resolve acute operational/maintenance problems reported by LLWSSSC staff. (by 2010)

- Install where necessary to loop existing dead-end water mains where this can be achieved while staying within public right-of-way. (by 2015)

- Install where necessary to improve pipeline systems characterized by extreme water loss. (by 2015)

- Install where necessary along streets to replace any lines aligned along backs of lots and possibly within ten feet of septic systems. (by 2015)

- Install where necessary to loop existing dead-end water mains where easements would be necessary. (by 2025)

- All adjacent service connections will be replaced as described above.

Itemized construction cost projections of these pipelines are presented in tabular form within the relevant sections of this Report. The unit prices within these projections were developed using cost data from recently constructed projects and analysis of recent inflationary trends.

Environmental analysis of the proposed pipeline routes will be necessary during the pre-design phase, to confirm suitability.

Overview of Facility Plan

A summation of recommended improvements and related construction cost projections, for all systems and phases, is presented in **Table 6.**

It is anticipated that implementation of the proposed first phase of improvements would commence as soon as possible after funding is secured, as presented in **Figure 9**.

The tabs that follow present, for each system, an analysis of improvements alternatives. The analysis includes:

- Brief description and identification of recommended alternative;
- Plant capacity analysis table for each alternative;
- Detailed, phased scope of improvements and related construction cost projections for each alternative;
- Drawings of each alternative;
- System photos

LAKE LIVINGSTON WATER SUPPLY & SEWER SERVICE CORPORATION

2006 REGIONAL WATER FACILITY PLAN

FUNDED IN PART BY
TEXAS WATER DEVELOPMENT BOARD

April 2007

Prepared by

TRC

Page #

GENERAL

LIBERTY COUNTY

APPENDICES

Figure 1
Historical and Projected Growth:
Liberty County Systems

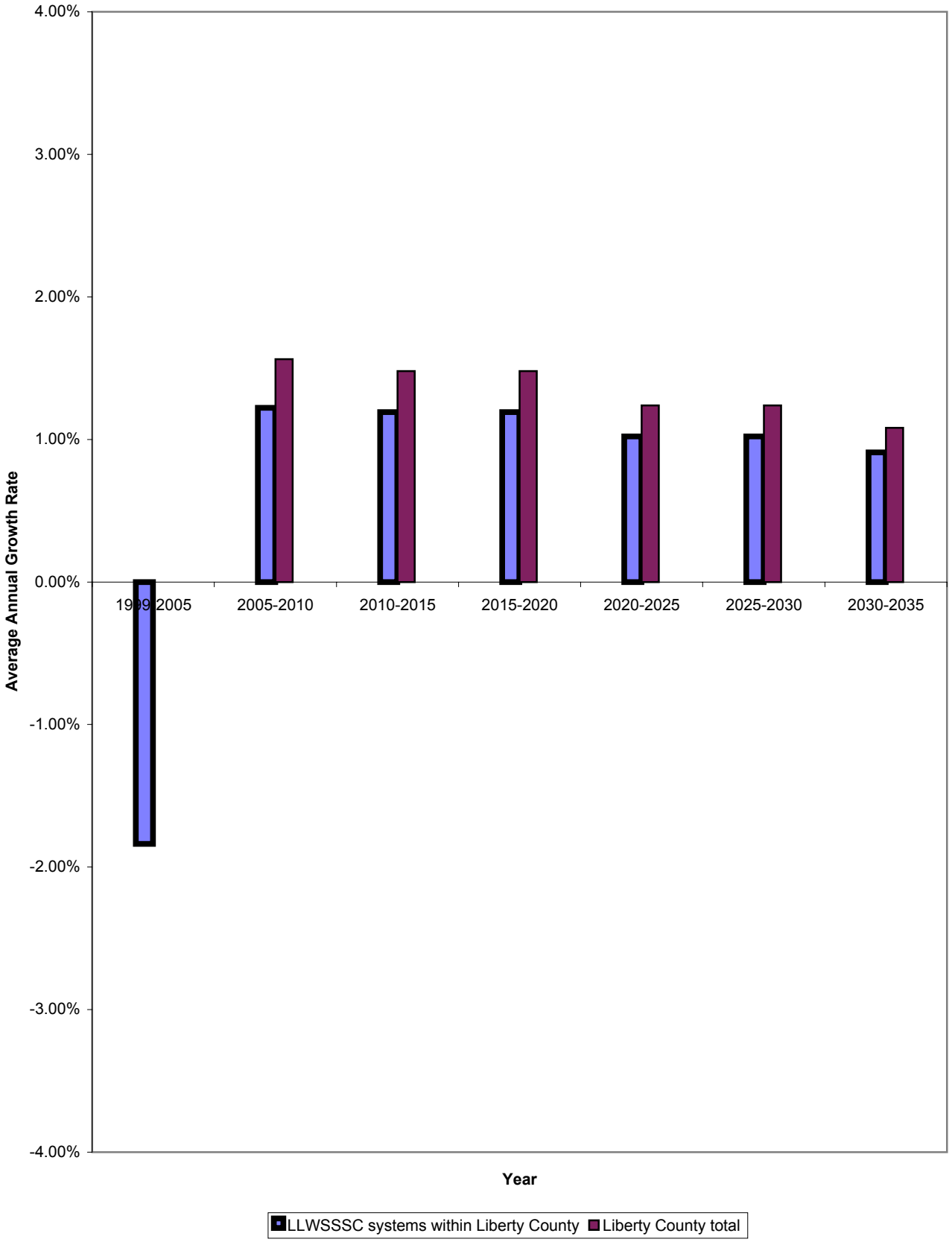

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Figure 2
Historical and Projected Growth:
Polk County Systems

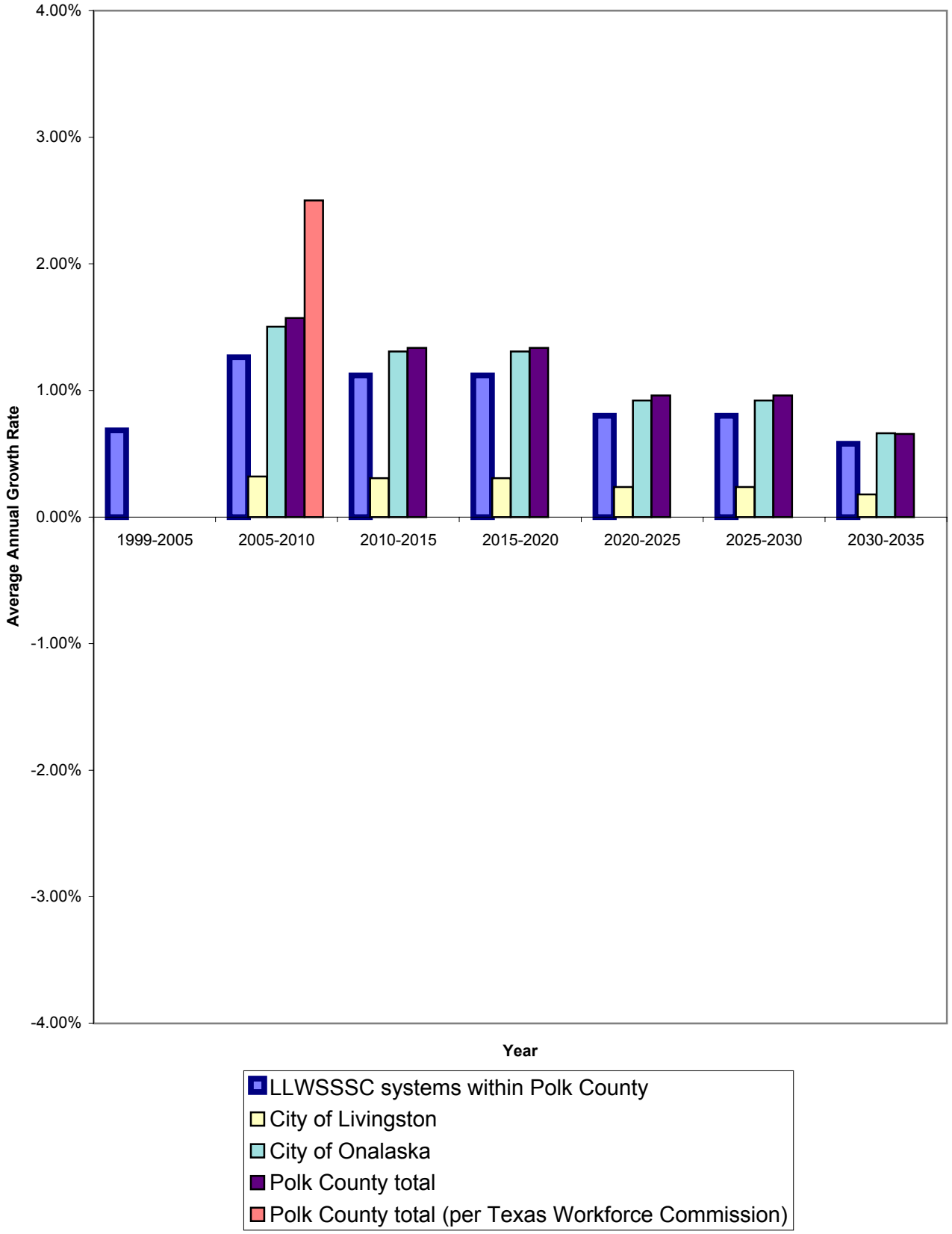

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Figure 3
Historical and Projected Growth:
San Jacinto County Systems

