Final Report

Burnet-Llano County Regional Water Facility Study

For

TWDB Regional Facility Planning Grant (Project Contract No. 100-483-1072)

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**This study is dedicated to John Miloy.
He was actively involved in this planning study and the community. He will be greatly missed.**

BURNET-LLANO COUNTY
TWDB REGIONAL WATER FACILITY STUDY

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1.0 EXECUTIVE SUMMARY

During the drought in 2009, a number of communities in Central Texas were faced with challenging water issues; groundwater supplies were depleted in areas and surface water intake structures were limited in accessing water due to receding lake levels. Also, many communities did not have an emergency interconnect to neighboring communities and were faced with having to purchase treated drinking water transported in from private companies. As a result, Burnet and Llano Counties focused on planning for regional water treatment and transmission facilities in the area in order to improve system redundancy and reliability of water supply, as well as efficient sharing of resources.

Burnet County submitted an application to the Texas Water Development Board (TWDB) to receive funding assistance to conduct a regional water facility planning study for Burnet and Llano Counties. TWDB awarded Burnet County, as the primary applicant, the planning grant in March 2010. As a result, Burnet County, in conjunction with 24 cities and entities, participated in this study to evaluate the feasibility of developing regional water infrastructure to serve existing and future populations through 2040 in Burnet and Llano Counties.

Susan Roth Consulting, LLC and her team (‘Roth Team’), Camp Dresser & McKee (CDM), Inc. and Plauché International, Inc., identified and evaluated several options for regional water treatment and transmission facilities in Burnet and Llano Counties in order to improve system redundancy and reliability of water supply; this report summarizes the findings of this evaluation. Information regarding the study area, projected population and water demands, description of regional distribution and treatment alternatives, water quality modeling results for blending source water, cost estimates, and potential funding options are also included in this study.

During the initial data review, many of the project participants were experiencing similar water issues in various geographic regions. As a result, the Roth Team found it useful to divide the study area into four quadrants based on these commonalities. A number of regional alternatives, along with infrastructure assets and challenges for the area, were initially identified and presented to the participants during a working session held at the second project team meeting. As a result of the working session, Quadrants 1 and 2 were combined to form the “Northern Region” and the following alternatives were further evaluated; North Option 4 represents the most extensive regional option for this area:

- **North Option 1:** Fall Creek Vineyards would supply treated water (wholesale) to Tow Village.
- **North Option 2:** Two sets of intake and treatment plant sites were proposed along Northeast Lake Buchanan in order to provide long-term reliable service; in North Option 2A, a new raw water intake would pump to a Regional Water Treatment Plant near Bonanza Beach and transmission mains would deliver water south to Council Creek Village and north to the other participants in this area. In North Option 2B, a new intake would pump to a Regional Water Treatment Plant located southwest of Council Creek Village, and a transmission main would deliver water to Council Creek Village and then north to the other participants.
- **North Option 3:** City of Burnet would provide treated water from their existing water treatment plant site to areas near Inks Lake and the southeast shore of Lake Buchanan (Cassie and Buena Vista), as well as to the City of Bertram.

- **North Option 4:** City of Burnet would provide treated water to the entities served in North Option 3, as well as the entities on the northeast side of Lake Buchanan that were included in North Option 2; North Option 4 would also include extending service south of the City of Bertram to Whitewater Springs.

In the northern region, the City of Burnet water treatment plant is the only existing water treatment plant that the Roth Team recommends expanding (North Options 3 and 4). Also, the Roth Team recommends the consideration of the following intake locations in the northern region:

- Expand the City of Burnet intake structure on Inks Lake (North Options 3 and 4); and,
- Construct a new intake structure on the northeast side of Lake Buchanan (North Options 2A and 2B).

A summary of the northern regional options are detailed in Figures 6-5 through 6-9 in Section 6.4.1; reference Appendix E for an overview map of all the northern regional alternatives.

In the "Southern Region", the following alternatives were further evaluated as a result of combining Quadrants 3 and 4:

- **South Option 1:** City of Marble Falls would provide treated water to Blanco San Miguel (development south of Highway 71) from a new raw water intake and Regional Water Treatment Plant at Max Starcke Dam and a new transmission line running south from the Max Starcke Dam site to Highway 71 and then south of Highway 71 to Blanco San Miguel.
- **South Option 2:** From the new raw water intake and Regional WTP noted in South Option 1, the City of Marble Falls would serve Blanco San Miguel, as well as entities southeast along Highway 71 (Quail Creek, Spicewood Beach, Windermere Oaks, Ridge Harbor). The City of Marble Falls would also extend service to Cottonwood Shores and to Smithwick Mills.
- **South Option 3:** City of Meadowlakes could possibly provide 1.0 MGD of treated water to the City of Marble Falls within the planning period, which would take advantage of unused treatment capacity at the Meadowlakes' WTP.
- **South Option 4:** City of Granite Shoals would provide treated water to the City of Highland Haven through an interconnect for either permanent or emergency water needs.

In the southern region, the Roth Team agrees with the City of Marble Falls' plan to construct a new intake and water treatment plant just upstream of the Max Starcke Dam, since this site would provide reliable access to raw surface water from a pass-through lake with a relatively constant level. Thus, the Roth Team recommends the following key infrastructure for the southern region:

- Construct a new intake structure on Lake Marble Falls upstream of Max Starcke Dam; and,
- Construct a new Marble Falls water treatment plant near the Max Starcke Dam and the new intake site (South Options 1 and 2).
- Minimal expansion of the Granite Shoals water treatment plant (South Option 4).

The southern regional options are shown in Figures 6.10 through 6.14 in Section 6.4.2. Reference Appendix F for an overview map of all the southern regional alternatives. A summary of the project costs by option and entity is provided in Table 9-43.

2.0 INTRODUCTION

In December 2009, Burnet County submitted an application to the Texas Water Development Board (TWDB) to receive funding assistance to conduct a regional water facility planning study for Burnet and Llano Counties. TWDB awarded Burnet County, as the primary applicant, the planning grant in March 2010. As a result, Burnet County, in conjunction with 24 other cities and entities, has undertaken this study to evaluate the feasibility of developing regional water infrastructure to serve existing and future populations through 2040 in Burnet and Llano Counties. A complete list of the project participants is provided below:

- Burnet and Llano Counties;
- Central Texas Groundwater Conservation District;
- City of Bertram;
- City of Burnet,
- City of Cottonwood Shores;
- City of Granite Shoals;
- City of Highland Haven;
- City of Marble Falls;
- City of Meadowlakes;
- Chisholm Trail Special Utility District;
- Capstone Water System;
- Burnet County Municipal Utility District No. 2;
- Buena Vista Property Owners Association;
- Cassie Property Owners Association;
- Kempner Water Supply Corporation;
- Kingsland Water Supply Corporation;
- Windermere Oaks Water Supply Corporation;
- Council Creek Water System;
- South Silver Creek (I, II & III) Water System;
- Fall Creek Vineyards;
- Ranches and Rivers Realty (Blanco San Miguel Development);
- Copper Station Holdings;
- Brazos River Authority; and,
- Lower Colorado River Authority.

Susan Roth Consulting, LLC and her team ('Roth Team'), Camp Dresser & McKee (CDM), Inc. and Plauché International, Inc., identified and evaluated several options for regional water transmission and treatment facilities in Burnet and Llano Counties; this report summarizes the findings of this evaluation. Information regarding the study area, projected population and water demands, description of regional distribution and treatment alternatives, water quality modeling results for blending source water, cost estimates, and potential funding options are also included in this study.

2.1 Project Background

Service Area Description

The study area primarily includes Burnet County, as well as the communities surrounding the Highland Lakes in Llano County. The study area includes the incorporated limits and extraterritorial jurisdictions of the Cities of Bertram, Burnet, Cottonwood Shores, Granite Shoals, Highland Haven, Marble Falls and Meadowlakes and the surrounding unincorporated areas. A map of the study area is shown below in Figure 2-1. The water CCN (Certificate of Convenience and Necessity) boundaries of the project participants are highlighted in purple.

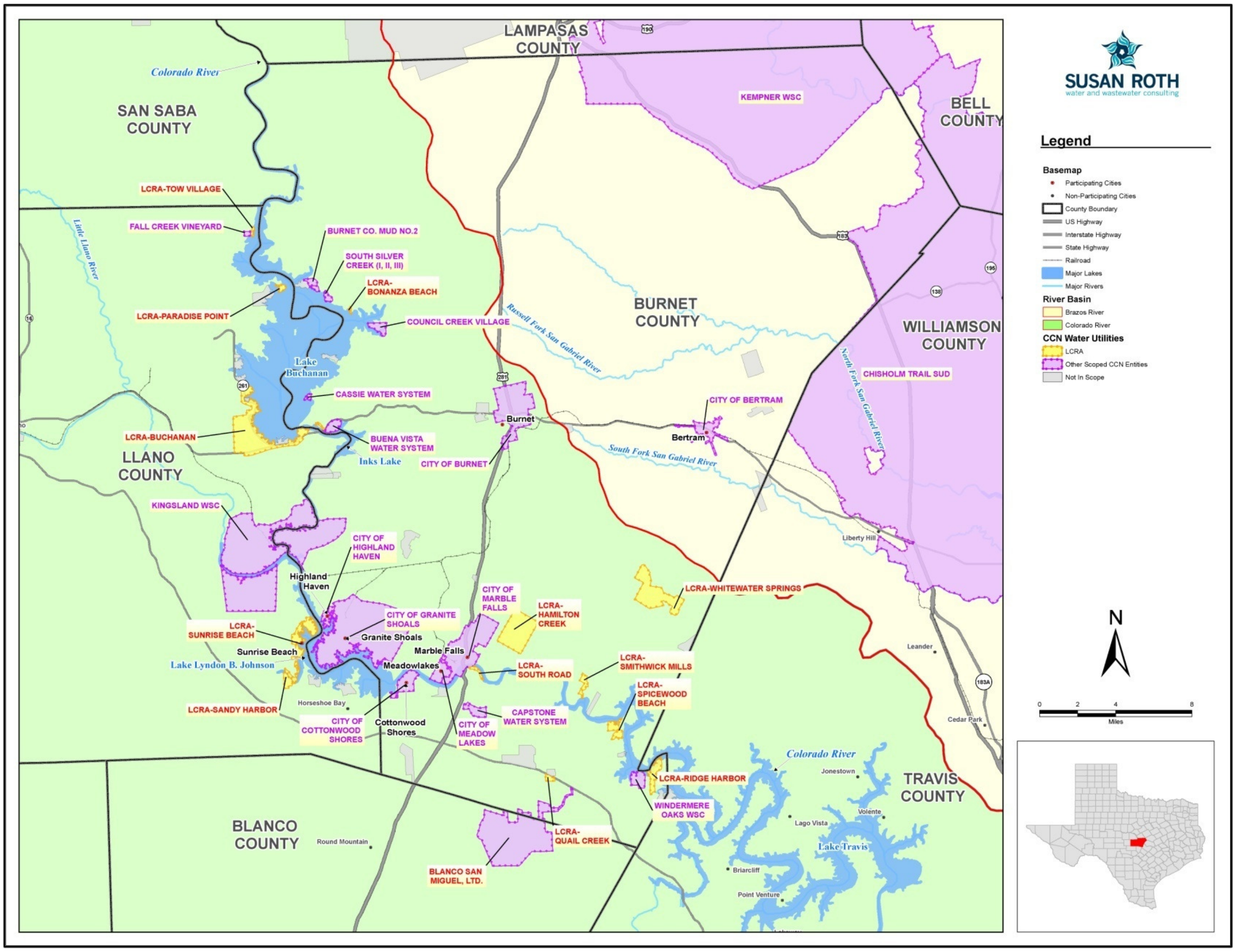

Figure 2-1: Map of Study Area

The Lower Colorado River Authority (LCRA), also a project participant, currently owns and operates a number of water systems within the study area; the water CCN or service area boundaries for the LCRA systems that were owned by them at the time of the kick-off of the study in August 2010 are highlighted in yellow in Figure 2-1:

- Bonanza Beach (Burnet County);
- Hamilton Creek (Burnet County);
- Quail Creek (Burnet County);

- Ridge Harbor (Burnet County);
- Smithwick Mills (Burnet County);
- Spicewood Beach (Burnet County);
- South Road (Burnet County);
- Whitewater Springs (Burnet County);
- Tow Village (Llano County);
- Paradise Point (Llano County);
- Lake Buchanan (Llano County);
- Sandy Harbor (Llano County); and,
- Sunrise Beach (Llano County).

Approximately three months after the project kick-off meeting for this study, the LCRA Board passed a resolution directing the General Manager to seek qualified buyers for all assets comprising the water and wastewater utilities. As a result, Burnet County requested that the study team define the regional options such that each of the existing LCRA water systems within the study area was included in one or more regional options.

In addition, a number of the project participants are served by either surface water from the Highland Lakes or groundwater wells. Reference the overview map in Appendix A for a detailed summary of all water systems included in the evaluation of this study; this map notes the water source, means of disinfection, current water demand (2010) and projected water demand (2040) for each of the project participants.

Basis for the Study

During the drought in 2009, a number of communities in Central Texas were faced with challenging water issues; groundwater supplies were depleted in areas and surface water intake structures were limited in accessing water due to receding lake levels. Also, many communities did not have an emergency interconnect to neighboring communities and were faced with having to purchase treated drinking water from private companies. As a result, Burnet and Llano Counties focused on planning for regional water distribution and treatment facilities in the area in order to provide system redundancy and reliability of water supply, as well as efficient sharing of resources.

The population in the study area has increased significantly in the past 10 years and is projected to double over the next 20 years. This planning study for Burnet and Llano Counties considers several regional solutions and focuses on the following areas of interest of the project participants:

- Feasibility of developing a regional water system to replace and/or supplement the multiple systems currently in service;
- Options to provide a reliable water supply in regards to location/type of intake structure;
- Interconnections of existing water systems, where needed, to provide redundancy in case of system failures; and,
- Options for smaller water systems that do not want to be in the water utility business to connect to a larger water system.

2.2 Scope of Study

The scope of work for this study involved evaluating the feasibility of developing regional water distribution and treatment facilities to serve existing and future development in Burnet and Llano Counties. The following items were included in the study from an engineering standpoint, as well as to satisfy the requirements of the TWDB grant program:

- ***Population and Water Demand Projections*** – Population and growth projections, number of existing water connections, utility development agreements and additional water system information were collected from each of the entities. This data was used to develop population and water demand projections for each entity in five year increments through year 2040.
- ***Regional Distribution Alternatives*** – Options were developed for connecting existing water systems participating in the study into an overall regional water distribution system.
- ***Regional Water Treatment Alternatives*** – Various options were developed that included expanding existing infrastructure, as well as constructing new regional infrastructure to serve the study area. A desktop water quality analysis was conducted for areas that involved blending groundwater with surface water supplies.
- ***Implementation Schedule*** – An implementation plan was developed for the phased construction of regional distribution and treatment facilities for the study area through 2040. This plan takes into consideration the existing distribution and treatment capacities, water quality issues, future developments, anticipated growth and cost-effectiveness.
- ***Cost Estimates and Recommendations*** – An economic analysis including the capital and O&M costs for each identified entity for the various options was determined. The capital and O&M costs for the final regional distribution and treatment system alternatives were combined and utilized a present worth analysis.
- ***Funding Options*** – Potential funding sources and traditional financing programs for the construction of various options of the Burnet-Llano County Regional Water Systems were provided.
- ***Water Conservation and Drought Contingency Plans*** – TWDB requires project participants receiving grant funding through the Regional Water and Wastewater Facilities Planning Grant Program to prepare and implement water conservation and drought contingency plans. Copies of both of these plans from each of the project participants are included in Appendix G and H.

Information about each of the items listed in the scope of work is detailed in the following sections of the report.

3.0 DESCRIPTION OF STUDY AREA

3.1 Physical Aspects

Prior to the development of project alternatives, the geology and the topography of the study area were studied and factored into the evaluation. The boundary of the study area includes all of Burnet County and a portion of Llano County to include Kingsland Water Supply Corporation and the communities surrounding Lake Buchanan. Burnet County is located within two geographic regions. The eastern portion of Burnet County is located in the Hill Country Region of the Balcones Escarpment. Llano County and the western portion of Burnet County are located in the Llano Uplift Region, where Precambrian igneous and metamorphic rock is exposed. The Colorado River and its tributaries drain the western and southern portions of Burnet County. The tributaries of the Brazos River drain the northern and eastern portions of Burnet County.

LCRA operates six dams on the lower Colorado River in Central Texas: Buchanan, Inks, Wirtz, Starcke, Mansfield and Tom Miller. These dams form the six Highland Lakes: Buchanan, Inks, LBJ, Marble Falls, Travis and Austin. While all the dams were built to help handle floods, Mansfield Dam, which forms Lake Travis, is the only one designed to hold back floodwaters. The other dams pass floodwaters downstream to Lake Travis, where the water is stored in a flood pool until LCRA can safely release it downstream. The Highland Lakes located within the study area include the following:

- Lake Buchanan;
- Lake LBJ;
- Inks Lake;
- Lake Marble Falls; and,
- Lake Travis.

Burnet and Llano Counties have access to a variety of groundwater resources. The study area includes one major and three minor aquifers. Major aquifers are defined by TWDB as aquifers that are capable of producing yields greater than 500 gallons per minute to wells or that produce groundwater over a large area. Minor aquifers are defined by TWDB as aquifers that may be capable of producing only limited yields (less than 100 gallons per minute) to wells or that produce groundwater over a limited area.

3.2 Sources of Water

Infrastructure and water supply go hand in hand when developing a regional water facility plan. However, based on the TWDB planning grant requirements, this study focuses on evaluating regional infrastructure alternatives and does not include identifying new sources of water supplies to serve the area. Through TWDB's on-going regional water planning efforts, sources of water supply and water strategies are identified in the plans developed for each planning region; Burnet and Llano are located within Region K. This section highlights information regarding existing water supply resources within the study area.

3.2.1 <u>Surface Water Resources</u>

The LCRA Highland Lakes are the primary source of surface water for many of the project participants; however, Kempner WSC and Chisholm Trail SUD receive their water supply from the Brazos Basin. Many of the participants have existing surface water contracts with LCRA for municipal and irrigation customer needs, as shown below in Figure 3-1 (reference Appendix B for a larger map).

The Highland Lakes system is comprised of two water supply reservoirs, Lakes Buchanan and Travis, and three intermediate pass-through reservoirs, Inks Lake, Lakes LBJ and Marble Falls. As previously noted, the Highland Lakes located within the study area include Lake Buchanan, Lake LBJ, Inks Lake, Lake Marble Falls and Lake Travis.