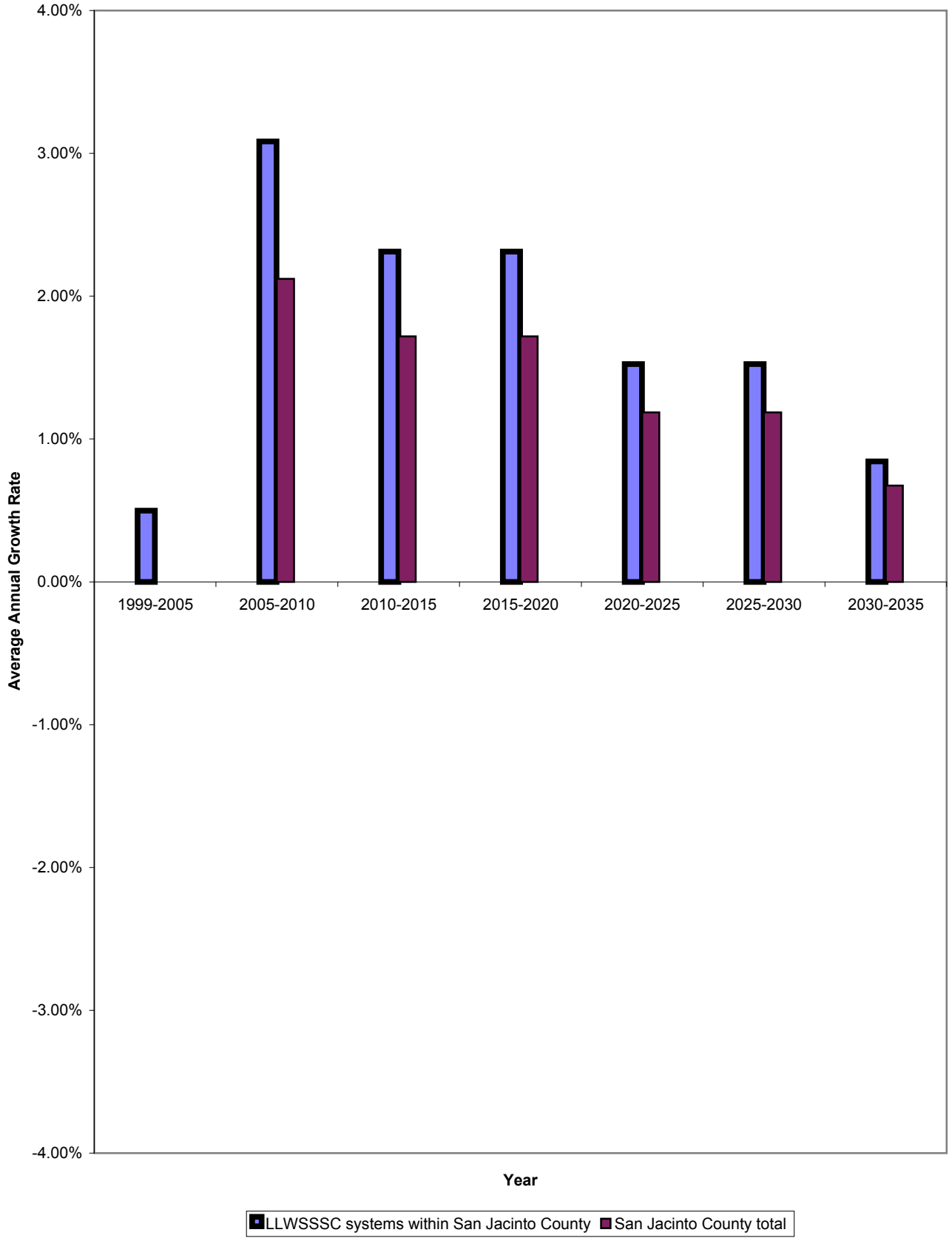

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Figure 4
Historical and Projected Growth:
Trinity County Systems

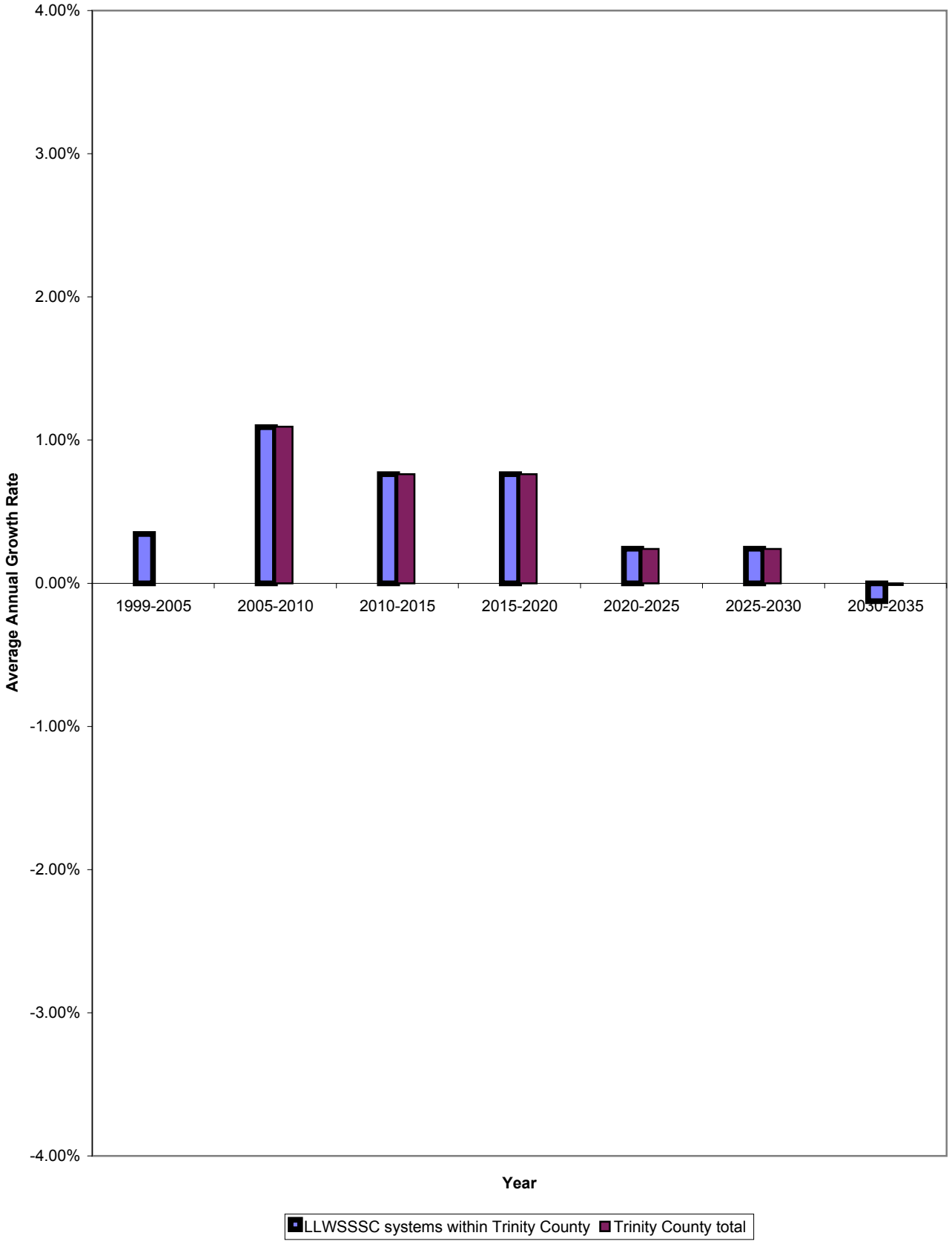

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Figure 5
Historical and Projected Growth:
Tyler County Systems

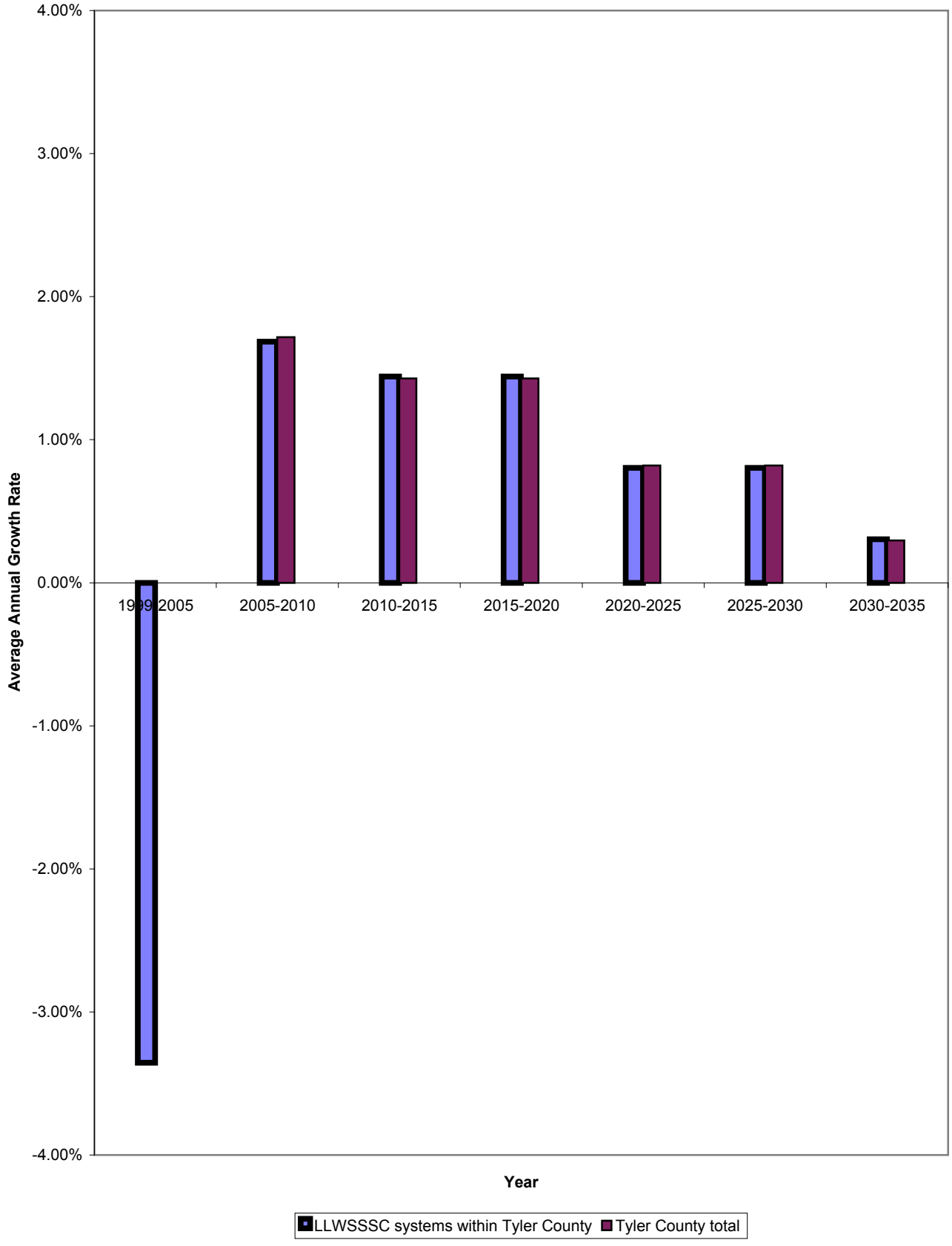

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Figure 6
Historical and Projected Growth:
Walker County Systems

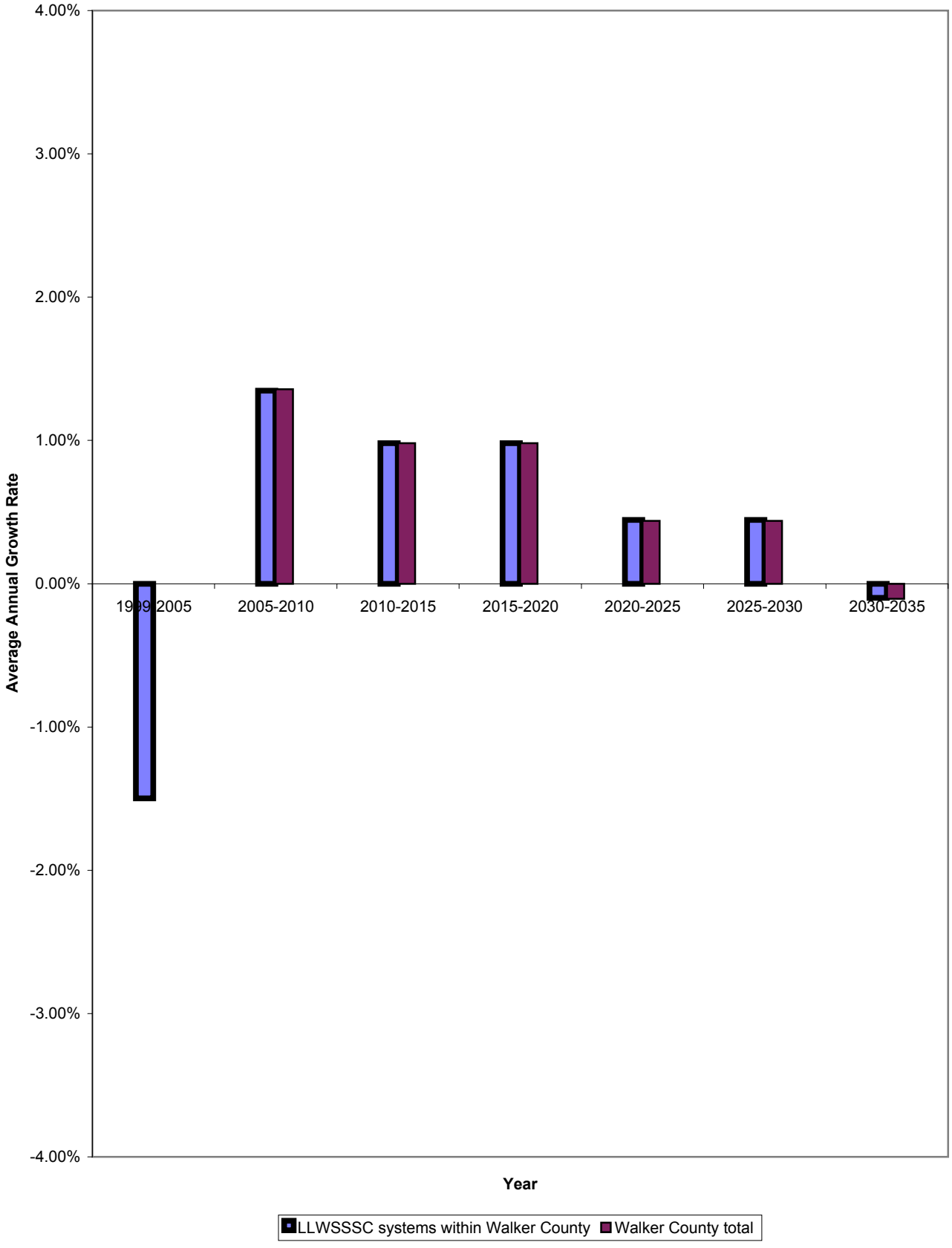

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Figure 7
Historical and Projected
LLWSSSC Connections
by County