Lake Travis is located downstream of the Pedernales River and is not a pass-through lake. It has steep banks and has good water quality most of the year. However, the banks are much shallower in Lake Buchanan, which cause a noticeable impact on intake location as the water level recedes during drought conditions. Lake Buchanan is also not a pass-through lake and experiences water quality issues resulting from turnovers of the thermocline.

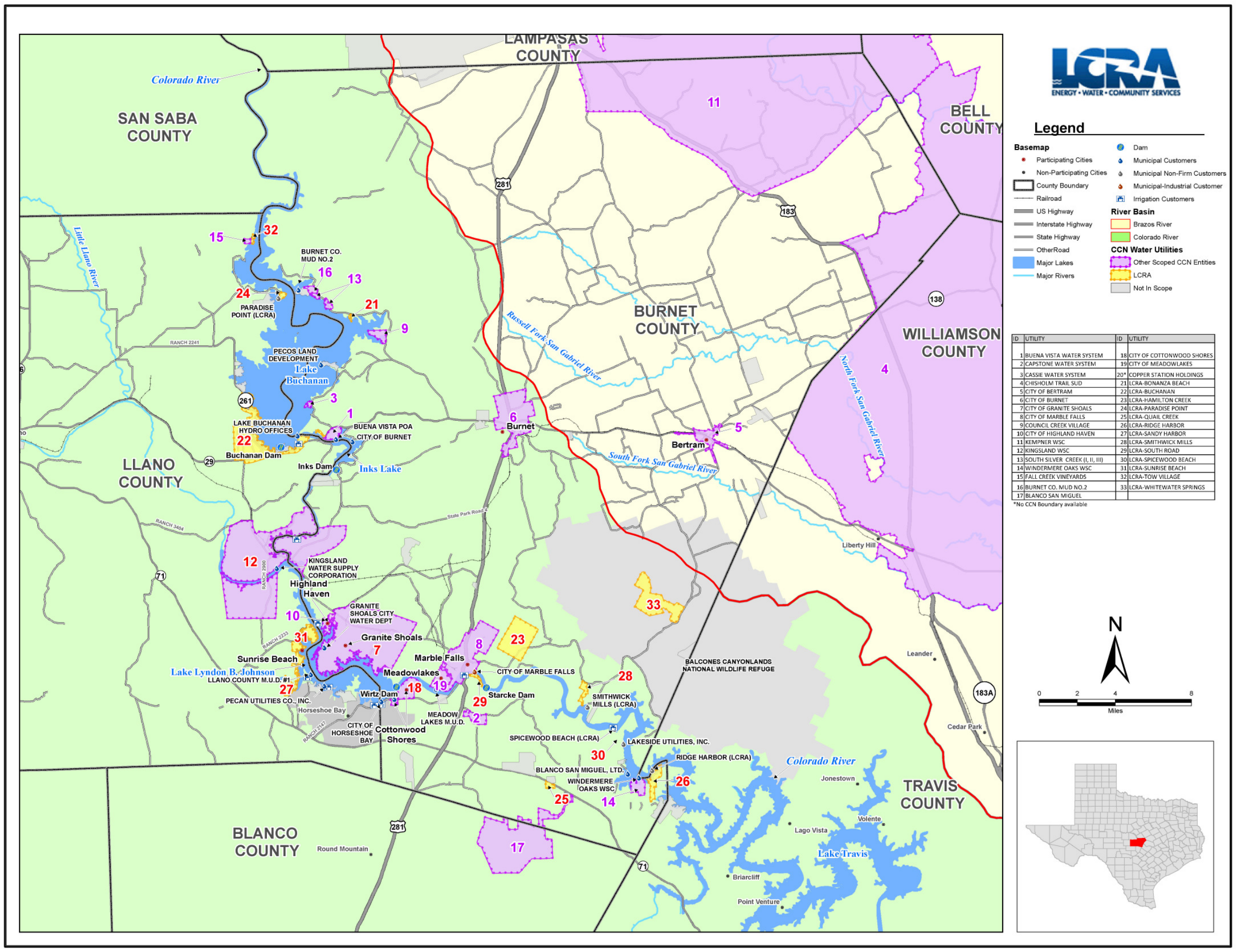

Figure 3-1: LCRA Municipal & Irrigation Surface Water Contracts

In light of the information obtained from LCRA, it has been assumed that the participants of a regional water system would be able to obtain surface water contracts to meet their demands out to year 2040. LCRA is currently moving forward with implementing one of the three water supply strategies listed in the LCRA Water Supply Resource Plan. This strategy involves constructing off-channel reservoirs further downstream in the basin to reduce the amount of water released from the Highland Lakes.

LCRA submitted a water rights permit application to TCEQ, and it was approved in April 2011 (Water Rights Permit No. 5731). As a result, this allows the LCRA to accomplish the following:

- Divert from river up to 853,514 acre-ft per year at higher flows at five existing locations in Colorado, Wharton and Matagorda Counties at a combined rate of 10,000 cfs;
- Store water in a series of off-channel reservoirs in three lower counties; up to 500,000 acre-feet in total capacity;
- Use 327,591 from off-channel reservoirs for municipal, industrial and agriculture anywhere in LCRA's service area; no interbasin transfer is authorized;
- Diversions can only occur if certain specific environmental flows criteria have been met; and
- LCRA has until 2021 to authorize a reservoir location or extend timeframe.

3.2.2 <u>Groundwater Resources</u>

Groundwater resources play an important role in the overall evaluation of water resources and alternatives to diversify an entity's water supply portfolio. The Central Texas Groundwater Conservation District ('District') was formed in 2005 to protect the underground water resources for the citizens of Burnet County. To manage the groundwater resources under its jurisdiction, the District has limited the production of new groundwater wells to half acre-ft per acre of property. A groundwater conservation district has not been created to govern Llano County. According to Chapter 36 of the Texas Water Code, the definition of "managed available groundwater" is the amount of water that may be permitted by a groundwater conservation district. The estimated total annual volume of groundwater calculated represents the total amount of pumping from the aquifer.

The following major and minor aquifers are located within the study area (reference Figure 3-2; larger map size in Appendix C):

- Trinity Aquifer (major)
- Ellenburger-San Saba Aquifer (minor)
- Hickory Aquifer (minor)
- Marble Falls (minor)

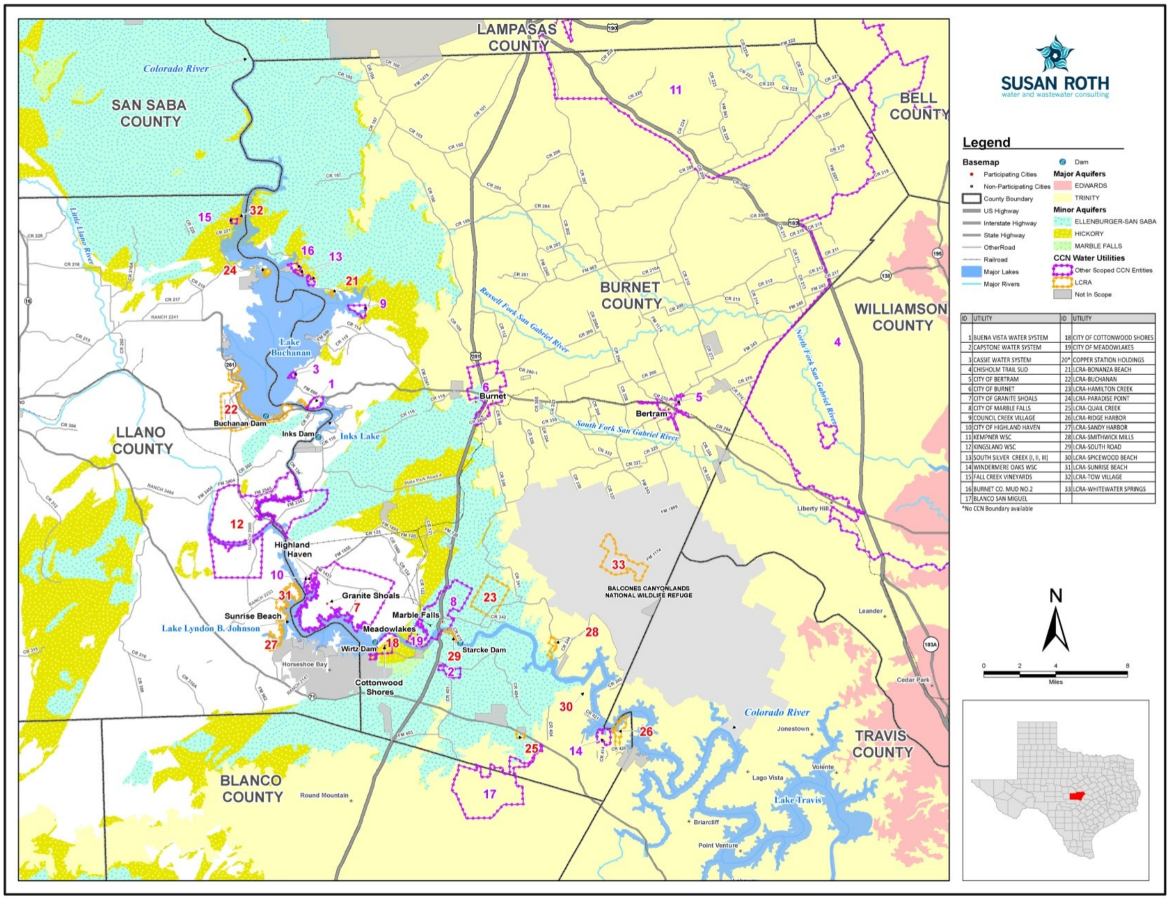

Figure 3-2: Groundwater Aquifers in Study Area

Major Aquifers

The only major aquifer located in the study area is the Trinity aquifer. The Trinity aquifer is composed of three subdivisions; the Upper Trinity; the Middle Trinity and the Lower Trinity aquifers. The Upper Trinity aquifer is composed of the Paluxy Sand and Glen Rose Formation; the Middle Trinity aquifer is composed of the Hensell Sand and Cow Creek Limestone; and the Lower Trinity aquifer is composed of the Sligo Limestone and Hosston Sand. The Upper Trinity aquifer crops out in the majority of eastern and central Burnet County. The Middle and Lower Trinity have limited outcrops in Burnet County, which both occur at or near the western most extent of the Trinity aquifer in Burnet County. The availability of groundwater from the Trinity aquifer is based on the management of aquifer pumping to maintain the resulting draw down within acceptable limits.

Based on the findings noted in the report by the Central Texas Groundwater Conservation District and Tom Partridge, *Trinity Aquifer Characterization and Groundwater Availability Assessment Burnet County (May 2011)*, the Trinity wells located in the eastern part of the study area are typically low producing wells.

Minor Aquifers

Additional groundwater sources that are particularly important to Burnet and Llano Counties are three minor aquifers in the area, which include the Ellenburger-San Saba, Hickory and Marble Falls aquifers. The information available on the characteristics of each of these minor aquifers is based on draft aquifer assessments issued by TWDB on January 25, 2011. The CTGCD will continue to monitor how the minor aquifers respond to the actual magnitude and distribution of groundwater currently pumped now and in the future. As a result, the CTGCD will further refine the data regarding ‘managed available groundwater’ in Burnet County. A summary of each of the minor aquifers is presented below.

Ellenburger-San Saba Aquifer

The Ellenburger-San Saba aquifer occurs along the margin of the Llano Uplift in Central Texas. Discontinuous outcrops of the aquifer surround older rocks of the uplift, and the remaining downdip portion may extend to depths of up to 3,000 feet below the surface. The aquifer is composed of the limestone and dolomite of the San Saba Member of the Wilberns Formation of late Cambrian age, and the Honeycut, Gorman, and Tanyard formations of the Ellenburger Group of early Ordovician age. The Ellenburger-San Saba aquifer can produce higher capacity wells; this aquifer is the most promising source for groundwater. The estimated total pumping from the Ellenburger-San Saba aquifer in Burnet County that achieves the adopted desired future condition is approximately 5,526 acre-feet per year.

Hickory Aquifer

The Hickory aquifer occurs in the Llano Uplift region of Central Texas. Non-continuous Hickory Sandstone outcrops may overlie or flank exposed Precambrian rocks forming the central uplift core. The artesian portion of the aquifer surrounds the uplift and may extend to depths approaching 4,500 feet. The estimated total pumping from the Hickory aquifer in Burnet County that achieves the adopted desired future condition is approximately 2,148 acre-feet per year.

Water from the aquifer is generally fresh, but contains naturally-occurring radionuclides and consistently exceeds the MCLs for Radium-226, Radium-228 and or gross alpha radiation; this water may contain high levels of radon gas. It has also been found that Hickory water may contain iron concentrations exceeding drinking water standards. Treatment options to remove these contaminants are expensive, especially with the disposal of the hazardous waste solids.

Marble Falls Aquifer

The Marble Falls aquifer occurs in several separated outcrops. Water occurs in fractures and solution cavities in the limestone of the Marble Falls Formation of the Pennsylvanian Bend Group. The Marble Falls aquifer is about 400-ft thick and is separated from the Ellenburger-San Saba aquifer by 50-ft of confining beds; the estimated total pumping from this aquifer in Burnet County that achieves the adopted desired future condition is approximately 1,978 acre-feet per year. The quality of water produced from the Marble Falls aquifer is suitable for most purposes.

4.0 GROWTH PROJECTIONS

4.1 Population Projections

The population in the study area has increased significantly over the past 10 years and is projected to double over the next 20 years. In order to accurately capture the population growth of the study area, the following information was collected from each participant towards the beginning of the study:

- Current population and growth projections;
- Number of existing water connections;
- Water system information;
- Utility development agreements for planned developments; and
- Build-out schedules and conceptual plans of planned developments.

This information, along with population and growth projection data obtained from the 2010 U.S. Census Bureau, *TWDB 2011 Region K Water Plan,* Capital Area Council of Governments (CAPCOG) and the *Burnet County 2010 Comprehensive Transportation Plan* was used to develop population projections for each entity in five year increments through a 2040 planning horizon, including year 2040 build-out of planned developments. Table 4-1 summarizes the population and growth projections from the sources cited above; this data was used for comparison purposes.

Table 4-1: Burnet and Llano Counties – Population & Growth Projections

Reference	Year 2010	Year 2040	Annual Growth Projection
BURNET COUNTY			
2010 U.S. Census Bureau	42,750	---	---
TWDB (2011 Region K Water Plan)	47,160	94,716	2.35%
CAPCOG	47,581	88,614	2.09%
Comprehensive Transportation Plan	47,300	104,000	3.47%
LLANO COUNTY			
2010 U.S. Census Bureau	19,301	---	---
TWDB (2011 Region K Water Plan)	21,284	23,932	0.39%
CAPCOG	19,344	23,112	0.59%

In Figures 4-1 and 4-2, the population growth identified by CAPCOG through their planning efforts for Burnet County is shown for 2009 and 2035, respectively. Note the areas of forecasted population growth are highlighted by the red circles in Figure 4-2.

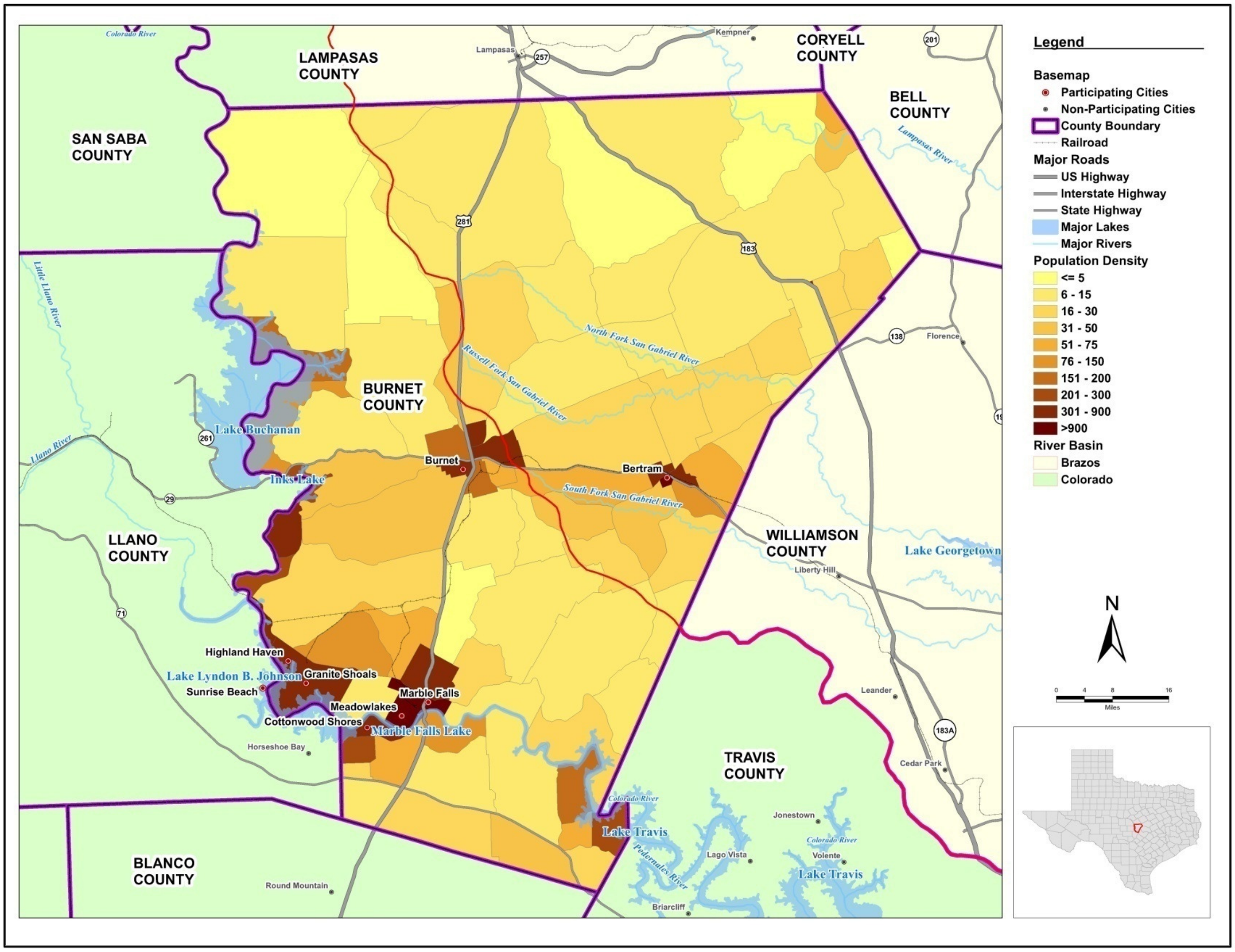

Figure 4-1: Burnet County – 2009 Population Density (CAPCOG)