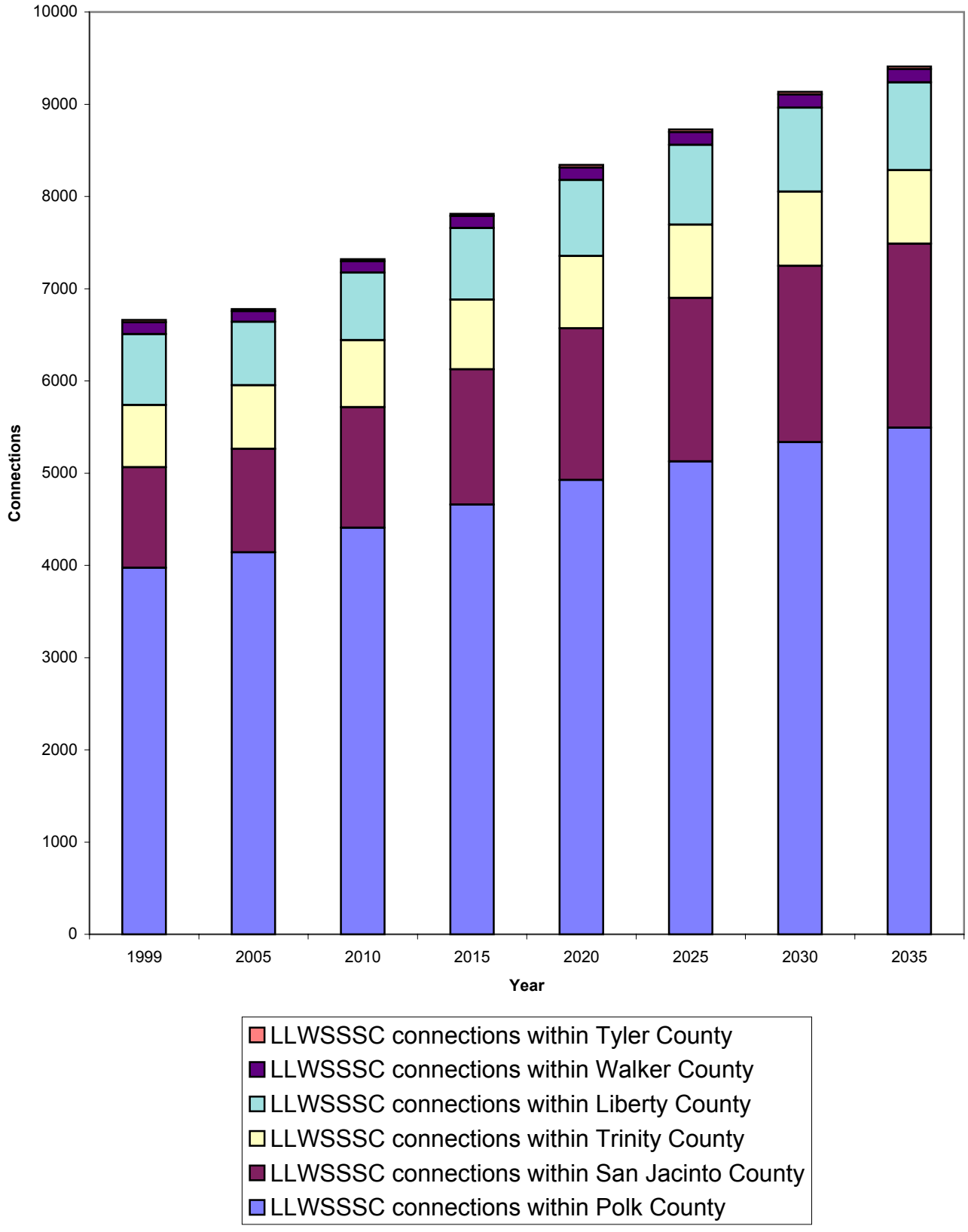


FIGURE 8
SURFACE WATER TREATMENT PLANT
CONCEPTUAL PROCESS FLOW DIAGRAM
FOR SURFACE WTP

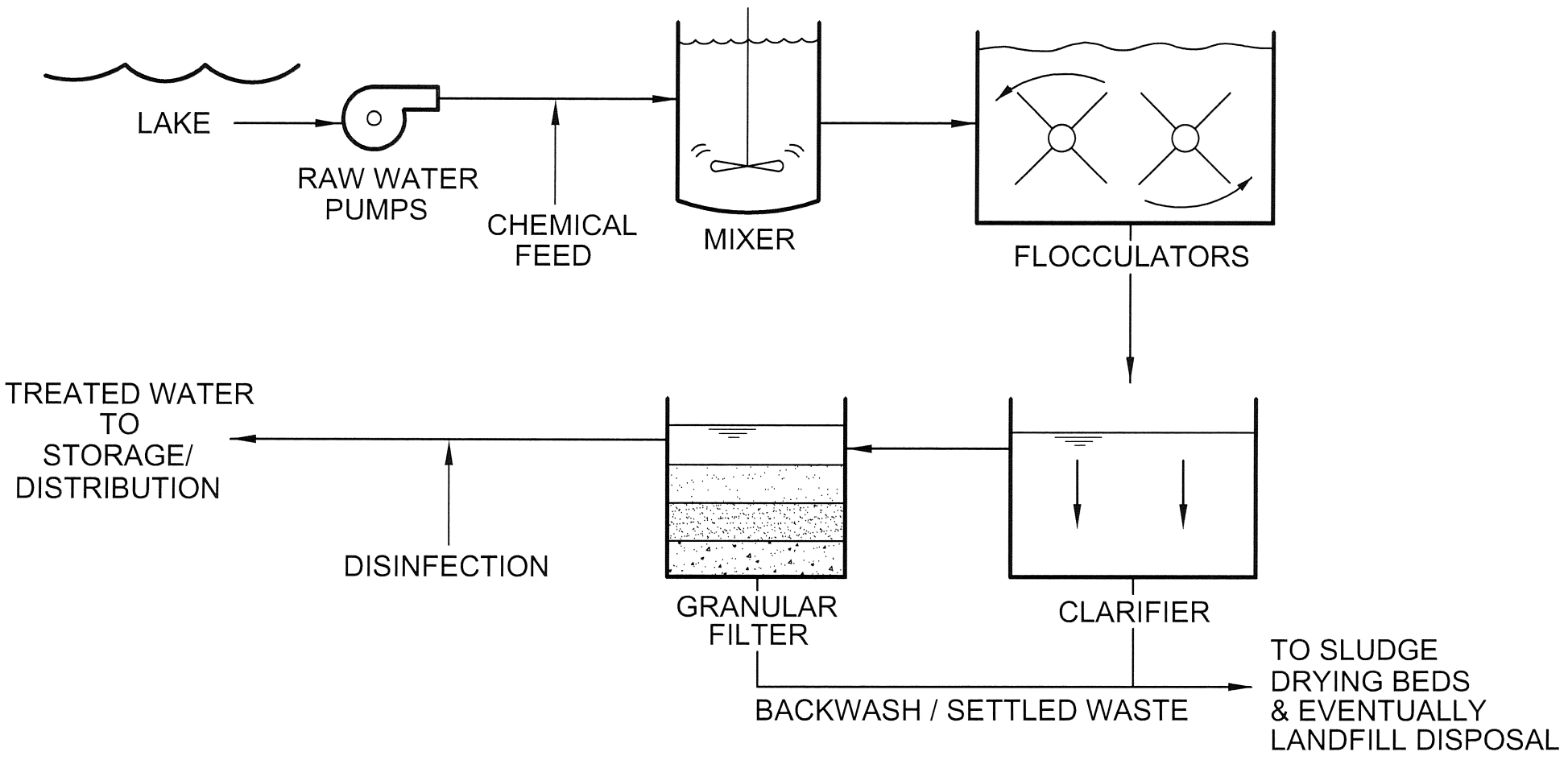


Table 1
Existing Connection Data

System Name	2005 Estimated Capita per Conn.	2005 Conn's	2005 Estimated Population
LIBERTY COUNTY			
Big Thicket Lake Estates No. 1	2.45	92	225
Big Thicket Lake Estates No. 2	2.45	157	385
Hoop and Holler Lake Estates	2.45	119	291
Horseshoe Lake Estates	2.46	157	386
New River Lake Estates	2.56	52	133
Old Snake River Estates East	2.76	49	135
Old Snake River Estates West	2.78	18	50
Sam Houston Lake Estates No. 1	2.55	31	79
Sam Houston Lake Estates No. 2	2.54	13	33
POLK COUNTY			
Bass Bay	2.29	38	87
Beech Creek	2.69	123	331
Crystal Lakes	2.67	91	243
Eagles Nest	2.39	23	55
Forest Hills	2.30	128	295
Goodrich North	2.44	63	154
Green Acres	2.50	30	75
Hoot Owl Hollow	2.75	4	11
Indian Hill No. 2	2.26	267	603
Indian Springs Lake Estates	2.44	348	849
Lake Livingston Estates No. 1	2.42	67	162
Lake Livingston Estates No. 2&3	2.42	114	276
Natasha Heights	2.50	155	388
Nugents Cove (East)	2.24	77	172
Paradise Acres	2.24	391	876
Pine Shadows	2.27	929	2,109
Putnam's Landing	2.42	116	281
Sandy Ridge	2.11	103	217
Sportsmens Retreat	2.28	143	326
Wiggins Village No. 1	2.51	186	467
Wiggins Village No. 2	2.46	151	372
Wild Country Lake Estates	2.38	222	528
SAN JACINTO COUNTY			
Flowing Wells	2.70	44	119
Holiday Shores No. 1-2-3	2.31	274	632
Northwoods	2.16	184	397
Paradise Cove	2.35	40	94
Point Lookout Estates	2.16	173	373
Shepherd Woods	2.83	6	17
TRINITY COUNTY			
Timber Bay	2.30	476	1,093
TYLER COUNTY			
Wayward Winds Oasis	2.41	22	53
WALKER COUNTY			
Riverside Harbor	2.32	116	269

Table 2
Historical Pumpage and Demand

System Name	2003 Annual Water Pumped (Gal.)	2003 Annual Water Consumed (Gal.)	2004 Annual Water Pumped (Gal.)	2004 Annual Water Consumed (Gal.)	2005 Annual Water Pumped (Gal.)	2005 Annual Water Consumed (Gal.)	2003-2005 Avg. Water Pumped per Conn. (gpd)	2003-2005 Avg. Water Pumped per Capita (gpd)	2003 Water Loss
Note: Blanks indicate data is either not available or not representative of current system									
LIBERTY COUNTY									
Big Thicket Lake Estates No. 1	7,052,000	3,939,000	16,194,000	4,381,000	8,089,000	4,305,000	311	127	60%
Big Thicket Lake Estates No. 2	29,032,000	7,916,000	27,866,000	7,441,000	41,708,000	8,070,000	574	234	76%
Hoop and Holler Lake Estates	23,708,000	7,067,000	23,980,000	6,525,000	22,001,000	6,357,111	535	219	71%
Horseshoe Lake Estates					21,500,000	4,709,049	375	153	78%
New River Lake Estates	2,848,000	1,767,000	2,061,000	1,505,000	2,946,000	2,100,000	138	54	32%
Old Snake River Estates East					9,222,000	2,586,000	516	187	72%
Old Snake River Estates West					3,774,000	1,080,000	574	207	71%
Sam Houston Lake Estates No. 1	7,393,000	1,492,000	8,677,000	4,271,000	12,430,000	815,000	840	329	77%
Sam Houston Lake Estates No. 2	1,289,000	537,000	1,802,000	1,454,000	6,583,000	995,000	680	268	69%
POLK COUNTY									
Bass Bay	3,996,000	1,469,000	2,331,000	1,156,000	1,745,000	1,296,000	194	85	51%
Beech Creek	8,847,000	7,776,000	9,212,000	7,867,000	9,520,000	7,788,000	205	76	15%
Crystal Lakes	8,746,000	4,702,000	6,548,000	4,195,000	8,336,000	4,798,000	237	89	42%
Eagles Nest	2,355,000	1,449,000	3,395,000	1,212,000	5,629,000	2,205,000	452	189	57%
Forest Hills	12,943,000	7,622,000	15,640,000	6,502,000	15,417,000	8,478,000	314	136	49%
Goodrich North	6,001,000	3,810,000	6,094,000	3,910,000	6,453,000	4,390,000	269	110	35%
Green Acres	1,912,000	1,697,000	2,060,000	1,565,000	2,374,000	1,494,000	193	77	25%
Hoot Owl Hollow	586,000	458,000	719,000	396,000			447	163	35%
Indian Hill No. 2	14,586,000	9,788,000	18,521,000	9,407,000	21,614,000	13,882,000	187	83	40%
Indian Springs Lake Estates	46,492,000	18,604,000	48,613,000	16,423,000	47,281,000	17,603,000	374	153	63%
Lake Livingston Estates No. 1	2,278,000	2,148,000	2,637,000	2,305,000	3,297,000	2,240,000	112	46	18%
Lake Livingston Estates No. 2&3	3,175,000	3,072,000	3,592,000	3,210,000	4,871,000	3,309,000	93	39	18%
Natasha Heights	18,437,000	7,314,000	16,747,000	6,995,000	20,457,000	7,349,000	328	131	
Nugents Cove (East)					2,007,000	1,689,000	71	32	
Paradise Acres	21,421,000	11,629,000	20,717,000	13,680,000	24,251,000	14,277,000	155	69	40%
Pine Shadows	57,158,000	38,283,000	55,826,000	37,586,000	61,726,000	31,786,000	172	76	38%
Putnam's Landing	6,470,000	4,209,000	7,333,000	4,271,000	10,380,000	4,189,000	190	79	48%
Sandy Ridge	4,783,000	3,467,000	4,952,000	3,216,000	5,636,000	3,256,000	136	65	35%
Sportsmens Retreat	9,429,000	6,193,000	13,330,000	5,530,000	11,877,000	5,709,000	221	97	50%
Wiggins Village No. 1	22,681,000	11,754,000	19,973,000	9,811,000	16,369,000	9,737,000	290	115	47%
Wiggins Village No. 2	13,193,000	7,280,000	17,196,000	7,773,000	20,204,000	7,913,000	306	124	55%
Wild Country Lake Estates	15,248,000	8,037,000	19,007,000	8,061,000	28,878,000	7,852,000	260	109	62%
SAN JACINTO COUNTY									
Flowing Wells	2,851,000	2,419,000	4,344,000	2,453,000	4,699,000	2,256,000	247	91	40%
Holiday Shores No. 1-2-3	17,880,000	12,196,000	16,295,000	9,958,000			171	74	35%
Northwoods			9,623,000	8,047,000	16,954,000	9,762,000	198	92	33%
Paradise Cove	1,489,000	1,191,000	2,072,000	1,326,000	2,373,000	1,532,000	135	58	32%
Point Lookout Estates	9,372,000	6,973,000	10,332,000	6,660,000	10,883,000	8,411,000	161	75	28%
Shepherd Woods									
TRINITY COUNTY									
Timber Bay					28,026,000	20,537,000	161	70	27%
TYLER COUNTY									
Wayward Winds Oasis	3,974,000	829,000	3,828,000	724,000	4,385,000	735,000	506	210	81%
WALKER COUNTY									
Riverside Harbor	8,375,000	5,160,000	8,819,000	5,075,000	12,231,000	5,114,000	232	100	48%

2005 Average Water Consumed Per Capita Per Day = 48 gal

*2003-2004 Annual Water Pumped and Consumed Data is calculated from LLWSSSC's Monthly Meter Reading Records
*2005 Annual Water Pumped and Consumed Data from 2005 TWDB Water Audit

Table 3
Summary of Existing Deficiencies and Projected Future Plant Deficiencies

● currently deficient (or, for plant components, at 85+% of capacity)
20XX plant components projected to be deficient by 20XX

System	Water Quality		Plant Capacity				Distribution System			Unusual Problems (see next page)
	Primary Constituent(s)	Secondary Constituent(s)	Well	Ground Storage Tank	Service Pump	Pressure Tank	Severe Water Loss	Excessive Water Loss	Pressure Problems	
Liberty County										
Big Thicket Lake Estates No. 1					2035		●		●	1,2,6
Big Thicket Lake Estates No. 2			●	2025	●	2035	●		●	1,2,7,8
Hoop and Holler Lake Estates				2035	●		●		●	9
Horseshoe Lake Estates					●		●		●	17
New River Lake Estates					2035		●			
Old Snake River Estates East							●			16
Old Snake River Estates West						●	●			3
Sam Houston Lake Estates No. 1		●					●		●	1
Sam Houston Lake Estates No. 2							●			1,3,4
Polk County										
Bass Bay	●	●	●			●	●			
Beech Creek			●	●				●		
Crystal Lakes	●		●		●		●		●	
Eagles Nest						●	●			
Forest Hills	●	●	●	●	●	●	●		●	
Goodrich North					2015		●			10
Green Acres	●							●		
Hoot Owl Hollow							●			3,4
Indian Hill No. 2		●	●	●	●	●	●		●	
Indian Springs Lake Estates	●	●	●			●	●			
Lake Livingston Estates No. 1					●			●		
Lake Livingston Estates No. 2 & 3		●		●		2035		●		11
Natasha Heights	●		●		2025		●			
Nugents Cove (East)				●		●		●		
Paradise Acres	●	●	●			2025			●	
Pine Shadows			●	●	●	●	●		●	
Putnam's Landing			●		●		●		●	2
Sandy Ridge		●			2035		●			5,12
Sportsmens Retreat			2025	2035			●		●	5,13
Wiggins Village No. 1				●	●		●		●	
Wiggins Village No. 2				2025			●		●	2
Wild Country Lake Estates			●	2025	●	●	●			
San Jacinto County										
Flowing Wells					2035		●			2
Northwoods			●	●	2015	2025	●		●	
Paradise Cove			●			●	●		●	
Point Lookout Estates		●	●	●	●	2025		●		
Shepherd Woods			?			●	●			14
Trinity County										
Timber Bay			●					●		
Tyler County										
Wayward Winds Estates			2035				●			2,15
Walker County										
River Side Harbor		●			2010		●			