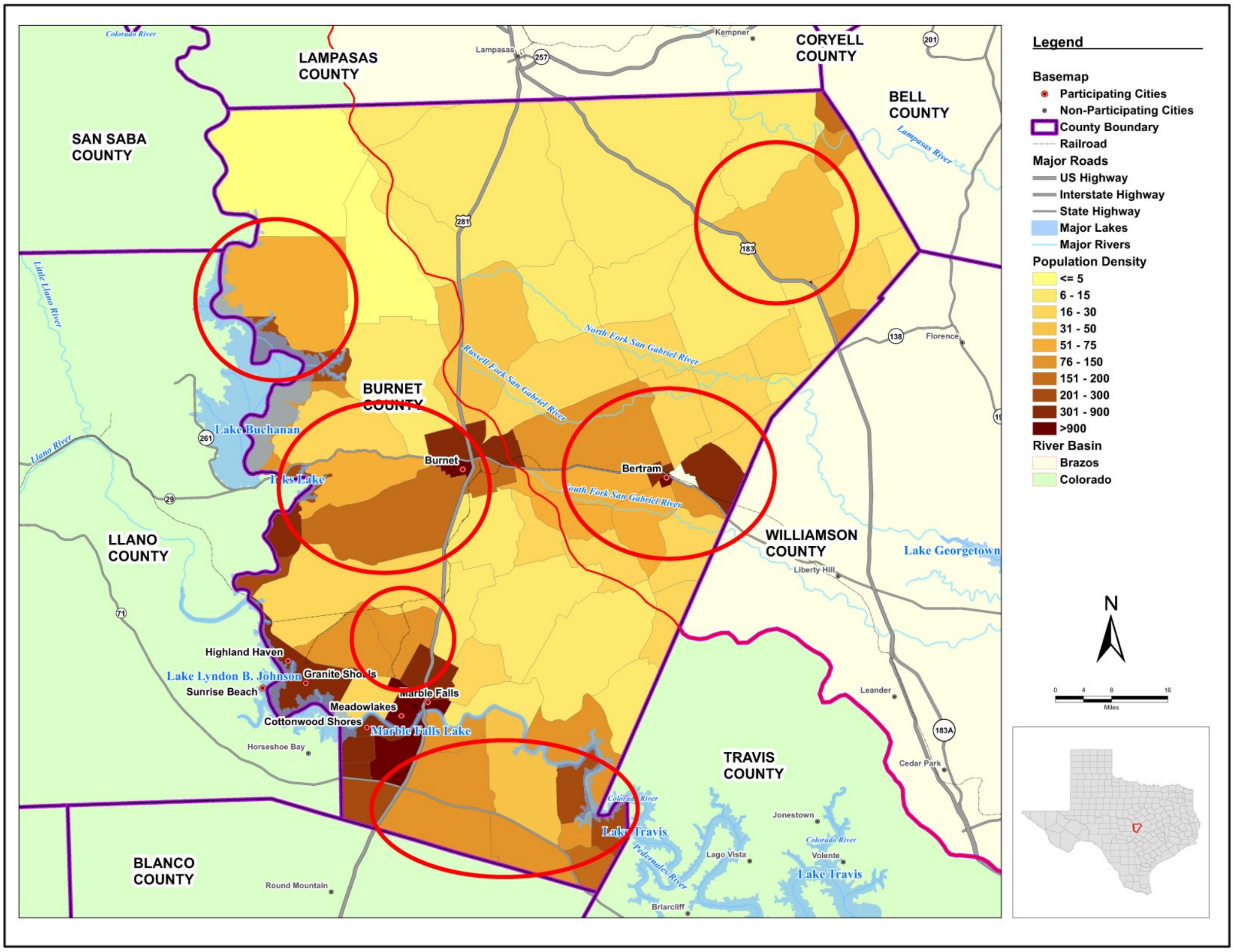

Figure 4-2: Burnet County – 2035 Population Density (CAPCOG)

The population projections developed for each entity were based on the 2010 U.S. Census Bureau figures using their respective growth rates outlined in the *TWDB 2011 Region K Water Plan*; this methodology used by the Roth Team was approved by TWDB staff on March 31, 2011. Refer to Appendix D for a complete summary of population projections for the project participants.

4.2 Planning and Design Criteria

Primary design criteria used for planning and evaluating water supply systems are listed below, along with a description of how these criteria are used in the sizing of the various water system components:

- *Average yearly water demand:* Used for estimating long-term surface water and aquifer withdrawal rates and for estimating yearly operational costs.
- *Maximum daily demand:* Used for sizing wells, raw water intakes, treatment plants, and major transmission mains (for example, between treatment plants and storage facilities).
- *Peak hour demand:* Used for sizing pumps and hydro pneumatic tanks that supply water directly into the distribution system, and for distribution piping. Peak hour demands are also involved in sizing elevated water storage tanks.
- *Fire flow:* In systems that are designed to provide water for firefighting, fire flow combined with peak hour demands are used in lieu of using peak hour demands only.

- *Minimum and maximum pressures:* Dictate the elevations of elevated storage tanks, pipe sizing, service areas for each elevated or hydropneumatic tank, and pumping heads.
- *Minimum water storage requirements:* Used to size clearwells, ground storage tanks and elevated tanks.

As presented below, not all of the above criteria is applicable when planning a regional water system as most apply only or primarily to the planning of the local storage and distribution system. This is especially true if the regional system primarily provides wholesale treated water to the participating entities.

The Texas Commission on Environmental Quality (TCEQ) has established minimum values for most of the criteria listed above and 30 TAC 290 Subchapter D requires that a system be designed to meet the minimum criteria or better, unless the system can provide data that their water usage is consistently lower than the TCEQ minimum criteria. Several of the smaller systems included in this study have requested and received exemptions from the minimum TCEQ requirements.

Water systems tend to establish more stringent design criteria if their water usage is typically higher than the minimum standards. For example, LCRA has established standards that exceed the TCEQ minimum design standards in several areas. Table 4-2 compares the TCEQ minimum criteria with the LCRA's design criteria, while the historical water demands provided by several of the participants in the study are included in Table 4-3. An analysis of the data in these tables is described below.

Average Yearly Water Demand

The average yearly water demand is used to determine the long-term water needs of a community. This demand is used as a basis for acquiring surface water contracts, or determining long-term impacts on an aquifer. Average yearly demands are seldom used for sizing the infrastructure of a water system but they are used for estimating yearly operational costs, such as the cost of chemicals, energy, and solids hauling and disposal.

The *TWDB 2011 Region K Water Plan* assumed an average yearly demand of 194 gallons per day per person by year 2030, which is equivalent to 0.31 gallons per minute (GPM) per connection assuming 2.3 persons per connection.

As shown in Table 4-2, TCEQ's minimum standards do not include the average water demand as one of their design criteria. LCRA's Water and Wastewater Utilities Design Criteria (February, 2009) specify that the average yearly water demand for designing urban systems is 0.6 GPM per connection and is 0.45 GPM per connection for rural systems. The 0.45 GPM per connection minimum criteria was developed using Master Plan data from rural portions of the LCRA's West Travis County Water System. Historical design in the Burnet County LCRA Hill Country Water Systems has utilized TCEQ minimum standards or variances via TCEQ approved minimum alternative capacity requirements. However, in reviewing the historical water demand information provided by LCRA, their systems in the study area experience significantly lower average yearly water demands (0.07 to 0.25 GPM per connection) when compared to LCRA's design criteria.

Table 4-3 indicates that the range of average daily water demands for larger systems (0.12 to 0.30 GPM per connections) was generally higher than the range for smaller systems (0.07 to 0.23 GPM per connection). This was expected as many of the smaller systems served weekend homes or more rural areas. In some cases, insufficient capacity may have contributed to the lower water demands. All but one of the participating systems in this study reported average yearly demands of 0.30 GPM per connection or less, thus indicating that the 0.31 GPM per connection assumed in the *TWDB 2011 Region K Water Plan* was a reasonable, though somewhat conservative, average daily water demand.

Table 4-2: TCEQ and LCRA Water System Design Criteria

Criteria	Units	TCEQ 30 TAC 290 Subchapter D (See Notes 1 & 2)			LCRA Water & WW Utilities Design Criteria (Feb 2009; See Note 4)		Recommended Design Criteria for Sizing Regional Facilities in This Planning Study (See Note 3)
		Groundwater Supply (50 to 250 connections)	Groundwater Supply (>250 connections)	Surface Water Supply	Urban	Rural	
Water demands							
Average daily water demand	gpm/connection				0.6	0.45	0.3
Maximum day water demand	gpm/connection	0.6	0.6	0.6	1.3	0.8	0.6
Peak hour demand	gpm/connection	2.0	2.0	2.0	2.2	1.6	Not Applicable to Regional Facilities
Fire flow demands							
For areas with lots larger than 1/2 acre	gpm					750	Not Applicable to Regional Facilities
For areas with lots smaller than 1/2 acre	gpm				1000	1000	
Commercial areas	gpm				1500	1500	
Fire flow duration	minutes				120	120	
System Pressures							
Minimum pressure at maximum day demand	psi	35 psi under normal operating conditions (or flow rates of 1.5 gpm/connection)			50	50	35
Minimum pressure at peak hour demand	psi				35	35	Not Applicable to Regional Facilities
Minimum pressure at peak hour demand plus fire flow	psi	20 psi during emergencies such as fire fighting			20	20	Not Applicable to Regional Facilities
Maximum static pressure	psi				115	115	200
Storage Requirements							
Clearwell capacity	gal/connection			50 (or 5% of daily plant capacity)			50 (or 5% of daily plant capacity)
Elevated storage	gal/connection		100	100	100	100	Not Applicable to Regional Facilities
Emergency (fire flow) storage	gal/connection				100	100	Not Applicable to Regional Facilities
Total storage	gal/connection	200	200	200	200	200	Not Applicable to Regional Facilities
		Pressure tanks may be used in lieu of elevated storage for systems up to 2500 connections, but total storage must equal 200 gal/connection			Pressure tank may be used in lieu of elevated storage but total storage must equal 200 gal/connection		Not Applicable to Regional Facilities
Hydropneumatic tank volume	gal/connection	20	20	20	20	20	
Miscellaneous							
Maximum velocity in water transmission mains at max day demand	feet/second						5
Maximum velocity in water supply pipes at peak hour demand	feet/second				5	5	Not Applicable to Regional Facilities
Maximum velocity in water supply pipes at peak hour demand plus fire flow	feet/second				10	10	Not Applicable to Regional Facilities
Booster pump design			Two or more pumps with a total capacity of 2 gpm/connec. Or a capacity of 1000 gpm plus the ability to meet peak hour demands with the largest pump out of service.		All pumps operating must be capable of pumping max day demand Average day demands must be met with largest pump out of service		Max day demands must be met with largest pump out of service

Notes:

1 TCEQ's minimum standards include other categories of service other than the 3 shown, but these are most applicable to this project.

2 TCEQ's minimum standards use different terminology for the design criteria but they are equivalent to those described in this table.

3 Applicability notes in column assume the regional facility will be providing wholesale treated water to existing and future local utilities responsible for their local storage and distribution systems.

4 LCRA Design Criteria applies specifically to new water systems constructed by LCRA or developers. The LCRA Burnet/Llano County systems were constructed prior to LCRA acquisition and follow TCEQ design criteria for system additions.

Table 4-3: Project Participants - Historical Water Demands

Larger Water Systems								Smaller Water Systems						
Criteria	**Units**	**City of Marble Falls**	**City of Burnet**	**City of Meadowlakes**	**City of Bertram**	**Kempner WSC**	**Range for Larger Systems**	**Lake Buchanan (LCRA)**	**Smithwick Mills (LCRA)**	**South Silver Creek (I, II, & III)**	**Windermere Oaks WSC**	**Ridge Harbor (LCRA)**	**Sunrise Beach (LCRA)**	**Range for Smaller Systems**
Average daily water demands	gpm/ connection	0.29	0.23 to 0.30	0.30	0.12	0.20	0.12 to 0.30	0.23	0.18	0.11	< 0.21	0.25	0.07	0.07 to 0.23
Maximum day water demand	gpm/ connection	0.57	0.64	0.76	0.49	0.56	0.49 to 0.76	0.42	0.58	0.45	0.31	0.63	0.32	0.31 to 0.63

Based on the information presented in Tables 4-2 and 4-3, the Roth Team used an average yearly water demand of 0.30 GPM per connection in this study to assess long-term water requirements for each entity and for estimating operating costs.

Maximum Day Water Demand

The maximum day water demand is the most important criteria in an infrastructure planning study since it is used to determine the required capacities of wells, intakes, water treatment plants, transmission mains, and most of the pumping stations found in a regional water system. LCRA's Water and Wastewater Utilities Design Criteria includes criteria for both urban and rural systems based on data from the LCRA West Travis County Water System, as shown in Table 4-2. The maximum day water demand for designing urban systems is 1.3 GPM per connection; for rural systems, it is 0.8 GPM per connection. Both criteria exceed the TCEQ minimum design standard of 0.6 GPM per connection.

As shown in Table 4-3, a majority of the larger participant systems report maximum day demands in the range of the TCEQ minimum design standard, with the exception of the City of Meadowlakes (reporting a maximum day demand of 0.76 GPM per connection in 2009 and a historical high of 1.24 GPM per connection). Several of the smaller systems also reported maximum day demands in the range of the TCEQ minimum design standard, although at least two reported demands almost half of the TCEQ standard.

As a result, the Roth Team used a maximum day water demand of 0.6 GPM per connection (TCEQ minimum) to size the infrastructure in each of the alternatives considered in this study. Although a few of the participants have experienced maximum day demands greater than 0.6 GPM per connection, these would not have a significant impact on the overall sizing of the regional facilities for each alternative. If a regional system is implemented, the demands specific to each part of the regional system will need to be used in the final engineering design.

Peak Hour Demand

Peak hour demands dictate the sizing and layout of the distribution network within a water system and the sizing pumps and hydro-pneumatic tanks that supply water directly into a distribution system. Peak hour demands are also involved in sizing both ground and elevated storage tanks.

Most water systems do not monitor peak hour demands due to the difficulty of measuring these water demands. For this reason, the TCEQ minimum design criterion of 2.0 GPM per connection is typically used when planning and designing new infrastructure. LCRA's design criteria specify a slightly higher criterion of 2.2 GPM per connection for its urban systems.

Peak hour demands are not applicable to a regional water system whose purpose is to provide treated water to existing entities that already have their local water distribution systems in place, or to future entities that will be constructing their own local water distribution infrastructure. Peak hour demands will typically be met by the local infrastructure within each system; reference discussion later in this section.

Maximum and Minimum Pressures

Maximum and minimum pressures impact pipeline sizes, storage tank elevations and booster pump locations regarding the planning and design of regional water facilities. Besides LCRA, many of the participants did not report maximum or minimum design pressures for their water systems; it is assumed that these systems follow the TCEQ minimum pressures shown in Table 4-2.

The Roth Team selected the TCEQ minimum pressure criteria of 35 pounds per square inch (psi) for use in laying out regional alternatives in this study. LCRA's maximum pressure criterion (115 psi) is a reasonable approach for distribution systems, but it is not uncommon for segments of transmission mains to be designed for pressures exceeding 115 psi, especially in terrain with many hills. For transmission mains, higher pressures do not pose a problem because regional transmission mains would not normally be tapped for service connections. Transmission main pressures are typically designed for operating pressures not to exceed 200 psi; but in some cases, higher pressures may be allowed in order to avoid the additional costs of installing a booster pumping station, as an example.

Minimum Water Storage Volume

TCEQ's water storage requirements vary with source water type and system size, as shown in Table 4-2. Systems with surface water sources must have a clearwell(s) with a volume of at least 50 gallons per connection or a volume equal to 5% of the daily plant capacity, whichever is greater. TCEQ requires all water systems to provide a total storage of no less than 200 gallons per connection. At a minimum, 100 gallons of elevated storage must be provided for larger groundwater systems and surface water systems. For smaller systems, pressure (hydropneumatic) tanks may be used in lieu of elevated storage tanks, but the total storage must equal 200 gallons per connection.

However, TCEQ's rules do not specifically address water storage requirements for firefighting. Systems that provide water for firefighting normally provide additional storage beyond the TCEQ minimum requirements. For example, the LCRA requires that an additional 100 gallons per connection of elevated storage be provided, as noted in Table 4-2.

For the purpose of this study, each regional alternative has been developed such that a minimum of 50 gallons of clearwell storage is provided at the regional treatment facility. It is assumed that the local entity already has sufficient total and elevated storage for its current customers, and that the local entity will be responsible for adding additional storage as its connections increase.

Regional storage facilities are usually provided where booster pumping stations are required due to the length of a regional transmission main or where significant elevation increases occur along the main. In this study, each booster station is accompanied by a storage tank with a capacity of 30 minutes times the firm pumping capacity of the booster station. These tanks are either ground storage or elevated storage tanks depending on the topography along the transmission main.

Water storage is also an important component of firefighting capability of a water system. The next section addresses regional versus local storage with respect to firefighting or emergency storage requirements.

Fire Flow Demands and Emergency Storage

Regional water systems are designed to provide wholesale, retail service or a combination of both. If retail service is provided, then the question of whether the regional system is to provide sufficient capacity for firefighting must be addressed early in the planning phase of the system. On the other hand, if wholesale service is to be provided by the regional water system, then the decision about whether to provide fire flow would be made at the retail service level, normally with minimal impact on the quantity of water needed from the wholesale regional provider.

Firefighting demands can be quite large for short periods of time (usually for up to two hours). Fire flows are typically in the range of 750 GPM to 1000 GPM in residential areas and about 1500 GPM in light commercial areas, but depend on the local fire department's equipment and applicable firefighting codes. Although the short term fire flows are quite large, the volume of water used for firefighting is not as large; the impact on monthly demands or even on peak day demands is not that significant, especially in larger systems, such as the Cities of Burnet and Marble Falls.