Table 3
Summary of Existing Deficiencies
and Projected Future Plant Deficiencies

Unusual Problems (see far right column on previous page)

Symbol	Description
1	Many uncovered water mains.
2	Many dead-end water mains.
3	Plant lies within area prone to flooding.
4	Plant is barely accessible due to poor condition of access road(s).
5	Several water lines are aligned along backs of lots, near septic systems.
6	Level indicator on ground storage tank is broken.
7	Understanding Plant no longer being used due to hole in on-site well casing.
8	Jennifer Plant lies within area prone to flooding.
9	Approximately 20 ft. of fence at Hoop & Holler Plant needs to be repaired or replaced.
10	Pinhole leak in pressure tank.
11	Flowmeter on well in back of plant is broken.
12	Support structure and ladder for aerator is severely corroded.
13	Ground storage tank needs refurbishing.
14	Well is not currently metered but we understand that LLWSSSC has ordered a meter.
15	At least one of the existing pressure tanks has a leak. We understand that LLWSSSC has ordered a new 2,500-gallon tank, to replace the existing tanks. In this report the 2,500-gallon tank is considered to be the "Existing" pressure storage capacity.
16	Pressure tanks in poor condition and in need of replacement.
17	Karenence Dr. Plant no longer being used due to hole in on-site well casing.

Table 4
Historical and Projected
Average Annual Growth Rates

Rates calculated from TWDB projections unless otherwise indicated.
Rates used in this project are shown in **bold**.

	1999-2005	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035
LLWSSSC service areas within Liberty County	-1.84%	**1.22%**	**1.19%**	**1.19%**	**1.02%**	**1.02%**	**0.91%**
Liberty County total		1.56%	1.48%	1.48%	1.24%	1.24%	1.08%
LLWSSSC service areas within Polk County	0.68%	1.26%	**1.12%**	**1.12%**	**0.80%**	**0.80%**	**0.58%**
Polk County total		1.57%	1.34%	1.34%	0.96%	0.96%	0.66%
Polk County total (per Texas Workforce Commission)		**2.50%**					
City of Livingston		0.32%	0.31%	0.31%	0.24%	0.24%	0.18%
City of Onalaska		1.50%	1.31%	1.31%	0.92%	0.92%	0.66%
LLWSSSC service areas within San Jacinto County	0.50%	**3.08%**	**2.31%**	**2.31%**	**1.52%**	**1.52%**	**0.84%**
San Jacinto County total		2.12%	1.72%	1.72%	1.19%	1.19%	0.67%
LLWSSSC service areas within Trinity County	0.34%	**1.09%**	**0.76%**	**0.76%**	**0.24%**	**0.24%**	**-0.13%**
Trinity County total		1.09%	0.76%	0.76%	0.24%	0.24%	-0.01%
LLWSSSC service areas within Tyler County	-3.36%	**1.68%**	**1.44%**	**1.44%**	**0.80%**	**0.80%**	**0.30%**
Tyler County total		1.72%	1.43%	1.43%	0.82%	0.82%	0.30%
LLWSSSC service areas within Walker County	-1.50%	**1.35%**	**0.98%**	**0.98%**	**0.45%**	**0.45%**	**-0.10%**
Walker County total		1.36%	0.98%	0.98%	0.44%	0.44%	-0.11%

Table 5
TWDB Projections for LLWSSSC systems, by County

County	Water Demand Projections (acre-feet) 2000	2010	2020	2030	2040
Liberty	103	108	116	124	130
Polk	840	890	944	985	1004
San Jacinto	237	301	359	402	421
Trinity	104	109	111	110	104
Tyler	6	7	7	8	8
Walker	27	29	30	30	29

County	Population Projections 2000	2010	2020	2030	2040
Liberty	1479	1670	1880	2081	2278
Polk	12091	13706	15319	16590	17577
San Jacinto	3419	4632	5822	6773	7366
Trinity	1501	1673	1805	1849	1826
Tyler	88	104	120	130	134
Walker	384	439	484	506	501

County	Water Demand Per Capita (gall/day/person) 2000	2010	2020	2030	2040
Liberty	62.2	57.7	55.1	53.2	50.9
Polk	62.0	58.0	55.0	53.0	51.0
San Jacinto	61.9	58.0	55.0	53.0	51.0
Trinity	61.9	58.2	54.9	53.1	50.8
Tyler	60.9	60.1	52.1	54.9	53.3
Walker	62.8	59.0	55.3	52.9	51.7

Table 6
Construction Cost Projection

			County:	(Recommended Alternatives For All Systems Combined)							
			System Name:	SUMMARY							
				2005-2010		2010-2015		2015-2025		2025-2035	
Item	Units	Unit Price		Quantity	Total	Quantity	Total	Quantity	Total	Quantity	Total
Surface water treatment plant	**mgd**	**(varies)**		**2.75**	**$5,414,797**	**0.00**	**$0**	**0.00**	**$0**	**0.00**	**$0**
Transmission and Distribution											
Service pumps	Hp	$300		380	$114,000	65	$19,500	0	$0	15	$4,500
Rating (eff ,gpm, TH)	*60%*	*160*		5,100	$0	900	$0	0	$0	200	$0
12" PVC Pipe	LF	$34		5,270	$179,180	0	$0	0	$0	0	$0
10" PVC Pipe	LF	$28		2,160	$60,480	0	$0	0	$0	0	$0
8" PVC Pipe	LF	$22		70,864	$1,559,008	2,160	$47,520	5,250	$115,500	0	$0
6" PVC Pipe	LF	$17		44,660	$759,220	9,750	$165,750	7,320	$124,440	2,350	$39,950
4" PVC Pipe	LF	$13		169,883	$2,208,479	51,729	$678,407	0	$0	0	$0
3" PVC Pipe	LF	$11		22,750	$250,250	33,652	$370,172	2,900	$31,900	0	$0
2" PVC Pipe	LF	$9		27,750	$249,750	96,410	$876,000	55,110	$495,990	0	$0
Service connections	EA	$400		871	$348,516	740	$295,823	100	$39,834	0	$0
Specials	LS	(varies)		0	$0	0	$0	0	$0	0	$0
Transmission and Distribution Subtotal					**$5,728,883**		**$2,453,172**		**$807,664**		**$44,450**
Source											
Well rehab	LS	(varies)		0	$0	0	$0	1	$15,000	0	$0
Abandon well	Inches	$500		120	$60,000	0	$0	0	$0	0	$0
Test hole	LF	$20		4,400	$88,000	0	$0	0	$0	0	$0
Log & tests	EA	$7,500		6	$45,000	0	$0	0	$0	0	$0
Well base cost	Inches	$2,500		42	$105,000	0	$0	0	$0	0	$0
Well depth	LF	$50		3,200	$160,000	0	$0	0	$0	0	$0
Completion	EA	$5,000		6	$30,000	0	$0	0	$0	0	$0
Well pumps	Hp	$650		100	$65,000	0	$0	10	$6,500	0	$0
Rating (eff ,gpm, TH)	*60%*	*250*		825	$0	0	$0	75	$0	0	$0
Chlorinators	EA	$7,500		4	$30,000	0	$0	0	$0	0	$0
Forced draft aerator	LS	(varies)		1	$25,000	0	$10,000	0	$0	0	$0
Arsenic treatment	LS	(varies)		0	$0	0	$0	0	$0	0	$0
Source Subtotal					**$608,000**		**$10,000**		**$21,500**		**$0**
Storage											
Storage tanks (bolted)	Gals	*Variable*		185,000	$132,000	20,000	$20,400	20,000	$20,400	51,000	$47,200
Refurbish GS tank	Gals	$0.25		161,636	$40,409	0	$0	0	$0	0	$0
Pressure tanks	Gals	$4.50		23,500	$105,750	2,000	$9,000	3,500	$15,750	1,000	$4,500
Refurbish pressure tank	Gals	$0.55		3,500	$1,925	0	$0	0	$0	0	$0
Air compressor	EA	$1,200		7	$8,400	2	$2,400	3	$3,600	1	$1,200
Elevated storage/standpipe	Gals	(varies)		400,000	$340,000	0	$0	0	$0	0	$0
Storage Subtotal					**$628,484**		**$31,800**		**$39,750**		**$52,900**
Misc.											
Plant piping	LS	30%			$258,745		$18,390		$13,875		$17,220
Electrical	LS	25%			$68,188		$7,975		$2,525		$1,425
Controls	LS	25%			$205,038		$15,325		$11,563		$14,350
Aux generator	LS	$15,000		7	$105,000	2	$30,000	2	$30,000	2	$30,000
Buildings	SF	$85		710	$60,350	0	$0	0	$0	0	$0
Security fence	LF	$18		1,610	$28,980	70	$1,260	120	$2,160	290	$5,220
Access road	SY	$10		3,200	$32,000	0	$0	0	$0	0	$0
Sitework	LS	15%			$111,465		$4,410		$5,423		$7,755
Demolition	LS	(varies)		8	$130,000	0	$0	0	$0	0	$0
Other	LS	(varies)		0	$0	0	$0	0	$0	0	$0
Misc. Subtotal					**$999,765**		**$77,360**		**$65,545**		**$75,970**
Construction Contingency		10%		10%	$1,337,993	10%	$257,233	10%	$93,446	10%	$17,332
Construction Subtotal					**$14,717,923**		**$2,829,566**		**$1,027,905**		**$190,652**
Land (sites)	Ac	(varies)		18.20	$191,000	0.00	$0	0.10	$500	0.25	$1,250
Easements	LF	$2.00		11,850	$23,700	0	$0	24,340	$48,680	0	$0

Big Thicket Lake Estates No. 1
Big Thicket Lake Estates No. 2

Improvement Alternative #1: Combine systems, eliminate Jennifer plant, re-utilize Understanding plant

By 2010:

- Drill new offsite well pumping into No. 2 Understanding plant.
- Eliminate Jennifer plant; abandon well and demolish/salvage remaining facilities.
- Refurbish ground storage tank at Bear Track and Understanding plants.
- Refurbish pressure tank at Understanding plant.
- Replace existing high service pumps, chlorinator, and air compressor at Understanding plant.
- Improve portions of distribution line network.