To accommodate fire flows in residential areas, the distribution system must include pipes of at least 8-inches in diameter with shorter runs of 6-inch diameter pipe for limited areas. When factoring in a minimum system pressure of 20 psi and a typical elevated storage tank height of 120 feet, elevated tanks can hypothetically provide a fire flow of 750 GPM to flat areas of approximately 6000 feet (1.1 miles in diameter), assuming the elevated tank is in the center of the area and an 8-inch pipe extends out to the edge of the circle. Using larger pipe diameters can increase the area served with fire flows. It is important to note that constraints such as topography and reasonable distribution pipe sizes dictate that providing fire flows is primarily a local issue, rather than a regional issue.

This study assumes that each local entity will individually decide whether fire flows and emergency water storage are to be provided and will have their water distribution system and local storage tanks designed accordingly. Typical infrastructure required for providing firefighting capabilities generally consists of additional elevated storage, a distribution system sized to pass fire flows and fire hydrants; upgrading a local water system with small pipes (4-inch diameter and less) to a system with primarily 8-inch piping requires a significant investment. As the typical lot size increases, the cost per connection for this investment also increases.

The regional systems developed and sized in this study will have the capability to make up and replace the emergency storage (i.e. water used for firefighting); however, the regional systems will not include the infrastructure required to store the emergency water and deliver it from an elevated/ground storage tank to a residence or commercial building during a fire. If participants in a regional system are relatively close to each other and share an interest in receiving adequate fire protection, then the design of a portion of the regional system could be adjusted to accommodate one or more aspects of achieving adequate fire protection. For example, a regional storage tank that would be large enough to provide emergency storage could be constructed near the participants interested in receiving fire protection; however, these entities would have to cover almost the entire cost of the tank, since its extra capacity would only benefit the local entities. It is also important to note that adding a larger storage tank is only one part of the infrastructure needed for firefighting; the local distribution pipes need to be sized large enough to deliver the water to the fire.

Recommended Criteria for Projecting Regional Water Demands

In summary, a maximum day demand or 0.6 GPM per connection was selected for sizing future facilities in this study. As previously mentioned, the maximum day demand has the largest impact on the sizing and cost of regional water facilities. Additional design criteria used are as follows:

- *Average daily water demand:* 0.30 GPM per connection
- *Minimum transmission main pressure:* 35 pound per square inch (psi)
- *Maximum transmission main pressure:* 200 psi
- *Minimum clearwell capacity:* 50 gallons per connection or 5% of daily plant capacity (for surface water systems)
- *Maximum velocity in water transmission mains:* 5.0 feet per second (fps)
- *Water storage for booster pumping stations:* 30 minutes of storage at the design pumping rate of the booster station

4.3 Water Demand Projections

Due to a number of residents owning second homes in the study area and not claiming permanent residency in Burnet and Llano Counties, the Roth Team based the water demand calculations on an entity's actual number of water connections instead of using the new 2010 U.S. Census population figures in order to adequately size the regional infrastructure. A summary of the number of water connections projected for each entity are summarized below in Table 4-4 (reference Appendix D).

The water connection data, population growth rates from the *TWDB Region K Water Plan* and a maximum day water demand of 0.6 GPM per connection (based on design criteria in Section 4.2) were used to determine the water demand projections for each entity in five year increments through 2040. Maximum water demand projections, converted to million gallons per day (MGD), for each entity are summarized below in Table 4-5.

Table 4-4: Project Participants - Water Connection Projections

Entity	Water Connections						
	2010	2015	2020	2025	2030	2035	2040
Blanco San Miguel	0	120	520	1220	2220	3220	4220
Bonanza Beach Water System (LCRA)	54	56	59	62	65	68	71
Buchanan Water System (LCRA)	576	652	737	834	944	1068	1208
Buena Vista Water System*	222	248	275	303	331	360	389
Burnet Co. MUD No. 2	0	40	80	120	160	200	252
Capstone Water System	9	31	61	83	108	121	136
Cassie Subdivision	234	244	254	264	274	284	294
Chisholm Trail SUD (Burnet Co.)	20	22	24	27	30	33	36
City of Bertram	738	914	1119	1365	1664	2011	2434
City of Burnet	2535	3059	3653	4329	5228	6077	6975
City of Cottonwood Shores	536	592	653	721	796	879	971
City of Granite Shoals	2032	2243	2477	2735	3019	3334	3681
City of Highland Haven	360	388	418	440	440	440	440
City of Marble Falls	3202	3798	4538	5486	6562	7887	9388
City of Meadowlakes	880	920	960	960	960	960	960
City of Sunrise Beach (LCRA)	926	973	1023	1075	1130	1188	1248
Council Creek Village	146	150	153	157	161	165	170
Hamilton Creek Water System (LCRA)	40	42	44	46	49	51	54
Kempner WSC (Burnet Co.)	67	67	68	68	68	69	69
Kingsland WSC	3813	3909	4008	4109	4213	4319	4428
NE Lake Buchanan Developments	0	250	500	750	1000	1188	1188
Paradise Point Water System (LCRA)	140	143	146	149	152	155	158
Quail Creek Water System (LCRA)	40	40	40	40	40	44	44
Ridge Harbor Water System (LCRA)	159	178	200	224	251	281	315
South Silver Creek (I,II, III)	84	86	88	91	93	95	98
Sandy Harbor Water System (LCRA)	97	102	107	113	118	124	131
Smithwick Mills Water System (LCRA)	64	66	69	72	74	77	80
South Road Water System (LCRA)	58	61	63	66	69	73	76
Spicewood Beach Water Sys. (LCRA)	437	448	459	471	483	495	508
Tow Village Water System (LCRA)	33	35	36	38	40	42	44
Whitewater Springs Water Sys.(LCRA)	62	72	83	97	112	130	150
Windermere Oaks WSC	231	237	243	249	255	262	268

*Includes the following adjacent developments: Laguna Vista, Clear Creek, Willows and Inks Lake Village Subdivisions

Table 4-5: Project Participants - Water Demand Projections

Entity	Maximum Day Water Demands (MGD)						
	2010	2015	2020	2025	2030	2035	2040
Blanco San Miguel	0.00	0.10	0.45	1.05	1.92	2.78	3.65
Bonanza Beach Water System (LCRA)	0.05	0.05	0.05	0.05	0.06	0.06	0.06
Buchanan Water System (LCRA)	0.50	0.56	0.64	0.72	0.82	0.92	1.04
Buena Vista Water System*	0.19	0.21	0.24	0.26	0.29	0.31	0.34
Burnet Co. MUD No. 2	0.00	0.03	0.07	0.10	0.14	0.17	0.22
Capstone Water System	0.01	0.03	0.05	0.07	0.09	0.10	0.12
Cassie Subdivision	0.20	0.21	0.22	0.23	0.24	0.25	0.25
Chisholm Trail SUD (Burnet Co.)	0.02	0.02	0.02	0.02	0.03	0.03	0.03
City of Bertram	0.64	0.79	0.97	1.18	1.44	1.74	2.10
City of Burnet	2.19	2.64	3.16	3.74	4.52	5.25	6.03
City of Cottonwood Shores	0.46	0.51	0.56	0.62	0.69	0.76	0.84
City of Granite Shoals	1.76	1.94	2.14	2.36	2.61	2.88	3.18
City of Highland Haven	0.31	0.34	0.36	0.38	0.38	0.38	0.38
City of Marble Falls	2.77	3.28	3.92	4.74	5.67	6.82	8.11
City of Meadowlakes	0.76	0.79	0.83	0.83	0.83	0.83	0.83
City of Sunrise Beach (LCRA)	0.80	0.84	0.88	0.93	0.98	1.03	1.08
Council Creek Village	0.13	0.13	0.13	0.14	0.14	0.14	0.15
Hamilton Creek Water System (LCRA)	0.03	0.04	0.04	0.04	0.04	0.04	0.05
Kempner WSC (Burnet Co.)	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Kingsland WSC	3.29	3.38	3.46	3.55	3.64	3.73	3.83
NE Lake Buchanan Developments	0.00	0.22	0.43	0.65	0.86	1.03	1.03
Paradise Point Water System (LCRA)	0.12	0.12	0.13	0.13	0.13	0.13	0.14
Quail Creek Water System (LCRA)	0.03	0.03	0.03	0.03	0.03	0.04	0.04
Ridge Harbor Water System (LCRA)	0.14	0.15	0.17	0.19	0.22	0.24	0.27
South Silver Creek (I,II, III)	0.07	0.07	0.08	0.08	0.08	0.08	0.08
Sandy Harbor Water System (LCRA)	0.08	0.09	0.09	0.10	0.10	0.11	0.11
Smithwick Mills Water System (LCRA)	0.06	0.06	0.06	0.06	0.06	0.07	0.07
South Road Water System (LCRA)	0.05	0.05	0.05	0.06	0.06	0.06	0.07
Spicewood Beach Water Sys. (LCRA)	0.38	0.39	0.40	0.41	0.42	0.43	0.44
Tow Village Water System (LCRA)	0.03	0.03	0.03	0.03	0.03	0.04	0.04
Whitewater Springs Water Sys.(LCRA)	0.05	0.06	0.07	0.08	0.10	0.11	0.13
Windermere Oaks WSC	0.20	0.20	0.21	0.22	0.22	0.23	0.23

*Includes the following adjacent developments: Laguna Vista, Clear Creek, Willows and Inks Lake Village Subdivisions

5.0 DESCRIPTION OF EXISTING WATER SYSTEMS

The study area includes a variety of water systems in terms of size, ownership, source of raw water, and physical location. The participating systems range in size from the Capstone Water System, serving just nine connections to Kempner WSC, which serves over 4600 connections (majority of connections located outside of the study area).

During the initial data review, it was discovered that many of the project participants were experiencing similar water issues in various locations within the study area. As a result, the Roth Team found it useful to divide the study area into four quadrants, as shown in Figure 5-1, based on these commonalities to explore the potential for regionalization. The quadrants overlap to include the Cities of Burnet and Marble Falls since their water systems play an important role in more than one quadrant.

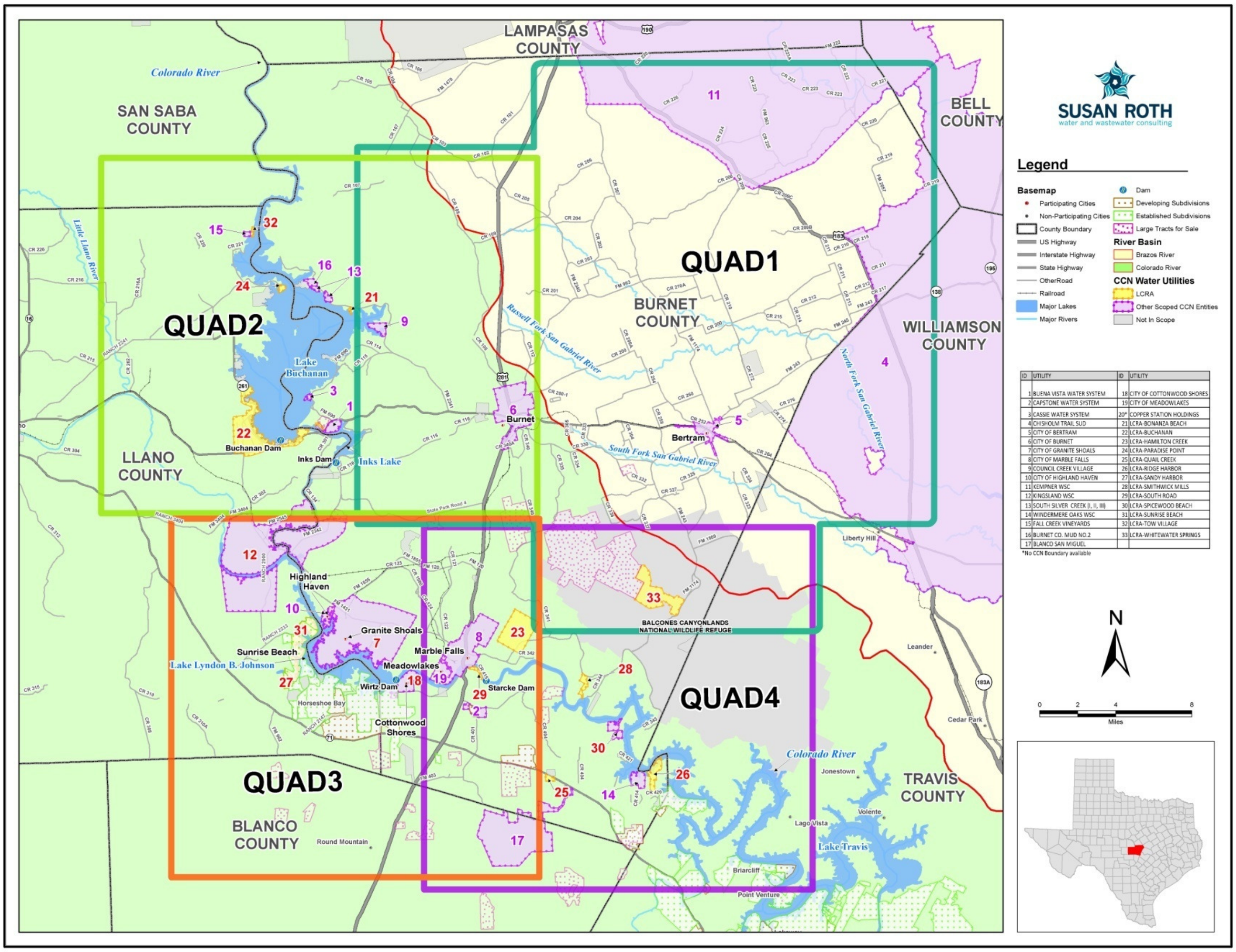

Figure 5-1: Study Area – Quadrant Overview

5.1 Quadrant 1 – City of Burnet and Northeast Burnet County

The participants in Quadrant 1 include the City of Burnet, City of Bertram, Whitewater Springs (water system owned and operated by LCRA), Chisholm Trail Special Utility District and Kempner Water Supply Corporation. The City of Burnet is a primary water system for the area because its intake is located on Inks Lake. Descriptions of the systems in Quadrant 1 are as follows:

City of Burnet

The City of Burnet obtains raw water from an intake on Inks Lake about nine miles west of the mid-point of the City. Two raw water pumps, each with a capacity of about 2000 GPM, pump raw water to the City's water treatment plant (WTP) on State Park Road 4. The treatment plant, which was built in 1986, consists of an upflow clarifier and two mixed media filters, followed by disinfection with chloramines. The site also includes two clearwells with a total capacity of 1,000,000 gallons and a high service pumping station. The current plant capacity is 2000 GPM or 2.88 MGD and there is room on the current site for at least another 2000 GPM of plant capacity. The site is currently bordered on three sides by undeveloped land.

Potable water is pumped to the City of Burnet via an 18-inch transmission main that runs east from the WTP along a route parallel and south of Highway 29. The Roth Team has estimated that this 18-inch main could provide as much as 4000 GPM of treated water to the City of Burnet if velocities were increased to 5.0 fps. However, the operating pressures at the existing high service pumping station at the WTP would be in the range of 325 psi at this flow rate. Since the pressure rating of the existing pipe is not know, it has been assumed that a intermediate booster pumping station would be needed along the 18-inch in order to use the existing pipe to pump up to 4000 GPM to the City of Burnet.

The City's distribution system includes two 500,000 gallon ground storage tanks (GSTs) on Post Mountain (elevation 1570 ft. pressure plane), and two 400,000 gallon GSTs (west and east of Highway 281, both serving the elevation 1470 ft. pressure plane. These four GSTs are located on hills and serve as elevated storage for their respective service areas. The City also has two booster pumping stations that serve higher areas of town. These are the Eagles Nest Booster Station and the East Tank Booster Station.

The City of Burnet also has 13 permitted wells, but only two of these (Cheatham wells located in the Ellenberger-San Saba aquifer) are currently in use. Free chlorine is used for disinfection purposes of the groundwater wells. It is reported that these two wells, which have a total capacity of 625 GPM, are only used as a back-up supply; the City tries to minimize mixing the treated surface water with treated groundwater.

City of Bertram

The City of Bertram currently has approximately 732 water connections and obtains its water from four wells. The two main wells, Felps No. 9 and No. 10, are each rated at 500-GPM and draw water from the Ellenberger-San Saba aquifer. It is important to note that the Felps wells are located over 11 miles west of Bertram and only about one to two miles south of downtown Burnet. Another important aspect about these wells is that the existing water contract with the property owner states that Bertram must serve 85% of the City's total water demand from these two wells.

Water is pumped from the Felps No. 9 and No. 10 wells, chlorinated, and then discharged into a 200,000 gallon GST at each of the well sites. Transfer pumps then pump the water east through approximately 11.6 miles of 8-inch transmission main running along County Road (CR) 330 and CR 243 to Bertram.

The system includes a 205,000-gallon standpipe about midway along the 8-inch transmission main running from the Felps wells to Bertram. This standpipe is located adjacent to the Headwaters, a development served by the City's system. The standpipe is 80-feet high with its overflow at elevation 1480 feet MSL. Since the bottom of the standpipe is at elevation 1400 feet, and the downstream elevated storage tank in Bertram has an overflow of 1262 feet, all of the standpipe volume is considered usable elevated storage. Two 500-GPM booster pumps take suction from the standpipe and deliver potable water to the Headwaters subdivision. Pressure maintenance is provided via a 3000-gallon hydropneumatic tank.

The eastern-most end of the 8-inch transmission main delivers potable water to the 50,000 gallon EST mentioned previously, or to a 125,000 gallon GST on the same downtown site as the EST, or directly to the distribution system. Pumps at this site take suction from the GST and deliver water into the distribution system when needed. The Roth Team has estimated that the Felps well system and 8-inch transmission main could furnish up to 650 GPM to the City of Bertram.

The City also has two additional wells (Roach and Crenshaw wells located in the Trinity aquifer) that serve as a back-up supply. The Roach Well is rated at 45 GPM and is located south of town, while the 40 GPM Crenshaw well is located west of town along Highway 29. Each of these well sites include a 200,000-gallon GST, chlorine feed facilities, and two 200-GPM pumps to deliver potable water into the distribution system.

Chisholm Trail Special Utility District (Chisholm Trail SUD)

Chisholm Trail SUD serves 6,194 connections in Williamson, Bell, and northeast Burnet County, but it is reported that approximately 20 connections are located in Burnet County. They obtain 9.91 MGD (11,100 acre-feet) of surface water from the Brazos River Basin and 4.83 MGD from four wells in the Edwards Aquifer. Chisholm Trail SUD purchases treated water from the City of Georgetown via Lake Georgetown and the City's North WTP.

Chisholm Trail SUD's water system is an extensive system, including two high service pumping stations near the well sites, two high service pumping stations that pump treated surface water into the system, five booster stations, seven ground storage tanks, four elevated storage tanks and three hydropneumatic tanks.

To meet its future needs, Chisholm Trail SUD has entered into a partnership with the City of Georgetown for the expansion of the City's North WTP. Chisholm Trail SUD is also participating with the City of Georgetown in the purchase of land for a new WTP on the south side of Lake Georgetown. Chisholm Trail SUD has reported that two of its four wells in the Edwards have been taken out of service due to maintenance problems and minor water quality issues.

Kempner Water Supply Corporation (Kempner WSC)

Kempner WSC is similar to the Chisholm Trail SUD in that it serves a large number of customer connections, but only approximately 67 connections are located in Burnet County. The majority of its 4,629 customer connections are located in Lampasas County. Kempner WSC also provides potable water to the City of Lampasas, which lies west of its service area.

Since 1980, Kempner WSC has obtained all of its water from intakes located on Stillhouse Hollow Lake, which lies within the Brazos River Basin. Kempner WSC is a participant in the Central Texas WSC, which operates a membrane filtration water treatment plant (recently completed in July 2010). Kempner WSC distribution system includes seven pumping stations with a total of 17 pumps, eight storage tanks with a total capacity of 10.6 MGD, and five hydro-pneumatic tanks.

Whitewater Springs Water System (LCRA)

The Whitewater Springs Water System is current owned and operated by LCRA and is located on FM 1174, approximately 9 miles south of the City of Bertram. The system serves approximately 60 connections within what is now known as the Preserve at Whitewater Springs subdivision, consisting of approximately 1200 acres. The service area for the Whitewater Springs Water System is surrounded by the Balcones Canyonlands National Wildlife Refuge; as a result, it is unlikely that the system will expand beyond the boundaries of the subdivision.

Whitewater Springs is currently served by two groundwater wells (located in the Trinity aquifer); these wells have a total capacity of 37 GPM. LCRA has drilled a third well at 12 GPM and is currently working on permitting the well with the Central Texas Groundwater Conservation District.

LCRA has an agreement with the current subdivision developer to construct and convey additional groundwater wells to the Whitewater Springs Water System.

5.2 Quadrant 2 – Lake Buchanan and Inks Lake Area

The participants in this area include nine small water systems (four of which are operated by LCRA), one private water system (Fall Creek Vineyards), and proposed developments along the northeast side of Lake Buchanan. The City of Burnet, whose water system is described above in Quadrant 1, is also included in this area because their intake is located on Inks Lake. Descriptions of the other systems are as follows:

Buchanan Water System (LCRA)

The Buchanan Water System serves an area south of the Buchanan Dam and along the lower west side of Lake Buchanan. Raw water is supplied from a small intake on Buchanan Dam, which pumps the raw water to a WTP located just south of the dam on LCRA property.

The treatment system consists of a chlorine dioxide feed system for taste and odor control, two 175 GPM Trimite adsorption clarifiers/gravity filters, transfer pumps, a 41,000 gallon clear well, and chloramine disinfection. The current capacity limitation in the treatment system is the transfer pumping capacity, which is 300 GPM (firm).

The distribution system includes a 150,000-gallon GST, three high service pumps of 350 GPM each, a standpipe with a total storage of 258,000 gallons (but an effective storage of only 44,600 gallons), and a newly constructed 150,000-gallon GST located on a hill, such that 128,000 gallons of that capacity can be considered effectively as elevated storage.

Paradise Point Water System (LCRA)

The Paradise Point Water System serves a peninsula on the west side of Lake Buchanan. Raw water is supplied from a small intake in the lake, which pumps the raw water to a WTP located on the peninsula. The treatment system consists of a cascade aerator, clarifier, filters, transfer pumps, a 68,000-gallon clearwell, and chloramine disinfection. The current capacity of the treatment system is reported to be 105 GPM. Pressure service to the distribution system is provided by high service pumps and a 3000-gallon hydropneumatic tank.

LCRA has reported that a marina and boat docks were constructed within 1000-ft of the original water treatment plant intake location. Current TCEQ rules adopted after the construction of the intake require these structures to be located no closer than 1000-ft. LCRA conducts water quality monitoring as required by TCEQ to verify there are no impacts to the permitted intake from these structures.

Tow Village Water System (LCRA)

Tow Village is located on the west side at the most northern upstream end of Lake Buchanan. This water system, owned and operated by LCRA, serves approximately 29 connections (reduced from 40 connections in 2006) with groundwater obtained from the Hickory aquifer. Chlorination is the only treatment provided. Facilities include one well with a capacity of 45 GPM, an 8,500-gallon clearwell, three high service pumps, and a 1,500-gallon hydropneumatic tank. The capacity of the system is reported to be 39 GPM, and the water supplied exceeds the maximum contaminant levels (MCLs) for Radium-226 and Radium-228.

LCRA has reported that they have a Compliance Agreement with TCEQ for the Tow Village Water System which is based on the "*Draft Feasibility Report Feasibility Analysis of Water Supply for Small Public Water Systems*" from Council Creek Village for the Texas Commission on Environmental Quality (TCEQ) in August 2010. The agreement with TCEQ states that the system is not required to meet the federal radionuclide MCLs because none of the alternatives presented in the study are currently economically feasible. However, LCRA reports that the agreement could be revoked at some point in the future depending on enforcement priorities and other pressures.

Fall Creek Vineyards

Adjacent to Tow Village are the Fall Creek Vineyards, which are privately owned. Fall Creek Vineyards has three wells located in the Hickory aquifer, each with a capacity of about 300 GPM. The wells were not constructed as public drinking water supply wells and no water quality data has been provided. The owners of Fall Creek have expressed an interest in using their wells to supply groundwater to a joint treatment facility that would provide drinking water to both Tow Village and themselves. The proposed joint treatment plant would need to include reverse osmosis (RO) or similar type of treatment.

Burnet County MUD No. 2

On the east side at the northern end of Lake Buchanan is the proposed Eagle Mountain Reserve development. The developer has established the Burnet County MUD No. 2 to provide water service to the homes planned for the development. A water contract for 123 acre-feet/year has been negotiated with LCRA, and the proposed floating intake would be located in a cove fed by Beaver Creek on the eastern side of Lake Buchanan, opposite from Paradise Point Water System. The proposed facilities would also include a 100-GPM surface water treatment plant, clearwell and pressure maintenance facilities.

The MUD has letters of intent to serve two other existing water systems in this area of the lake. These agreements specify that the MUD would provide up to 7.5 million gallons per year of treated water to South Silver Creek (I, II and III) and up to 0.4 million gallons per year of treated water to Silver Creek Village (not a participant in this study).

South Silver Creek (I, II and III) Water System

The South Silver Creek (I, II and III) Water System serves approximately 84 connections with groundwater obtained from three wells in the Hickory aquifer. Treatment consists only of chlorination. As mentioned above, the South Silver Creek Water System has entered into a letter of intent with the Burnet County MUD No. 2 to obtain up to 7.5 million gallons per year of treated surface water from the MUD.

Council Creek Village Water System

The water system at Council Creek Village serves about 146 connections on the east side of Lake Buchanan. The water system includes three wells in the Hickory aquifer, a chlorination system, three storage tanks with a combined capacity of 64,000-gallons, seven high service pumps (with capacities of 7 GPM to 30 GPM), and two hydropneumatic tanks (1750 gallons and 2500 gallons). A chemical is added for iron treatment, most likely a sequestering agent. The rated capacity of the system is reported to be 75 GPM.

Bonanza Beach Water System (LCRA)

The Bonanza Beach Water System is currently owned/operated by LCRA and serves approximately 54 connections on the east side of Lake Buchanan. The system includes three wells in the Hickory aquifer, a chlorination system, a 16,000-gallon clearwell, two high service pumps (80-GPM each), and a 2500-gallon hydropneumatic tank. The rated capacity of the system is reported to be 30 GPM. Water quality information provided indicates that the treated water exceeds the MCLs for Radium-226 and Radium-228.

LCRA has reported that they have a Compliance Agreement with TCEQ for the Bonanza Beach Water System which is based on the "*Draft Feasibility Report Feasibility Analysis of Water Supply for Small Public Water Systems*" from Council Creek Village for the Texas Commission on

Environmental Quality (TCEQ) in August 2010. The agreement with TCEQ states that the system is not required to meet the federal radionuclide MCLs because none of the alternatives presented in the study are currently economically feasible. However, LCRA reports that the agreement could be revoked at some point in the future depending on enforcement priorities and other pressures.

Cassie Subdivision

The privately owned Cassie Water System serves about 56 of the homes in the Cassie area, which is located on the eastern shore of Lake Buchanan. In addition, approximately 178 homes in the area are served by individual private wells. According to information on the TCEQ website, the Cassie Water System has two wells, each with a capacity of 22 GPM. The wells are 55 feet and 275 feet deep and are reported to be located in “Precambrian granite” and treatment consists only of chlorination. The system also includes a 20,000 gallon GST, high service pumps with a capacity of 120 GPM, and a 1200 gallon hydropneumatic tank. According to TCEQ, the rated capacity of the system is 41 GPM.

The water system includes two shallow wells; however, the capacities of these wells diminish when water levels in Lake Buchanan drop below approximately elevation 998 feet. The distribution system only serves a fraction of the homes in the Cassie Subdivision and is reported to be undersized with no capability to serve additional homes. In addition, water consumption restrictions will soon be implemented due to falling lake levels. It has been reported that residents have had to truck in water during previous droughts.

A majority of the homes in the subdivision that are served by individual private wells experience failure when water levels in Lake Buchanan drop below elevation 998 feet. A few residents have deeper wells, but these typically have poor water quality (hardness and iron). Those residents with deeper wells often purchase bulk water for drinking purposes, despite having installed water softeners and filters to provide some protection to appliances from the high levels of iron.

Buena Vista Water System (Buena Vista POA)

The Buena Vista development and water system is located on the north shore of Inks Lake just south of Highway 29. The water system serves approximately 125 connections and includes the following facilities: a fixed intake on Inks Lake, a sedimentation basin, four dual media pressure filters, a gas chlorination system, and three 7,000 gallon GSTs located on a hill and providing gravity service to the majority of the service area (note: water pressures below TCEQ’s minimum of 35 psi). A fourth 7,000 gallon GST is located at a booster station with three high service pumps and two 900 gallon hydropneumatic tanks, which serve connections in the higher parts of the service area.

Ownership of the system is currently in receivership and is operated by Gulf Utility Service. There are reports that the system has inadequate capacity, storage and pressure, treated water exceeds the MCLs for trihalomethanes (THMs), and the system has been frequently cited by TCEQ for low chlorine residuals; taste and odor problems have also been reported.

5.3 Quadrant 3 – City of Marble Falls and Lake LBJ Area

This area includes several large water systems each serving over 2,000 connections. The participant water systems in Quadrant 3 include the systems operated by the Cities of Marble Falls, Cottonwood Shores, Granite Shoals, Highland Haven, Meadowlakes, as well as Kingsland WSC and Capstone Water System. Four LCRA water systems are also located in this quadrant: Hamilton Creek, Sandy Harbor, Sunrise Beach, and South Road.

A majority of the water systems in Quadrant 3 have raw water intakes located on either Lake LBJ or Lake Marble Falls; however, three water systems in this quadrant use groundwater. Also, two of the LCRA systems purchase wholesale potable water from the City of Marble Falls.

The area also includes the City of Horseshoe Bay (not a participant in this study), which serves approximately 3800 connections on the south side of Lake LBJ; the City also provides wholesale water service to Sandy Harbor.

Capstone Water System

The Capstone Water System is privately owned and currently serves approximately 9 connections in a relatively new development located east of Highway 281 and south of the City of Marble Falls. Groundwater is obtained from two wells in the Ellenburger-San Saba aquifer. The wells are reported to have a capacity of 100 GPM each. The system includes chlorination facilities, a 40,000-gallon clearwell, two 150-GPM high service pumps, and a 2000-gallon hydropneumatic tank. The rated capacity of the system is reported to be 95 GPM or 0.137 MGD. At full build-out, the Capstone system is projected to serve 136 connections.

City of Cottonwood Shores

The City of Cottonwood Shores is located on the south shore of Lake Marble Falls, just downstream of the Wirtz Dam. The City's water system serves approximately 536 connections.

The City operates an intake on Lake LBJ just upstream of the Wirtz Dam. TCEQ reports that the intake capacity is 300 GPM, but the City has the ability to pump raw water into a quarry, which has an additional intake in it. The capacity of the existing treatment system is 350 GPM or 0.504 MGD; the treatment process includes coagulation, adsorption clarifiers and gravity filters, transfer pumps, a clearwell, and chloramine disinfection. The distribution system includes high service pumps with a TCEQ reported firm capacity of 540 GPM, and 235,000 gallons of elevated storage. The City of Cottonwood Shores currently has an interconnection with the City of Horseshoe Bay due to the poor condition of their existing treatment units.

City of Granite Shoals

The City of Granite Shoals serves approximately 2100 connections, which makes it one of the larger water systems on the north shore of Lake LBJ. It is reported that there are 11,000 platted lots in Granite Shoals; there is potential for substantial growth in the City.

Granite Shoals obtains raw water from a fixed intake, which is located in a cove on Lake LBJ. The water system includes an intake pipe and four 750 GPM raw water pumps. The existing WTP was built in 2005 and is reported to consist of a coagulant mixing system, upflow/solids contact clarifier, microfiltration units, and chloromine disinfection. The WTP site also includes a 200,000-gallon clearwell and high service pumps. According to the TCEQ website, the reported plant capacity is 3.073 MGD (or 2,134 GPM). Potable water storage is provided by two ESTs with a combined capacity of 250,000 gallons, and two GSTs with a combined volume of 600,000 gallons.

The City has indicated that its 1.4 acre site for the existing WTP has room for expansion to meet future water demands.

Hamilton Creek Water System (LCRA)

The Hamilton Creek Water System serves about 40 connections in an area northeast of the City of Marble Falls. An interconnect to the City of Marble Falls water system was installed in 1998 and for several years, Hamilton Creek has received all of its potable water from Marble Falls. In 2007, the LCRA Board approved transferring the Hamilton Creek water system to the City of Marble Falls, but LCRA has continued to operate the system since 2007. However, LCRA recently transferred the Hamilton Creek Water System to the City; this system was not included in the proposed sale of the other LCRA water and wastewater systems.

City of Highland Haven

The City of Highland Haven is located just west of the City of Granite Shoals and serves approximately 360 connections, as well as Camp Champion. Although the City is located on the shores of Lake LBJ, their water source is 6 groundwater wells (located in the Town Mountain Granite Formation). The wells have a total capacity of 310 GPM; treatment consists of disinfection by chlorine, except for the groundwater obtained from the Camp Champion well, which is also filtered. The system also includes a 100,000-gallon clearwell, four 200-GPM high service pumps, and two 4000-gallon hydropneumatic tanks. The rated capacity of the system is reported to be 0.31 MGD (or 216 GPM). The City of Highland Haven is interested in the possibility of having an interconnect with the City of Granite Shoals for back-up water supply.

Kingsland Water Supply Corporation

Kingsland WSC serves just over 3800 connections in the City of Kingsland and surrounding areas of Llano County. Kingsland WSC has a raw water intake on the Llano River branch of Lake LBJ. The intake includes two pumps, each with a capacity of 1800 GPM.

According to a website article about Kingsland WSC, they have recently constructed and are now operating a membrane water treatment process. Although TCEQ lists the current plant capacity at 2.51 MGD (or 1740 GPM), Kingsland reports the capacity as 3.0 MGD. Kingsland WSC also reports that it has 250,000 gallons of elevated storage and a total of 868,000 gallons of ground storage.

City of Marble Falls

The City of Marble Falls serves approximately 3,200 connections and also provides potable water to two LCRA systems, Hamilton Creek and South Road.

Marble Falls obtains raw water from an intake located on Lake Marble Falls about 3,500 feet west of the city center. The intake system includes a 36-inch intake pipe and three 1200 GPM raw water pumps, and a chlorine dioxide feed system for taste and odor control. Raw water is pumped to the City's WTP, which is located downtown just east of the Highway 281 bridge.

The treatment system consists of a coagulant mixing tank, an upflow/solids contact clarifier and 3 dual-media filters. Chloramine disinfection is accomplished by feeding chlorine and ammonia (LAS) into the coagulant mixing tank. The WTP site also includes two clearwells with a total capacity of 165,000 gallons and five 1000 GPM high service pumps. The City reports that the maximum the plant can produce is about 3.0 MGD.

The City is currently operating two ESTs with a combined capacity of 750,000 gallons, three GSTs with a combined volume of 815,000 gallons, and one standpipe with a volume of 259,000 gallons. The recently completed Flatrock EST, which is located near the Highway 281 and Highway 71 interchange and at the south end of the new 16-inch potable water transmission main, has a capacity of 1.0 million gallons; however, it has not been put into service.

To meet future demands, the City may increase the treatment capacity at the existing WTP site to 5.0 or 7.0 MGD; however, space is limited at the existing WTP site. In addition, the City recently acquired a site from LCRA for a future water treatment plant on the south side of Lake Marble Falls just southwest of the Max Starcke Dam; a new intake would be constructed just upstream of the dam.

City of Meadowlakes

The City of Meadowlakes is located adjacent to the southwest corner of the City of Marble Falls and serves about 880 connections. Meadowlakes obtains raw water from a fixed intake in Lake Marble Falls. The intake system includes intake screens installed in gravel beds, an intake pipe, three 750-GPM raw water pumps, and a sodium permanganate chemical feed system.

The WTP has three treatment trains and a total capacity of 2.0 MGD (or about 1400 GPM). The original train consists of a coagulant mixing system, a conventional settling basin, and gravity filters. In 1995, two 350 GPM Trimite adsorption clarifiers/gravity filters were added. All three treatment trains use chloramines for disinfection. The WTP site also includes a 200,000-gallon clearwell and four 550-GPM high service pumps. Potable water storage is provided by one 200,000-gallon EST.

The City expects to reach full build-out by the year 2020 at 960 connections, about 80 more than the current number of connections. Beyond the City's full build-out, it is anticipated that their treatment system will have approximately 1.0 MGD of excess treatment capacity.