Recommended Alternative: Alternative #1

Hoop and Holler

Improvement Alternative #1: Improve Existing Configuration

By 2010:

- Replace existing high service pumps and repair damaged fence at Hoop and Holler plant.
- Improve portions of distribution line network.

By 2015:

- Improve portions of distribution line network.

By 2025:

- Loop portions of distribution line network with new lines within easements.

By 2035:

- Construct another ground storage tank at Hoop and Holler plant.

Recommended Alternative: Alternative #1

Horseshoe Lake Estates

Improvement Alternative #1: Improve existing configuration

By 2010:

- Replace existing high service pumps.
- Abandon the existing well and demolish the plant at the east part of the system. The well screen is broken and repair would not be cost-effective.
- Improve portions of distribution line network.

By 2015:

- Improve portions of distribution line network.

By 2025:

- Loop portions of distribution line network with new lines within easements.

Recommended Alternative: Alternative #1.

New River Lake Estates

Improvement Alternative #1: Improve Existing Configuration

By 2035:

- Replace existing high service pumps.

Recommended Alternative: Alternative #1.

Old Snake River Estates East
Old Snake River Estates West

Improvement Alternative #1: Eliminate West plant, combine systems

By 2010:

- Replace both high service pumps at East plant.
- Replace pressure tanks and air compressor at East plant.
- Abandon well and demolish West plant.
- Improve portions of distribution line network.

By 2015:

- Improve portions of distribution line network.

Recommended Alternative: Alternative #1

Sam Houston Lake Estates No. 1
Sam Houston Lake Estates No. 2

Improvement Alternative #1: Eliminate No. 2 plant and combine systems

By 2010:

- Eliminate the No. 2 plant: abandon well and demolish/salvage the remaining facilities.
- Improve portions of distribution line network.

By 2015:

- Improve portions of distribution line network.

By 2025:

- Add another pressure tank to, and replace air compressor at, No. 1 plant.
- Loop portions of existing distribution system with new lines within easements.

Recommended Alternative: Alternative #1

Scenic Loop Area Systems (Pine Shadows, Indian Hills Estates, Lake Livingston Estates Nos. 4 & 5, Indian Hills No. 2, Bass Bay and Forest Hills, Natasha Heights, Green Acres)

Improvement Alternative #1: Improve groundwater systems

By 2010:

A system by system breakdown is included in Table 5. A new, remote well plant will be constructed to supplement the Pine Shadows plant. Together these plants will serve Pine Shadows, Lake Livingston Estates Nos. 4&5, Indian Hill Estates, and Indian Hills No. 2. The existing repump configuration for Indian Hills Estates will remain in place. Lake Livingston Estates Nos. 4&5 will be served through a new pump station, supplied by the remote well plant and Pine Shadows well plant. Existing wells located in Indian Hills No. 2, Green Acres, Bass Bay, and Nugent's Cove East will be abandoned, as well as one well in Natasha Heights. With the exception of the Nugent's Cove East well, these wells are being abandoned due to water quality problems. The Nugent's Cove East well is being abandoned due to the minimal water production and high cost for pump station improvements. Natasha Heights and Green Acres systems will be combined and a new well drilled in Natasha to supply the additional demand from Green Acres. The Forest Hills well plant will be upgraded to accommodate the Bass Bay demand.

- Construct remote well plant at south side of Scenic Loop. Plant will include pressure filters.
- Construct new transmission mains from the proposed remote well plant to Pine Shadows, Indian Hills No.2, and Lake Livingston Estates Nos. 4&5.
- Install new pump station at Lake Livingston Estates Nos. 4&5.
- Install an additional service pump at Forest Hills and Natasha Heights.
- Drill new wells in Natasha Heights and Forest Hills.
- Install an auxiliary generator at Pine Shadows, remote well plant, Natasha Heights, Lake Livingston Estates Nos. 4&5, Forest Hills, and Indian Hills Estates.
- Abandon one well at Natasha Heights and the entire well plants at Bass Bay, Green Acres, and Indian Hills No. 2. These wells have high levels of arsenic, manganese, and/or chlorides. Also abandon the entire well plant at Nugent's Cove.

- Install new pressure tanks and replace air compressors at Forest Hills and Indian Hill Estates plants.

- Improve portions of the distribution pipe network in Indian Hills Estates, Natasha Heights, and Lake Livingston Estates Nos. 4&5.

- Install arsenic treatment equipment for Natasha Heights wells.

- Install pressure filters at Forest Hills plant.

By 2025:

- Install new pressure tank and replace air compressor at Natasha Heights.

- Construct new ground storage tanks at Indian Hills Estates, Lake Livingston Estates Nos. 4&5, Forest Hills, and remote well plant.

Improvement Alternative #2: Add surface water treatment plant and elevated storage

By 2010:

A surface water treatment plant will be constructed. The planned capacity of this plant is 1.50 mgd. Along with this plant, new transmission mains and a new 150,000-gallon elevated storage tank will be constructed. Two existing pressure-boosting pump stations will be expanded.

- Construct surface water treatment plant at south side of Scenic Loop.

- Construct new transmission mains from the proposed plant to Pine Shadows, Indian Hills No.2, Natasha Heights, Green Acres, Lake Livingston Estates Nos. 4&5, Bass Bay, and Forest Hills.

- Install new pump station and service pumps for the SWTP and repump point for Lake Livingston Estates Nos. 4&5, Bass Bay, and Forest Hills.

- Install an auxiliary generator at Pine Shadows, SWTP, Natasha Heights, new plant at Lake Livingston Estates Nos. 4&5, and Indian Hills Estates.

- Abandon wells at Bass Bay, Green Acres, Indian Hills No. 2, and one well at Natasha Heights. These wells have high levels of arsenic, manganese, and/or chlorides. Also abandon the well at Nugent's Cove East.

- Remove the pump station plants at Indian Hills No. 2, Bass Bay, Green Acres, and Nugent's Cove East.

- Install new pressure tank and replace air compressor at Indian Hills Estates, new plant at Lake Livingston Estates Nos. 4&5, and the SWTP.

- Construct elevated storage tank.

- Construct new ground storage tanks at Indian Hills Estates, new plant at Lake Livingston Estates Nos. 4&5, Forest Hills, and SWTP.

Recommended Alternative: Alternative #2

Alternative #2 appears to be advantageous overall and is the recommended alternative.

Alternative #2 involves treatment of surface water, which would be a more reliable source of supply than groundwater.

Alternative #2 also features elevated storage, while Alternative #1 features pressure storage only. Elevated storage has many benefits over pressure storage, including the following:

- Dampens pressure fluctuations in the distribution system;

- Minimizes cycling of service pumps, which results in longer pump life;

- Provides another pressure point for the system;

- Is safer, because the tank itself is not pressurized;

- Helps satisfy the TCEQ total storage requirement.

The projected capital cost of Alternative #2 is slightly higher than that of Alternative #1. Alternative #2 features a slightly lower projected annual operational and maintenance (o&m) cost than Alternative #1. Additionally, the annual fees to be paid the local Groundwater Conservation District would be less for Alternative #2, due to the lesser well pumpage.

The attached cost tables indicate that the projected capital costs and the projected o&m costs are each within 5% of each other for both alternatives. Given the inexact nature of planning-stage cost projections, a reasonable “margin of error” is taken into account and the numbers are thus considered to be practically equal. That being the case, the clear advantages of source reliability and elevated storage lead to the selection of Alternative #2 as the recommended alternative.

Inquiries were made to several neighboring utilities in the Scenic Loop area regarding potential interest in purchasing wholesale water from LLWSSSC. None of these utilities

indicated an urgent interest in purchasing water, but those that expressed possible interest were Texas Landing Utilities and Monarch Utilities I LP. The service areas of these water systems are shown on **Figures _ and _**. Texas Landing Utilties' service area lies between Natasha Heights and Green Acres. Monarch Utilities I LP's service area (Pinwah Pines Estates Subdivision) lies between Lake Livingston 4 & 5 and Bass Bay. Those that expressed no interest were Tempe WSC 1, RC WSC, and Pure Utilities. It is recommended that, as LLWSSSC advances with the preliminary engineering for the Scenic Loop improvements, communication with Texas Landing Utilities and Monarch Utilities I LP continue, as all parties might well benefit from the economies of scale that could result from a water purchase agreement.

Beech Creek and Crystal Lake Estates

Improvement Alternative #1: Keep systems separate

By 2010:

- New wells for each system, with the existing Crystal Lake Estates well being abandoned.
- New ground storage tank at Beech Creek.
- New high service pumps at Crystal Lake Estates.
- New water lines throughout Crystal Lake Estates.

By 2035:

- Replace high service pumps at Beech Creek.

Improvement Alternative #2: Combine systems, construct distribution line along Hwy. 190 from Beech Creek to Crystal Lake Estates, demolish Crystal Lake Estates plant

By 2010:

- Construct new well at Beech Creek.
- Construct another ground storage tank at Beech Creek plant.
- Replace high service pumps at Beech Creek plant.
- New 6” distribution line along Hwy. 190 form Beech Creek to Crystal Lake Estates.
- New water lines throughout Crystal Lake Estates.

By 2015:

- Install new pressure tank and air compressor at Beech Creek plant.
- Install new auxiliary generator at Beech Creek plant.

Improvement Alternative #3: Abandon Crystal Lakes well, construct transmission line along Hwy. 190 from Beech Creek to Crystal Lake Estates, supply Crystal Lake Estates pump station from Beech Creek

By 2010:

- Construct new well at Beech Creek.
- Construct another ground storage tank at Beech Creek plant.
- Replace high service pumps at Beech Creek plant and at Crystal Lake Estates plant.
- New 4" transmission line along Hwy. 190 form Beech Creek to Crystal Lake Estates.
- New water lines throughout Crystal Lake Estates.

By 2015:

- Install new auxiliary generator at Beech Creek plant.

Recommended Alternative: Alternative #2

Projected capital costs of all three alternatives are within about $20,000 of each other. Alternative #2 is recommended because 1) it would facilitate the simplest operation, being that there would only be one pump station to maintain, and 2) the Beech Creek pump station is about 60 ft. higher in elevation than the Crystal Lake Estates pump station, so LLWSSSC should take advantage of the topographic pressurization, rather than storing and re-pumping at Crystal Lake Estates.

Eagles Nest and Wild Country Lake Estates

Improvement Alternative #1: Keep systems separate

By 2010:

- Add another pressure tank to, and replace air compressors at, both Eagles Nest plant and Wild Country Lake Estates plant.
- Replace existing high service pumps at Wild Country Lake Estates plant.
- Install auxiliary generator at Wild Country Lake Estates plant.
- Improve portions of distribution line networks at both Eagles Nest and Wild Country Lake Estates.

By 2015:

- Improve portions of distribution line network at Wild Country Lake Estates.