Sandy Harbor Water System (LCRA)

The Sandy Harbor Water System serves about 97 connections. It is located in southeast Llano County just south of the City of Sunrise Beach and west of the City of Horseshoe Bay. Since the construction of an interconnect pipeline in 2004, Sandy Harbor has purchased wholesale potable water from the City of Horseshoe Bay. It is reported that the interconnection contract specifies that Horseshoe Bay will provide up to 110 GPM to meet Sandy Harbor's peak hour demands.

South Road Water System (LCRA)

The South Road Water System serves approximately 57 connections along the south shore of Lake Marble Falls just east of the Highway 281 bridge. The surface water intake and WTP for this water system were abandoned in 2002, and the water system has been purchasing wholesale potable water from the City of Marble Falls since that time through an interconnect with the City's water system. LCRA recently transferred the South Road Water System to the City; this system was not included in the proposed sale of the other LCRA water and wastewater systems.

City of Sunrise Beach (LCRA)

The City of Sunrise Beach serves approximately 920 connections in southeast Llano County on the south shore of Lake LBJ. Originally, the Sunrise Beach system obtained its water from a small floating intake on Lake LBJ near the south end of its service area. Later, wells were drilled near the airport to supplement the capacity of the surface WTP and to boost water pressures in the north end of the system. The previous owners had also installed a small WTP at the airport site to treat the groundwater obtained from the wells.

After purchasing the system, LCRA drilled additional wells in the airport area and then abandoned the surface water intake and treatment plant. In 2005, LCRA also decommissioned the treatment system for the airport wells, except for chlorination. Currently, groundwater is obtained from five wells at the airport site having a total capacity of 702 GPM. The wells are 62 to 77 feet deep and take water from an alluvial or granite aquifer.

In addition to the chlorination facilities, the system includes a 19,000-gallon clearwell, 3 high service pumps with a total capacity of 1,050 GPM, and a 108,000 GST on Sandy Mountain (which serves as elevated storage). According to TCEQ, the rated capacity of the system is reported to be 905 GPM.

5.4 Quadrant 4 – Southeast Burnet County

The Quadrant 4 participants include the City of Marble Falls (also included in Quadrant 3), several existing water systems along Highway 71 and Lake Travis, and the Blanco San Miguel Development. The description for the City of Marble Falls system is included in Section 5.3; the other participant systems in Quadrant 4 are described below:

Blanco San Miguel (Ranches and Rivers Realty)

Blanco San Miguel is a large proposed development that is located primarily in Blanco County, but has negotiated a surface water contract with LCRA to receive raw water from Lake Travis. The planned development could ultimately serve as many as 6,000 connections and will include a golf course.

The current raw water contract specifies that Blanco San Miguel would install a floating intake in Lake Travis near Windermere Oaks WSC. Raw water would be pumped through a 5 to 6-mile raw water transmission main to a WTP built on the Blanco San Miguel property south of Highway 71. However, due to the reliability of intakes located in this part of Lake Travis during drought conditions, the developer has had previous discussions with the City of Marble Falls regarding a joint intake on Lake Marble Falls just upstream of the Max Starcke Dam.

Since the developer anticipates building the golf course as one of the first phases of the project, he has indicated that he may go forward with a small floating intake at the Lake Travis intake site and an 8-inch raw water transmission main to the development. These facilities would provide irrigation water for the golf course and would provide surface water to a small plant that would serve the initial phase of the project. However, he still wants to consider the Max Starcke Dam site as the long-term intake solution.

During the course of this study, the owners of the Blanco San Miguel development have filed for bankruptcy.

Quail Creek Water System (LCRA)

The Quail Creek Water System serves approximately 40 connections south of Highway 71. Groundwater is obtained from two wells located in the Ellenburger-San Saba aquifer. The system includes chlorination facilities, two 6,000-gallon ground storage tanks, high service pumps, and a 2500-gallon hydro-pneumatic tank. The rated capacity of the system is reported to be 33 GPM.

Ridge Harbor Water System (LCRA)

LCRA's Ridge Harbor System provides water and wastewater services to the Ridge Harbor development on the south shore of Lake Travis near Spicewood. The water system has approximately 158 connections; Ridge Harbor may also provide potable water in the future to Muleshoe Bend Park and T-Bar-M Camp, which would add an additional 53 connections to the system.

A floating intake on Lake Travis pumps water the WTP, which includes the following facilities: coagulant feed and mixing, two upflow/solids contact clarifiers, three rapid sand gravity filters, transfer pumps, a 60,000-gallon clearwell, and chloramine disinfection. The capacity of the existing treatment system is reported to be 140 GPM or 0.2 MGD. Two high service pumps feed the distribution system and pressure is maintained by means of a 3800-gallon hydropneumatic tank.

In 2008, LCRA had considered a number of improvements to the system, but the construction of a new clearwell was the only improvement completed in 2009. Prior to LCRA's decision to sell their water and wastewater utilities, the capital improvement plan for Ridge Harbor included the replacement of the existing clarifiers and filters by 2012 and intake improvements in 2013. It has been reported that Ridge Harbor's intake experiences problems when the water levels in Lake Travis drop below 630-feet MSL.

Smithwick Mills Water System (LCRA)

The Smithwick Mills Water System is the only water system that LCRA owns and operates on the north bank of Lake Travis. The system currently has approximately 64 connections. This system has access to both groundwater and surface water supplies. Limited ground water was obtained from two wells up until 2006; a third well was drilled in 2006, but it only provided an additional 6.0 GPM. In 2008, an intake was installed in Lake Travis along with two 70 GPM submersible pumps. The surface water treatment facilities include a coagulant feed and mixing system, a clarifier, gravity filters, and transfer pumps; chloramines are used for disinfection purposes. Groundwater, which is only chlorinated, can be delivered to the two 15,000-gallon clearwells, which also receive the treated water from the surface water plant. LCRA reports the capacity of the existing treatment system at 70 GPM or 0.10 MGD. The distribution system includes high service pumps, hydropneumatic tanks (8000-gallon and 3000-gallon), and a 7000-gallon GST on County Road 343A.

LCRA reports that Smithwick Mill's intake relies on releases from the Max Starke Dam when water levels in Lake Travis drop below 645-feet MSL. The intake is located in a "hole" in the riverbed, such that water releases through the Max Starcke Dam during the 2009 drought filled the hole with enough water to provide Smithwick Mills with surface water until the next release.

Spicewood Beach Regional Water System (LCRA)

The Spicewood Beach Regional Water System provides treated groundwater to the developments known as Spicewood Beach, Lakeside Beach, and Eagle Bluff, and also to the Marble Falls Independent School District, all located on the south shore of Lake Travis and north of Spicewood. The total existing connections are approximately 435.

Groundwater is obtained from three wells on a peninsula that extends into Lake Travis. The wells are 64 to 72 feet deep and take water from an alluvial aquifer. The bottom of the wells is located at an elevation of approximately 620-feet MSL; it is assumed that low water levels in Lake Travis could impact the production of these wells.

The system includes chlorination facilities, a 129,000-gallon clearwell, high service pumps, and two hydropneumatic tanks (7500-gallon and 5000-gallon). The rated capacity of the system is reported by TCEQ to be 0.547 MGD (or 380 GPM).

Windermere Oaks Water Supply Corporation

Windermere Oaks WSC serves an area located south of Lake Travis and east of Spicewood. LCRA's Ridge Harbor system is adjacent to Windermere Oaks WSC.

Raw water is supplied from a small floating intake in Lake Travis, which pumps the raw water to a chemical mixing tank on the WTP site. The treatment system also includes a preliminary clarifier, two 100 GPM Trimite adsorption clarifiers/gravity filters, transfer pumps, a 42,000-gallon filtered water tank, a 135,000-gallon clearwell, and chloramine disinfection. The capacity of the existing treatment system is 200 GPM or 0.29 MGD. Also, the distribution system is fed by two high service pumps of 250 GPM each and a hydropneumatic tank.

Windermere Oaks WSC has experienced few treatment issues since the installation of the Trimite units and the preliminary clarifier for removing solids during high turbidity events in Lake Travis. However, LCRA reports that Windermere Oaks' intake experiences problems when water levels in Lake Travis drop below 630-feet MSL.

LCRA previously explored the possibility of constructing an emergency interconnect between the Windermere Oaks system and LCRA's Ridge Harbor system; the estimated cost to abandon the LCRA Ridge Harbor WTP, add capacity to the Windermere Oaks WTP and construct a transmission line from Windermere Oaks to Ridge Harbor was approximately $950,000. Although there is room at the existing WTP site for another 175 GPM Trimite unit, it is not anticipated that additional capacity is needed to serve growth within Windermere Oaks; however, this additional capacity could be used to supply potable water to Ridge Harbor and allow for the abandonment of Ridge Harbor's old intake and water treatment plant.

5.5 Study Area Overview and Regional Issues

During the review of information for the participant systems, it became apparent that many of the systems in each quadrant shared common water issues and challenges, particularly in Quadrants 2 and 4. With the exception of the City of Burnet, the existing systems in Quadrant 2 are generally small systems dispersed along the shores of Lake Buchanan and Inks Lake. Although three of these small systems obtain raw water from Lake Buchanan or Inks Lake, many of them obtain groundwater from the Hickory aquifer, which is the predominate aquifer in the area. Unfortunately, the water from the Hickory Aquifer contains naturally-occurring radionuclides and consistently exceeds the MCLs for Radium-226, Radium-228 and/or gross alpha radiation. Treatment options to remove these contaminants are expensive, especially for the disposal of the waste solids. The waste solids are considered radioactive and must be transported out of state and disposed in special hazardous waste facilities. Another alternative for these water systems is to switch to a surface water source, but this would involve the construction and operation of a much more complex treatment plant. Many of the small water systems in this quadrant are faced with difficulties to finance and manage this level of treatment system on their own.

In Quadrant 4, the commonality between several of the systems is the location of their surface water intakes at the upstream end of Lake Travis, which are impacted during drought conditions. When the water level in Lake Travis falls below 630-ft to 645-ft MSL, the intakes tend to dry up. These systems, including the proposed Blanco San Miguel Development, are very interested in finding a more reliable intake location that can supply water during an extended drought.

The water issues identified in Quadrants 2 and 4 could serve as drivers for the establishment of a regional system. Other potential regional drivers include the following:

- Development pressures along Highway 29 towards Bertram as an extension of the rapid development that has occurred along the Highway 183 corridor into Cedar Park, Leander and Liberty Hill (Quadrant 1).
- The proximity of struggling or small water systems to larger systems in Quadrant 3. Since several of the large systems in Quadrant 3 are in relatively close proximity to each other, emergency interconnections could be mutually beneficial.
- Development pressures along the Highway 71 corridor, combined with insufficient groundwater supplies in this area (Quadrants 3 and 4).

These potential drivers for regionalization were the basis for the development of the regional alternatives presented in Section 6.0.

5.6 Potential Regional Infrastructure Assets

A review of the existing systems also revealed a number of facilities that are currently operated or owned by the participants to this study. The following facilities were identified as potential assets to the region and were taken into consideration in the development of the regional water facility alternatives for Burnet and Llano Counties:

- The City of Burnet's water intake on Inks Lake, water treatment plant (located on a site that could be expanded), and an existing 18-inch transmission main between the water treatment plant and the City of Burnet;
- The City of Burnet's existing groundwater wells that are not currently used or used for back-up supply;
- An existing 8-inch transmission main that runs from the City of Bertram's well fields near the City of Burnet east to Bertram; this line could serve as an initial link between the Cities of Burnet and Bertram;
- LCRA Buchanan Water System intake structure, which is located on the Lake Buchanan Dam. This location offers accessibility to a deep part of the lake and expansion opportunities. These benefits may be outweighed by constraints that may be imposed on the future owners/operators of the LCRA water utility systems;

- Excess capacity in the City of Meadowlakes WTP; and,
- Existing 16-inch water line and 1.0 million gallon Flatrock EST recently constructed by the City of Marble Falls to serve the proposed hospital and other developments near the Highway 281 and Highway 71 interchange.

In addition, the following proposed facilities identified by the project participants may serve as potential regional assets to the study area:

- The proposed Burnet County MUD No. 2 intake and treatment plant on Lake Buchanan; letters of intent have been finalized to provide treated water to other entities in the area from these proposed facilities;
- The proposed intake and water treatment plant site for the City of Marble Falls, both of which are located just upstream of the Max Starcke Dam on Lake Marble Falls; and,
- Blanco San Miguel's proposed intake site at Lake Travis and raw water transmission main (including easements) from the intake to the proposed development south of Highway 71.

6.0 DEVELOPMENT OF REGIONAL DISTRIBUTION ALTERNATIVES

6.1 Methodology

Several drivers for regionalization were identified in Section 5.0, as well as common water issues experienced by the participants, especially those located in Quadrants 2 and 4. These issues were taken into account during the development of the initial regional alternatives and include the following for each entity:

- Comparison of participants' surface water contracts with their long-term average daily water demands;
- Comparison of participants' existing water treatment plant capacities to their short-term maximum day water demands;
- Proximity of small water systems experiencing challenges to larger water systems; and,
- Projected growth patterns, especially along Highway 29 in north Burnet County and along Highway 71 in south Burnet and Llano Counties.

Surface Water Supply

A number of the project participants have existing surface water contracts with LCRA, as shown in Table 6-1; however, most of the volumes specified in the LCRA contracts will not provide sufficient water to meet the 2040 average daily demands of those participants. The average daily demands were calculated using the entity's projected number of connections for 2040 and the design criteria outlined in Section 4.0 for average day water demand.

Table 6-1: LCRA Surface Water Contract Volume vs. 2040 Average Day Water Demands

Entity	LCRA Surface Water Contract (ac-ft/year)	2040 Average Day Demand (ac-ft/year)	Excess/Deficit Surface Water Supply (ac-ft/year)
Blanco San Miguel Development	2,500	2,042	458
Buena Vista Water System	25	188	163
Burnet County MUD No. 2	123	122	1
City of Burnet	4,100	3,375	725
City of Cottonwood Shores	495	470	25
City of Granite Shoals	830	1,781	951
City of Marble Falls	3,000	4,606*	1,606
City of Meadowlakes	75	465	390
Kingsland WSC	890	2,143	1,253
Windermere Oaks WSC	55	130	75

*Total number of connections served by the City, including projected connections for South Road and Hamilton Creek Water Systems.

In light of the information obtained from LCRA and presented in Section 3.2.1, it has been assumed that the participants of a regional water system would be able to obtain additional surface water contracts to meet their demands out to year 2040.

Groundwater Supply

Groundwater sources that are particularly important to Burnet and Llano Counties are one major aquifer (Trinity aquifer) and three minor aquifers in the area, which include the Ellenburger-San Saba, Hickory and Marble Falls aquifers. The information available on the characteristics of each of these minor aquifers is based on draft aquifer assessments issued by TWDB on January 25, 2011. As previously mentioned in Section 3.2.2, the CTGCD will continue to monitor how the minor aquifers respond to the actual magnitude and distribution of groundwater currently pumped now and in the future.

Trinity wells located in the eastern part of the study area are typically low producing wells and would be expensive to develop for any sizable water demand. As an example, a developer owning lots in Whitewater Springs is planning to spend $1.5 million to develop new well fields and related improvements; these new wells, combined with their existing wells, will serve only about 150 connections. Existing and proposed wells in the Whitewater Springs system have capacities up to 25 GPM and are 500 to 700 feet deep.

The Ellenburger-San Saba aquifer can produce higher capacity wells, but the extent of those high production wells is limited. The City of Burnet currently has wells located in the Ellenburger-San Saba aquifer, but has only used these wells for back-up supply since constructing a surface water treatment plant. The City of Bertram also has two wells in the Ellenburger-San Saba aquifer, located just southeast of the City of Burnet and approximately 11 miles from Bertram.

It is anticipated that a few of the smaller water systems in the study area could continue to rely on groundwater to meet their existing and future drinking water needs; however, groundwater is unlikely to be the basis of a large regional water system.

Water Treatment Facilities vs. Maximum Day Water Demands

Based on the review of the participants' data collected and summarized in Section 5.0, many of the participants have capacity in their water treatment plants to meet their maximum day demands for several years, but only a few participants have constructed WTPs large enough to meet their projected 2040 maximum day demands. A summary of the participants' WTP capacities and future maximum day demands for year 2040 is shown in Table 6-2.

For those participants currently receiving treated water from other entities, it is assumed that they will continue to receive sufficient treated water to meet their projected demands in year 2040. As a result, these participants (Sandy Harbor, Hamilton Creek, and South Road) show no surplus or shortfall in WTP capacity.

Participants that have adequate WTP capacity to meet their water demands out to year 2040 include Capstone Water System, City of Meadowlakes, Paradise Point, Quail Creek, South Silver Creek (I, II, III), Smithwick Mills, Spicewood Beach, and Windermere Oaks WSC. The City of Meadowlakes is almost completely built-out and has a total WTP capacity of 2.02 MGD, more than twice the projected year 2040 demands (assuming their maximum day demands are in the range of 0.6 GPM per connection).

Based on the anticipated growth for the City of Marble Falls, they will have the largest need for additional water treatment capacity; the City's plans for expanding their current WTP and for constructing a new WTP near Max Starcke Dam will address the year 2040 deficit shown in the table.

Table 6-2: Summary of WTP Capacity vs. 2040 Maximum Day Water Demands

Entity	2040 Maximum Day Water Demands (MGD)	Existing WTP Capacity (MGD)	Excess/Deficit WTP Capacity (MGD)
Bonanza Beach Water System (LCRA)	0.06	0.03	0.03
Buchanan Water System (LCRA)	1.04	0.43	0.61
Buena Vista Water System	0.34	0.08	0.26
Capstone Water System	0.12	0.14	0.02
Cassie Subdivision	0.25	0.06	0.19
City of Bertram	2.10	0.94	1.16
City of Burnet	6.03	2.88	3.15
City of Cottonwood Shores	0.84	0.50	0.34
City of Granite Shoals	3.18	3.07	0.11
City of Highland Haven	0.38	0.50	0.12
City of Marble Falls	8.11	3.80	4.31
City of Meadowlakes	0.83	2.02	1.19
City of Sunrise Beach (LCRA)	1.08	0.96	0.12
Council Creek Village	0.15	0.10	0.05
Hamilton Creek Water System (LCRA)	0.05	---	N/A
Kingsland WSC	3.83	3.00	0.83
Paradise Point Water System (LCRA)	0.14	0.15	0.01
Quail Creek Water System (LCRA)	0.04	0.05	0.01
Ridge Harbor Water System (LCRA)	0.27	0.19	0.08
South Silver Creek (I, II, III)	0.08	0.11	0.03
Sandy Harbor Water System (LCRA)	0.11	---	N/A
Smithwick Mills Water System (LCRA)	0.07	0.10	0.03
South Road Water System (LCRA)	0.07	---	N/A
Spicewood Beach Water Sys. (LCRA)	0.44	0.55	0.11
Tow Village Water System (LCRA)	0.04	0.03	0.01
Whitewater Springs Water Sys. (LCRA)	0.13	0.03	0.10
Windermere Oaks WSC	0.23	0.29	0.06

6.2 Description of Initial Alternatives

During the initial stages of the project, the Roth Team reviewed the information obtained from the participants and developed an initial list of alternatives that were presented for discussion during the second public meeting on December 15, 2010. The initial alternatives for each of the four quadrants are listed below; maps showing the initial regional alternatives are shown in Figures 6-1 through 6-4 and are presented following each quadrant description.

Quadrant 1 – Regional Alternatives:

1) City of Bertram would develop its own stand-alone system by developing additional well fields and/or by obtaining groundwater from the City of Burnet's existing wells;
2) The City of Bertram would obtain surface water from the Liberty Hill WSC;
3) The City of Bertram would obtain surface water from City of Burnet;
4) Kempner WSC would expand its service area further south into Burnet County (area not currently served by a water provider) by bringing additional treated surface water from Stillhouse Hollow Reservoir; and,
5) City of Bertram would provide treated water to Whitewater Springs.

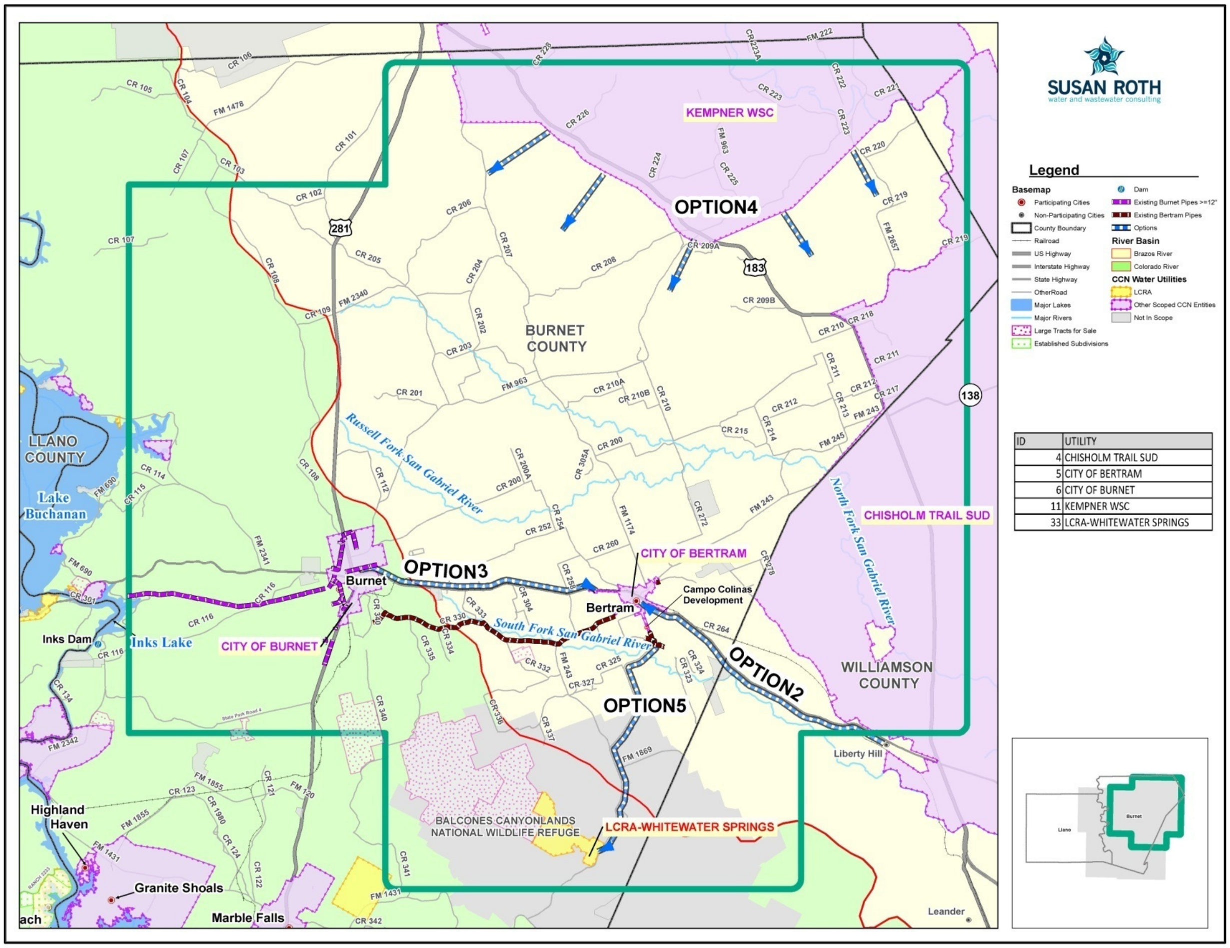

Figure 6-1: Quadrant No. 1 Regional Options

Quadrant 2 – Regional Alternatives:

2) LCRA's Buchanan Water System would be expanded and serve the western shore of Lake Buchanan up to Paradise Point;
3) The City of Burnet would provide treated surface water north along FM 2341 to Council Creek Village, Bonanza Beach, South Silver Creek (I, II, III) and across the lake to Paradise Point;
4) Fall Creek Vineyards would provide water service to Tow Village; and,

5) The City of Burnet would serve Buena Vista, Cassie and other small developments in area near the eastern end of the Buchanan Dam.

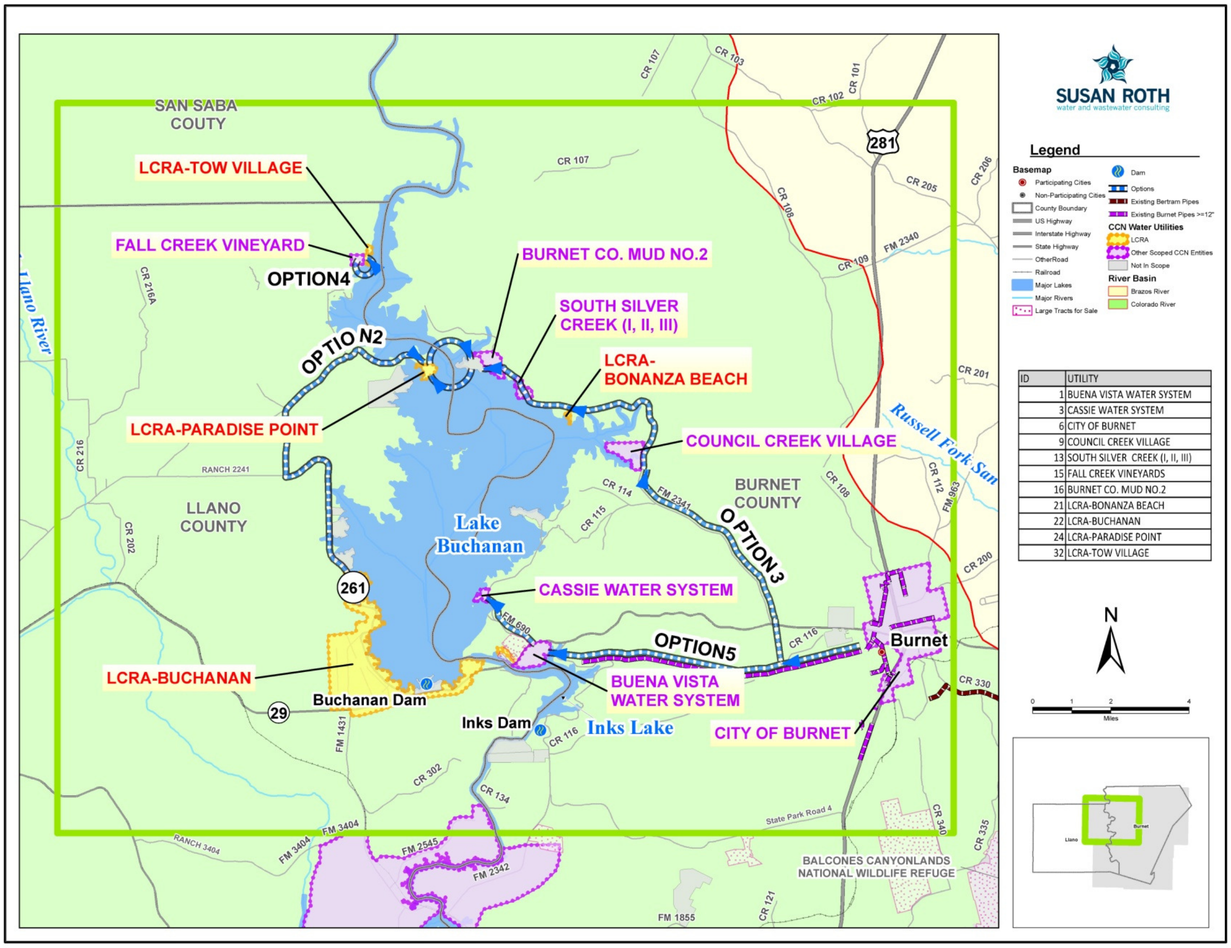

Figure 6-2: Quadrant No. 2 Regional Options

Quadrant 3 – Regional Alternatives:

2) Kingsland WSC would expand its system to serve the southern area of Lake LBJ (including the City of Sunrise Beach);

3) The City of Marble Falls would provide service to the City of Cottonwood Shores;

4) The City of Marble Falls would expand its system to serve the Highway 281/71 corridor, including Cottonwood Shores, and Capstone; and,

5) The City of Granite Shoals would expand its system to serve entities on the north side of Lake LBJ (including the City of Highland Haven).

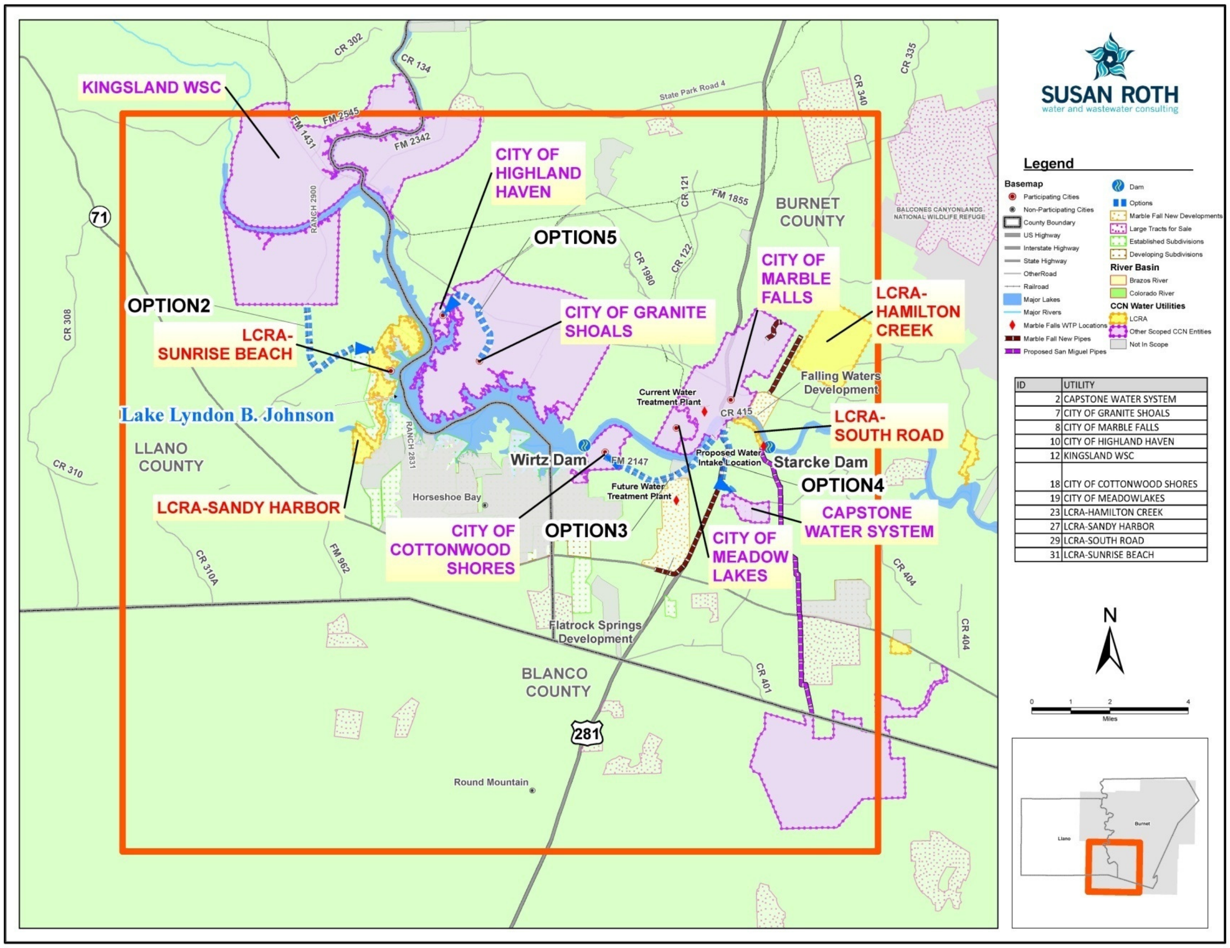

Figure 6-3: Quadrant No. 3 Regional Options

<u>Quadrant 4 – Regional Alternatives:</u>

2) The City of Marble Falls would extend its system south to serve the Highway 281/71 corridor, including Blanco San Miguel, Quail Creek and other developments in the area with possible extensions to the Upper Lake Travis area water systems;

3) The proposed Blanco San Miguel intake would be expanded to serve existing Lake Travis area water systems; and,

4) Secure a more reliable intake on Lake Travis, downstream of outlet of the Pedernales River, to serve the Highway 71 corridor, including the Blanco San Miguel development and the existing Lake Travis area water systems.

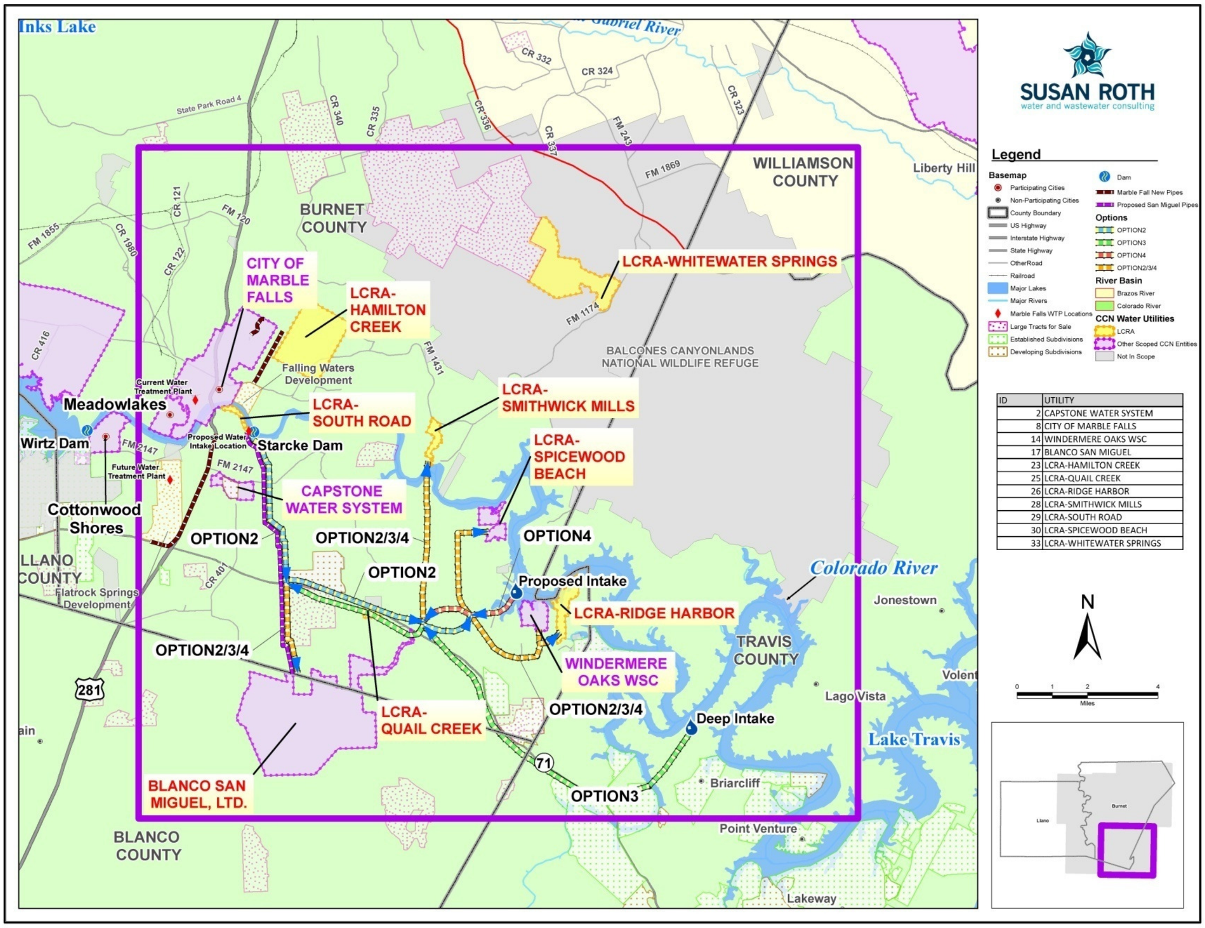

Figure 6-4: Quadrant No. 4 Regional Options

6.3 Screening of Initial Alternatives

The screening of the initial alternatives was accomplished during the second project meeting on December 15, 2010. The objective of the screening process was to consolidate and reduce the total number of final alternatives for further evaluation. For the project meeting, a presentation was given that outlined the initial alternatives for the four quadrant study areas. The presentation also included general observations of each quadrant that were relevant to the screening process.