By 2025:

- Construct another ground storage tank at Wild Country Lake Estates plant.
- Improve portions of distribution line network at Wild Country Lake Estates.

Improvement Alternative #2: Combine systems

By 2010:

- Replace existing high service pumps at Wild Country Lake Estates plant.
- Install auxiliary generator at Wild Country Lake Estates plant.
- Improve portions of distribution line networks at both Eagles Nest and Wild Country Lake Estates.

By 2015:

- Construct another ground storage tank at Wild Country Lake Estates plant.
- Improve portions of distribution line network at Wild Country Lake Estates.

By 2025:

- Add another pressure tank to, and replace air compressor at, Wild Country Lake Estates plant.

- Improve portions of distribution line network at Wild Country Lake Estates.

Recommended Alternative: Alternative #2

The projected capital costs of the two alternatives are very similar. Alternative #2 is recommended because the added redundancy will be beneficial when either plant is temporarily out of service. The two plants are located at about the same elevation, so they should operate well together.

Goodrich North

Improvement Alternative #1: Improve existing configuration

By 2010:

- Refurbish pressure tank.

By 2015:

- Replace high service pumps.

Recommended Alternative: Alternative #1

Hoot Owl Hollow

Improvement Alternative #1: Construct new plant above flood zone, abandon existing plant

By 2010:

- Abandon well and demolish plant.
- Construct new plant, including well, pressure tank, and building housing chlorination, electrical and control equipment.

Improvement Alternative #2: Sell system to interested party

By 2010:

- A local resident has expressed interest in purchasing this system from LLWSSSC.

Recommended Alternative: Alternative #2

Considering that Hoot Owl Hollow has only four connections, minor projected growth, a completely "unlooped" distribution system that requires regular flushing, and the need for a complete new groundwater plant, it is recommended that LLWSSSC pursue the potential sale.

Indian Springs Lake Estates

Improvement Alternative #1: Improve existing configuration

By 2010:

- Drill new well at Ole Don well site near James plant. Well to discharge into ground storage tanks at James plant.
- Add another pressure tank, and replace air compressor, at James plant.
- Install auxiliary generator at James plant.
- Improve portions of distribution line network.

Recommended Alternative: Alternative #1

Lake Livingston Estates No. 1

Improvement Alternative #1: Replace distribution line network

By 2010:

- Replace distribution line network, with larger pipes and no back-lot pipes.
- Replace high service pumps.

Recommended Alternative: Alternative #1

Lake Livingston Estates Nos. 2&3 and Putnam's Landing

Improvement Alternative #1: Keep systems separate

By 2010:

- Replace existing 2-ring ground storage tank at Lake Livingston Estates Nos. 2 & 3 plant with new 3-ring tank. There is not sufficient room in the plant site to build a supplemental tank, and the adjacent lots are already developed.
- Install new distribution pipe loop around Putnam's Landing.

Improvement Alternative #2: Combine systems

By 2010:

- Install new auxiliary generator at Putnam's Landing plant.
- Install new distribution pipe connecting systems.
- Install new distribution pipe loop around Putnam's Landing.

Recommended Alternative: Alternative #2

The projected capital costs of the two alternatives are practically identical. Alternative #2 is recommended because the added redundancy will be beneficial when either plant is temporarily out of service. The two plants are located at about the same elevation, so they should operate well together.

Sandy Ridge

Improvement Alternative #1: Improve existing configuration

By 2015:

- Refurbish the support structure and ladder for the aerator.
- Improve portions of the distribution line network.

Recommended Alternative: Alternative #1

Sportsmans Retreat

Improvement Alternative #1: Improve existing configuration

By 2010:

- Refurbish ground storage tank.
- Improve portions of distribution line network.

By 2015:

- Improve portions of the distribution line network.

By 2025:

- Rehabilitate existing 58 gpm well.

By 2035:

- Construct another ground storage tank.

Recommended Alternative: Alternative #1

Wiggins Village No. 1

Improvement Alternative #1: Improve existing configuration

By 2010:

- Construct new ground storage tank.
- Improve portions of distribution line network.

By 2015:

- Improve portions of distribution line network.

By 2035:

- Install new pressure tank and replace air compressor.
- Install auxiliary generator.

Recommended Alternative: Alternative #1

Wiggins Village No. 2

Improvement Alternative #1: Improve existing configuration

By 2010:

- Improve portions of distribution line network.

By 2025:

- Construct another ground storage tank.
- Loop portions of distribution line network with new lines within easements.

Recommended Alternative: Alternative #1

Wilson Lake Estates

Improvement Alternative #1: Improve existing configuration

By 2010:

- Improve portions of distribution line network. Raise system operating pressure by approx. 5 psi.

By 2015:

- Improve portions of distribution line network.

Recommended Alternative: Alternative #1

Flowing Wells

Improvement Alternative #1: Loop water mains

By 2015:

- Improve portions of distribution line network.

By 2025:

- Loop portions of distribution line network with new lines within easements.

Recommended Alternative: Alternative #1

Northwoods and Point Lookout Estates

Improvement Alternative #1: Keep systems separate

This would involve the construction of a complete new groundwater plant between Point Lookout West and Point Lookout Estates. The plant would replace all existing plant facilities within the Point Lookout Estates system except for the existing Point Lookout Estates well, which would pump into the new plant. This would also involve the expansion of the Northwoods groundwater plant.

By 2010:

- Construct new Point Lookout plant, with well, ground storage tank, high service pump station, pressure tank, and related building, chlorination, electrical, and control facilities. Construct well discharge line from existing well at Point Lookout Estates plant to ground storage tank at new plant.
- Abandon well at, and demolish, Point Lookout West plant.
- Construct new well at Northwoods.
- Construct new ground storage tank at Northwoods plant.

By 2015:

- Replace high service pumps at Northwoods.
- Improve portions of Northwoods and Point Lookout distribution pipe networks.

By 2025:

- Install new pressure tank and air compressor at Northwoods.
- Install new auxiliary generators at Northwoods and Point Lookout.

Improvement Alternative #2: Combine systems, improve Northwoods Plant, build elevated storage tank

This would involve connecting the two systems by way of a new line along Hwy. 190, and serving both systems from the Northwoods plant only. This plant is approximately 20 ft. higher in elevation than the two existing Point Lookout plants. A new high service pump building would replace the existing pump facilities at the Northwoods plant. A small elevated storage tank or standpipe would be built atop the hill about 1,000 ft. east of the Northwoods plant; at this tank site a new well would also be constructed and a

new line discharging into the existing ground storage tank would be installed. The standpipe would pressurize the system and would also help satisfy the TCEQ total storage (elevated plus ground) capacity requirement. The Point Lookout wells would be abandoned and the plants demolished.

By 2010:

- Construct new well and elevated storage tank/standpipe at Northwoods.
- Construct new service pump building at Northwoods.
- Abandon wells at, and demolish, Point Lookout West and Point Lookout Estates plants.
- Construct new distribution line, mainly along Hwy. 190, between Northwoods and Point Lookout West.

By 2015:

- Improve portions of Northwoods and Point Lookout distribution pipe networks.

Recommended Alternative: Alternative #1

Alternative #1 is less expensive in both the short-term and the long-term.

Paradise Cove

Improvement Alternative #1: Improve existing configuration

By 2010:

- Construct new well and associated discharge line to ground storage tank.

By 2025:

- Loop portions of distribution line network with new lines within easements.

Recommended Alternative: Alternative #1

Shepherd Woods

Improvement Alternative #1: Improve existing configuration

By 2010:

- Replace existing pressure tank and air compressor.
- Construct building housing chlorination equipment, air compressor, pressure tank sightglass, and plant electrical and control equipment.

Recommended Alternative: Alternative #1

Holiday Shores 1, 2, 3

Improvement Alternative #1: Improve existing configuration

By 2015:

- Improve portions of distribution line network.

Recommended Alternative: Alternative #1

Timber Bay, Paradise Acres, and Hawg Heaven

LLWSSSC is purchasing source water from the City of Trinity for the Timber Bay system. The available volume of water is less than what that system requires. Furthermore, the cost of this water has increased drastically in recent years.

The source water for the Paradise Acres system, which serves both Paradise Acres and Hawg Heaven, is the Brushy Creek well field. Water from these wells is high in radionuclides. Test wells recently drilled elsewhere in the area did not indicate viable groundwater is available.

Given these supply problems, and proximity to the Lake, it was determined that any viable improvement alternatives will involve treating surface water and abandoning the existing sources. Also, given proximity of these systems to each other, and economies of scale for plant construction, it was determined that one surface WTP should serve both of these water systems. The plant should be located between FM 356 and Barrett's Landing Rd.

The existing groundwater plants are generally in good condition and should be used to store and re-pump the water supplied by the proposed surface WTP and conveyed through proposed transmission mains.

On 3/15/01 TNRCC (now known as TCEQ) granted an exception to LLWSSSC, allowing a value of 0.39 (instead of 0.60) gallons per minute per connection to be used to calculate the required well capacity for the Paradise Acres system. The improvements proposed herein for the Paradise Acres system are sized such to accommodate the standard 0.60 value.

<u>Improvement Alternative #1: Regional surface water treatment plant; transmission mains to all three pump stations</u>

By 2010:

- Construct surface water treatment plant.
- Construct new transmission mains from the proposed plant to the existing pump stations located in, and serving, the Timber Bay, Hawg Heaven, and Paradise Acres systems.
- Replacement of both high service pumps at Hawg Heaven plant.
- Install an auxiliary generator at Timber Bay plant.
- Abandon Brushy Creek wells.

- Improvements to portions of the distribution pipe network at Hawg Heaven.

By 2015:

- Install new pressure tank and replace air compressor at Hawg Heaven plant.
- Install an auxiliary generator at Hawg Heaven plant.
- Improvements to portions of the distribution pipe network in the Timber Bay and Paradise Acres systems.

Improvement Alternative #2: Regional surface water treatment plant; transmission mains to Timber Bay and Hawg Heaven pump stations; elimination of Paradise Acres pump station

By 2010:

- Construct surface water treatment plant.
- Construct new transmission mains from the proposed plant to the existing pump stations located in, and serving the Timber Bay system and Hawg Heaven.
- The Hawg Heaven pump station will serve both Hawg Heaven and Paradise Acres. Delivery to Paradise Acres will be through the existing 6" line along FM 356. The Hawg Heaven plant will undergo a major expansion, including new ground storage, high service pumping, and pressure storage facilities. The Paradise Acres plant will be demolished.
- Abandon Brushy Creek wells.
- Install auxiliary generators at Timber Bay and Hawg Heaven plants.
- Improvements to portions of the distribution pipe network in Hawg Heaven.

By 2015:

- Improvements to portions of the distribution pipe network in Timber Bay and Paradise Acres.

Improvement Alternative #3: Regional surface water treatment plant; transmission mains to Timber Bay and Hawg Heaven pump stations; elimination of Paradise Acres pump station; wholesale supply to City of Trinity

The City of Trinity currently purchases water from Trinity River Authority, and also produces their own water via wells. Alternative #3 involves LLWSSSC providing wholesale supply to the City, in an amount sufficient to meet the entire City demand.

By 2010:

- Construct surface water treatment plant.
- Construct new transmission mains from the proposed plant to the existing pump stations located in, and serving, the Timber Bay system and Hawg Heaven.
- The Hawg Heaven pump station will serve both Hawg Heaven and Paradise Acres. Delivery to Paradise Acres will be through the existing 6" line along FM 356. The Hawg Heaven plant will undergo a major expansion, including new ground storage, high service pumping, and pressure storage facilities. The Paradise Acres plant will be demolished.
- Abandon Brushy Creek wells.
- Install auxiliary generators at Timber Bay and Hawg Heaven plants.
- Improvements to portions of the distribution pipe network in Hawg Heaven.

By 2015:

- Improvements to portions of the distribution pipe network in Timber Bay and Paradise Acres.

Recommended Alternative: Alternative #1

Alternative #1 is less expensive in both the short-term and long-term.

Wayward Winds

Improvement Alternative #1: Improve existing configuration

By 2010:

- Improve portions of the distribution line network.

By 2025:

- Loop portions of distribution line network with new lines within easements.

Improvement Alternative #2: Sell system to another utility

By 2010:

- A neighboring utility (Pure Utilities, Inc.) is familiar with this system and has expressed openness to the idea of purchasing it from LLWSSSC.

Recommended Alternative: Alternative #2

Considering that Wayward Winds has only 22 connections, minor projected growth, a completely “unlooped” distribution system that requires regular flushing, and considering its location (it is approximately 35 miles from the nearest other LLWSSSC system), it is recommended that LLWSSSC resume contact with Pure Utilities regarding the potential sale.

Riverside Harbor

Improvement Alternative #1: Improve existing configuration

By 2010:

- Install forced-draft aerator at plant.
- Replace existing high service pumps.

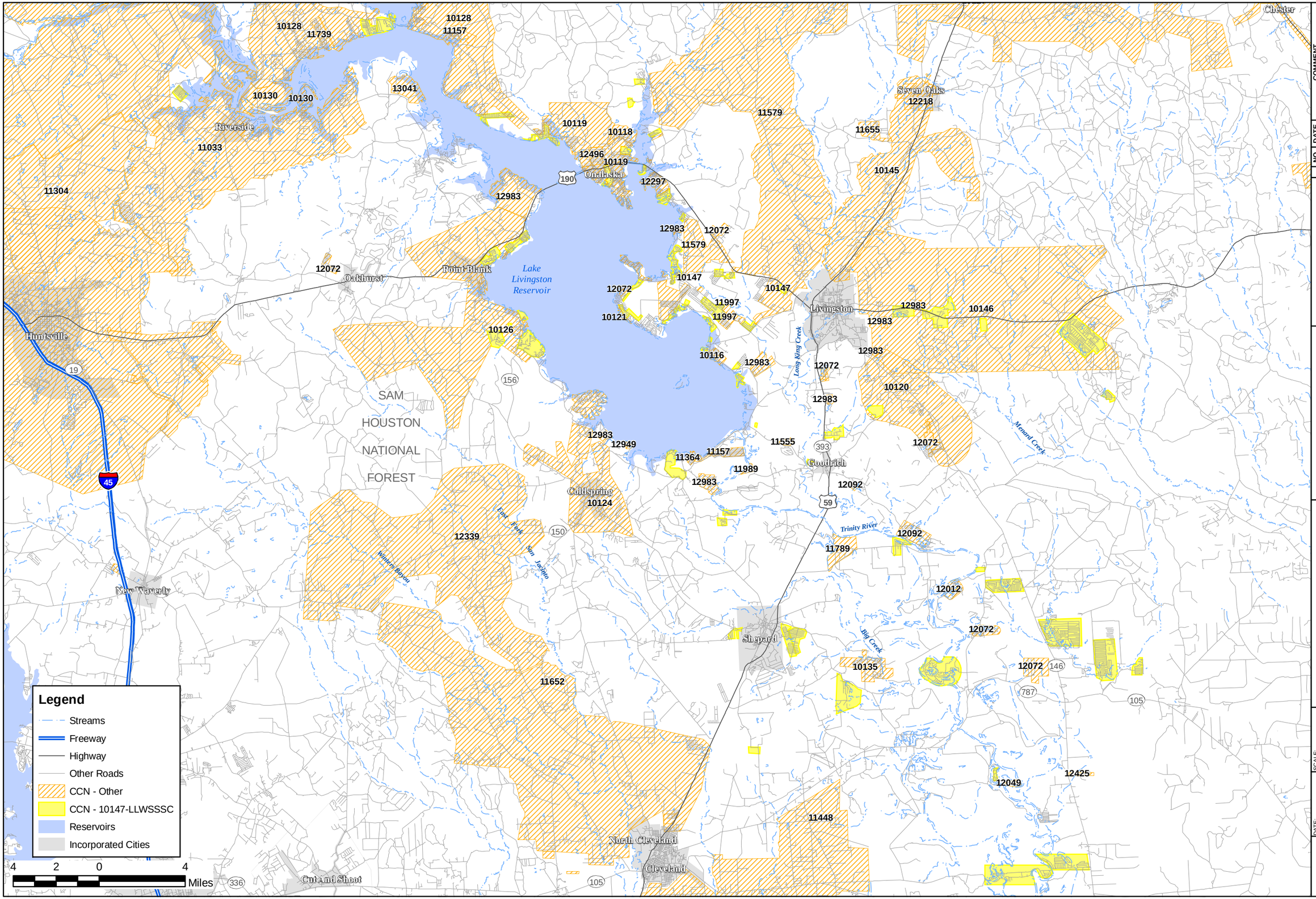
Improvement Alternative #2: Abandon existing well and receive supply from City of Huntsville water system

By 2010:

- Construct water transmission main from existing City of Huntsville water main to Riverside Harbor ground storage tank.
- Abandon existing well.
- Replace existing high service pumps.

Recommended Alternative: Alternative #1

Alternative #1 is much less expensive in both the short-term and long-term.



REVISIONS

NO.	DATE	COMMENT

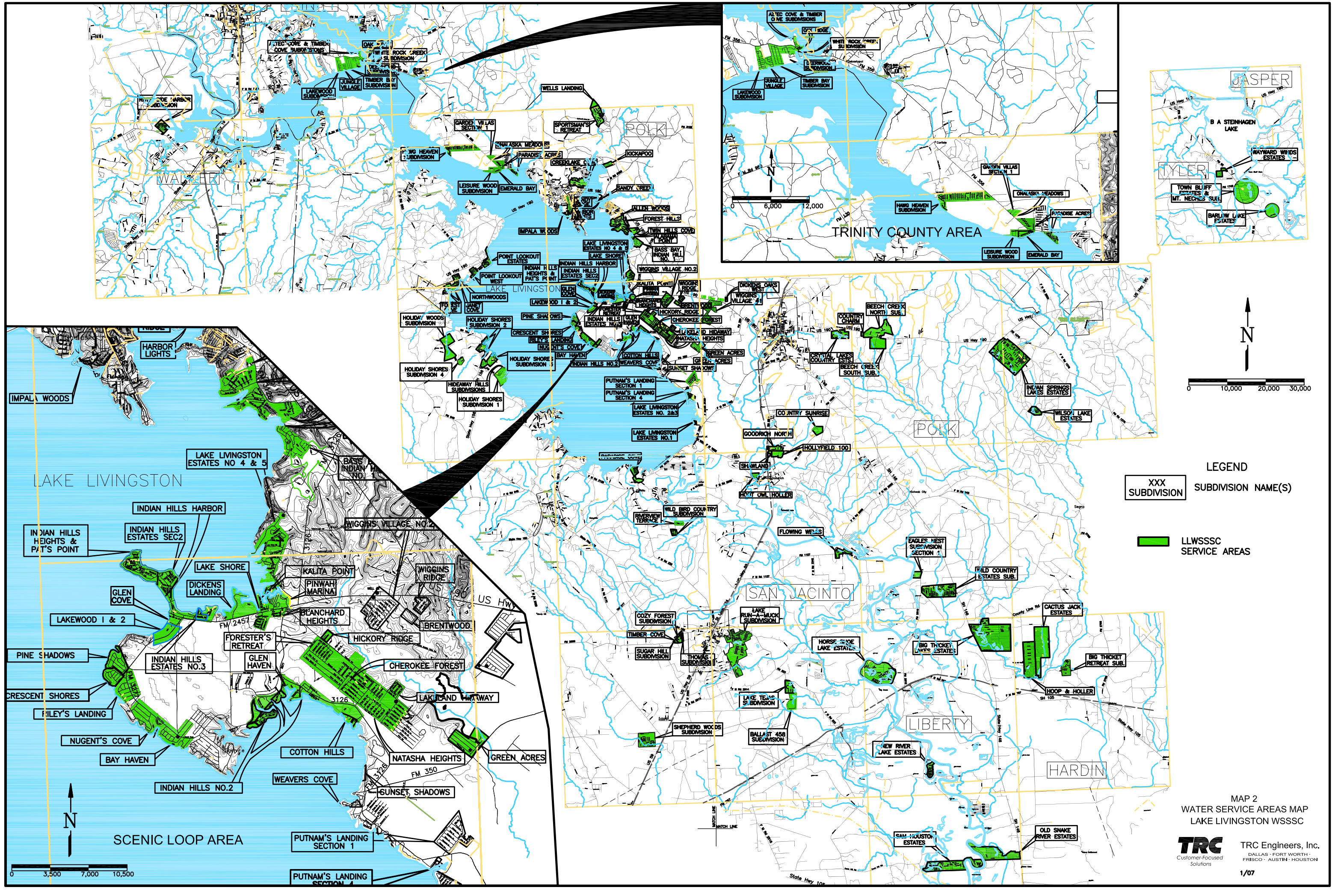
N

TRC

LAKE LIVINGSTON OVERALL WATER CCN MAP

SCALE: 1" = 4 Miles	DRAWN BY: JKA	JOB NUMBER:	
DATE: DEC 2006	DESIGN BY:	SHEET NO:	SHEET ID:

MAP 1



MAP 2
WATER SERVICE AREAS MAP
LAKE LIVINGSTON WSSSC

TRC Customer-Focused Solutions

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