Following the presentation, the participants were divided into four groups representing each of the quadrant areas for a "working session" to discuss the initial alternatives, as well as the observations of the consulting team about the study area. Facilitated discussions were held with each of the four groups as part of the process to gather feedback and to narrow the list of alternatives; the meeting attendees were requested to share critical success factors and goals of the project, as well as their concerns. A summary of the feedback is summarized below:

Quadrant 1 (Northeast Area)

<u>Goals and Challenges:</u>

- Whitewater Springs: limited water sources; area isolated
- Kempner WSC: Two inch distribution lines throughout service area in Burnet County; primary growth in Bell and Coryell Counties
- Brazos River Authority: growth in Burnet County similar to Kempner WSC

- City of Burnet: desire to expand their water system and become provider for area
- City of Bertram: more sources; concerned about where money will come from to fund infrastructure improvements
- Central TX Groundwater Conservation District: identifying additional supplies; permitting allowances
- Chisholm Trail SUD: small distribution lines; only serve 20 customers in Burnet County and provides service to portion of Liberty Hill customers in Williamson County (remaining customers served by Liberty Hill WSC—groundwater Trinity wells)

Issues and Comments:

- Likelihood of contractual changes for water rights between Colorado and Brazos Basins
- City of Burnet – options for serving entities around Inks Lake; City favors Options 1 & 3
- City of Bertram favors purchasing treated water from City of Burnet and providing wholesale service to Whitewater Springs and Smithwick Mills
- Whitewater Springs POA favors Option 5 of the City of Bertram providing them with water service
- Advantage: lakes on both ends of regional option (i.e. Inks Lake to Lake Travis)
- City of Bertram could become conduit for interbasin transfer (IBT)

Quadrant 2 (Northwest Area)

Goals:

- Collaborate with other entities to form regional utility authority and sell wholesale water.
- Learn where Texas is headed in water supply and find a more reliable water supply.
- Need to determine financial viability of regional water supply.
- Identify possible partners for regional water systems.
- Need to provide safe drinking water at a reasonable price.

Concerns:

- Entities located on East side of Lake Buchanan need to identify reliable and safe water source.
- No way to insure adequate water supply due to declining lake levels.
- Low lake levels and concern whether LCRA will honor existing water contracts.
- Cassie Subdivision indicated that they need a more reliable water supply.

Quadrant 3 (Southwest Area)

General Comments:

- Granite Shoals stated that the water quality in Lake Marble Falls was a concern of the City due to the number of septic tanks surrounding the lake.
- The City of Marble Falls is looking at a new intake near Starke Dam. They would be open to getting help from a regional system and would be interested in being a regional supplier.

- Capstone's groundwater supply stayed at a constant level with pumping during drought conditions. They would be interested in a regional system serving as a backup to their wells (emergency connection)
- The City of Highland Haven has an adequate water system to supply water to the remaining lots within the City; however, there is a need for an emergency interconnect between Granite Shoals and Highland Haven.

Quadrant 4 (Southeast Area)

Goals and Challenges:

- Unanimous agreement that the option of constructing a regional raw water intake just upstream of the Starcke Dam would offer the most reliable water source during times of drought. The main advantage of this option was that the intake would be on a lake whose levels did not vary as much as Lakes Travis and Buchanan.
- Blanco San Miguel agreed with the other attendees that an intake at the Starcke Dam site would be the best long-term solution. Their investigations indicated that any option based on a Lake Travis intake would only be reliable in the long-term if the intake were located on Lake Travis downstream of the confluence of the Pedernales and Colorado Rivers.
- Extensions of a regional system to Smithwick Mills and Spicewood Beach, for example, may have to be delayed until pipelines are extended by future developments towards both water systems.

Additional Comments:

- During the drought of 2009, several water systems along the upper parts of Lake Travis were close to running out of water in the lake. Fortunately, the uppermost water systems were able to capture enough raw water to meet their demands due to daily releases of water through the upstream dams (Buchanan through Max Starcke).
- The option of a regional intake at the proposed Blanco San Miguel intake site just northwest of Windermere Oaks would not offer any significant advantage since an intake at this site would not be more reliable than several of the existing intakes in that section of Lake Travis. In addition, the pipelines needed to convey water from this site to the water systems in the area would involve a large investment with no appreciable benefits.

Summary of Initial Alternative Screening Process

Based on the feedback received from the project participants, a few of the initial alternatives were deleted and/or modified. A summary of the revised initial alternatives are presented below in Table 6-3; those alternatives that were deleted from further consideration are highlighted in red.

Table 6-3: Results of Initial Alternative Screening Process

Summary of Regional Water Facility Options
Quadrant 1
1) City of Bertram would develop its own stand-alone system by developing additional well fields and/or by obtaining groundwater from the City of Burnet's existing wells 2) City of Bertram receive surface water from City of Liberty Hill 3) City of Bertram would obtain surface water from City of Burnet 4) Kempner WSC expand its service area into Burnet County (area not currently served by a provider); bring additional surface water from Stillhouse Hollow Lake 5) City of Bertram would provide treated water to Whitewater Springs
Quadrant 2
1) LCRA's Buchanan Water System would be expanded and serve the western shore of Lake Buchanan up to Paradise Point 2) City of Burnet would provide treated water north along FM 2341 to Council Creek Village, Bonanza Beach, South Silver Creek (I,II,III) and across the lake to Paradise Point 3) Fall Creek Vineyards would provide water service to Tow Village 4) City of Burnet would serve Buena Vista, Cassie and other small developments in area near the eastern end of the Buchanan Dam
Quadrant 3
1) Kingsland WSC would expand its system to serve southern area of Lake LBJ (including City of Sunrise Beach) 2) City of Marble Falls would provide service to City of Cottonwood Shores 3) City of Marble Falls would expand its system to serve Highway 281/71 corridor, including Cottonwood Shores and Capstone 4) City of Granite Shoals would expand its system to serve entities on north side of Lake LBJ (including City of Highland Haven)
Quadrant 4
1) City of Marble Falls would extend its system south to serve Highway 281/71 corridor, including Blanco San Miguel, Quail Creek and other developments in the area with possible extensions to the Upper Lake Travis area water systems 2) Secure more reliable intake on Lake Travis, downstream of outlet of the Pedernales River to serve Hwy. 281/71 corridor, including Blanco San Miguel and Lake Travis area water systems 3) Proposed Blanco San Miguel intake would be expanded to serve existing Lake Travis area water systems

6.4 Regional Alternatives Selected for Detailed Evaluation

Following the second project meeting, each of the initial options identified in Table 6-3 that were kept for the next stage of the analysis were further defined by the Roth Team for a more rigorous evaluation. Since the City of Burnet was included in both Quadrants 1 and 2, and the City of Marble Falls was included in both Quadrants 3 and 4, the final regional options considered transmission systems that crossed those respective quadrant boundaries. For this reason, the options were consolidated and grouped according to northern and southern regions.

These final options assume that most of the existing wholesale agreements identified for the entities in this study would remain in place. The City of Marble Falls would continue to supply treated water to South Road and Hamilton Creek Water Systems, and the City of Horseshoe Bay would continue to provide treated water to Sandy Harbor Water System. However, it is assumed that the City of Horseshoe Bay would eventually discontinue providing treated water to Cottonwood Shores.

6.4.1 Northern Regional Options

The alternatives considered during the detailed evaluation for the northern region (Quadrants 1 and 2 combined) of the study area are presented in Figure 6-5 (overview map of all northern region options included in Appendix E) and further described below.

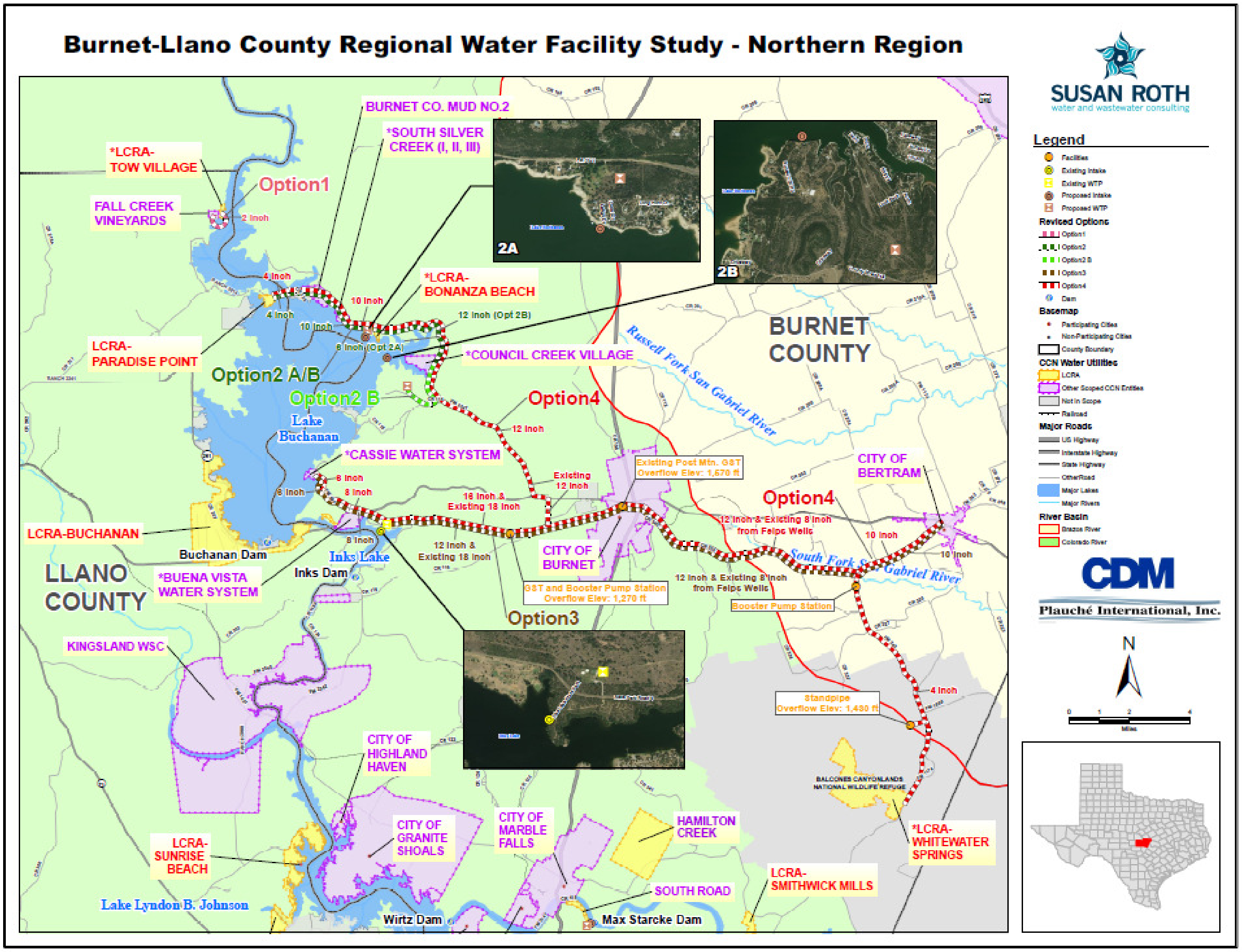

Figure 6-5: Northern Regional Options

North Option 1: Tow Village / Fall Creek Vineyards System

This alternative assumes that Fall Creek would provide treated water to Tow Village (reference Figure 6-6).

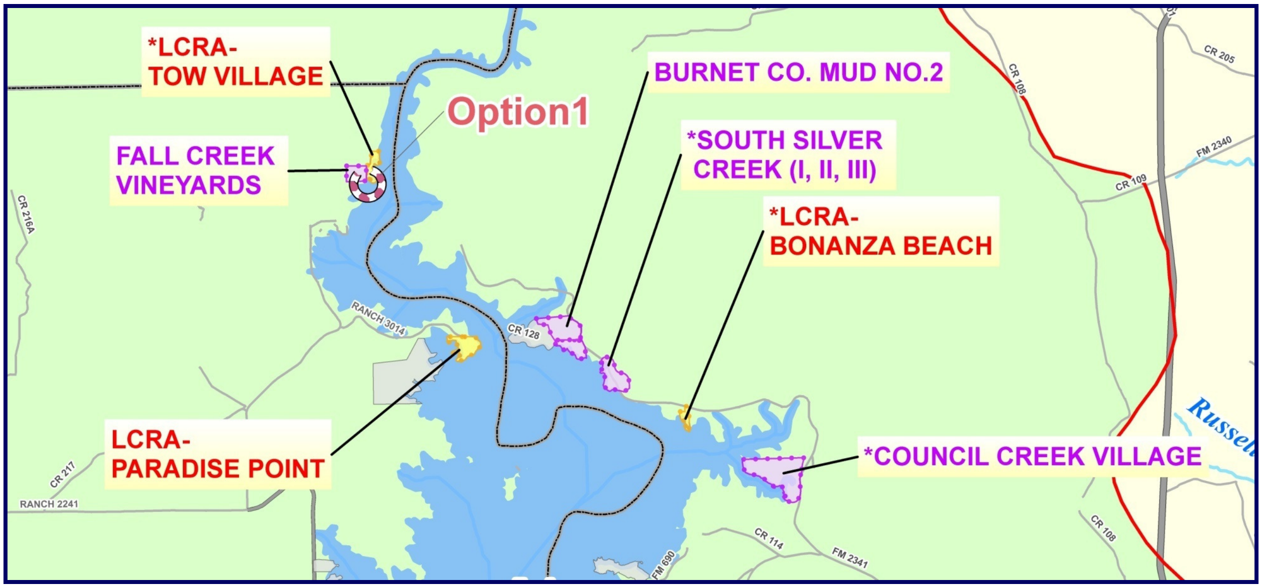

Figure 6-6: North Region – Option 1

North Option 2: Northeast Lake Buchanan Regional Alternative

In this alternative, an intake and water treatment plant would be located on the northeast side of Lake Buchanan and transmission mains would be constructed to provide service to the following participants (reference Figure 6-7):

- Burnet County MUD No. 2
- South Silver Creek I, II and III
- Bonanza Beach Water System
- Council Creek Village
- Northeast Lake Buchanan Developments
- Paradise Point (via underwater pipeline crossing)

Initially, the proposed Burnet County MUD No. 2 intake, which is to be located in Lake Buchanan at the entrance to Beaver Creek, was considered as a potential regional intake site. Advantages to this site are that the MUD already has a water contract for this site and has initiated easement negotiations. In addition, the MUD has letters-of-intent to provide water to South Silver Creek I, II and III and to Silver Creek Village (non-participant in this study), so there are already the beginnings of a regional system. As a result, the Roth Team has concluded that the proposed Beaver Creek may not be reliable during extended droughts.

Based on the bathometry map for Lake Buchanan, the minimum bathometry contour at the proposed Burnet County MUD No. 2 intake location is 980 ft-MSL; however, we do not recommend installing the lowest intake point for an intake structure at the bottom of the lake. Moreover, raw water pumping units typically require 5 to 6 feet of static water head above the impeller to satisfy the net positive suction head (NPSH) requirements so they can operate effectively. Therefore, the minimum water surface elevation above the pump impeller would be approximately 990 ft-MSL (i.e., 980 ft-MSL plus 10 ft). Section 7.0 more fully discusses the concerns that the Roth Team has related to using this location for a regional water system intake location.

For this reason, the team considered two other intake locations: one in the vicinity of Bonanza Beach (North Option 2A) and a second one further south along the lake and east of Council Creek (North Option 2B). The Option 2A intake in the Bonanza Beach area would put the intake and water treatment plant closer to the largest water demands, but access to the lake and the aesthetics of a floating intake near an already built-out area on the lake may raise objections to this site. The Option 2B site offers access to a deeper part of the lake, thus increasing reliability, and the shoreline is relatively undeveloped.

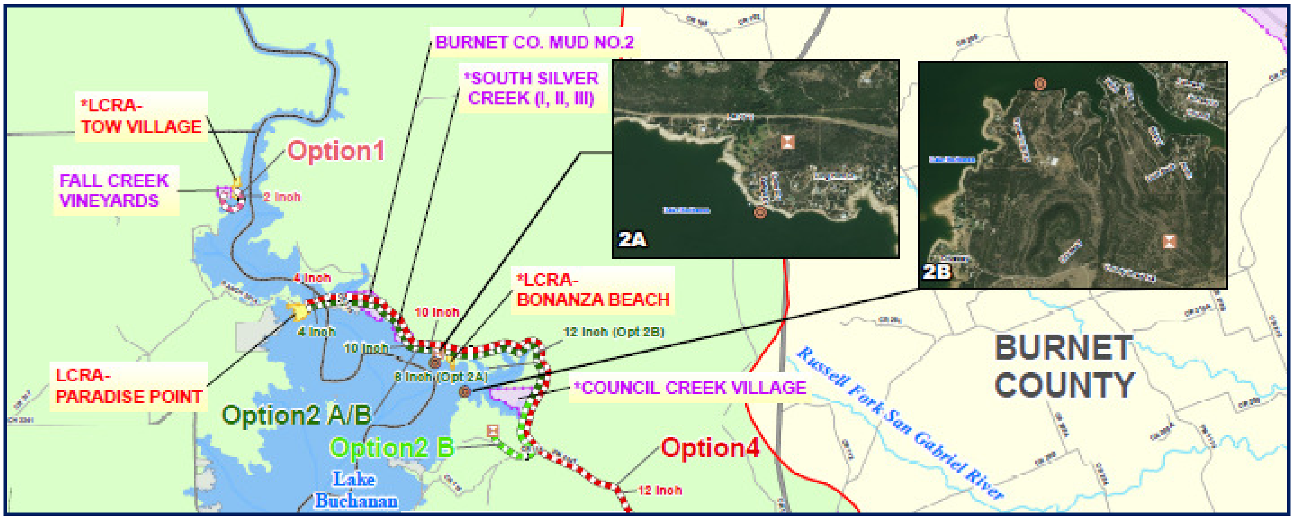

Figure 6-7: North Region – Option 2

North Option 3: Cassie, Buena Vista, Burnet and Bertram

In this alternative, the City of Burnet's existing raw water intake, existing WTP and existing 18-inch transmission main would serve as the core of the initial system; however, a new transmission main would be extended west and northwest from the WTP to serve the Buena Vista and Cassie Subdivision areas. The City of Bertram would maintain the Felps well field (capacity of approximately 650 GPM) but would meet future water demands with treated surface water from the City of Burnet system. Initially, treated surface water would be delivered to Bertram via excess capacity in the City of Burnet's 18-inch transmission main and a new transmission main from the City of Burnet to Bertram. When Burnet demands and Bertram's demands (above 650 GPM) exceeded the capacity of the City of Burnet's 18-inch transmission main, a second transmission main would be constructed along the route of the existing 18-inch transmission main to supplement the existing transmission main capacity from the WTP to the City of Burnet. Reference Figure 6-8 for an overview map of this option.

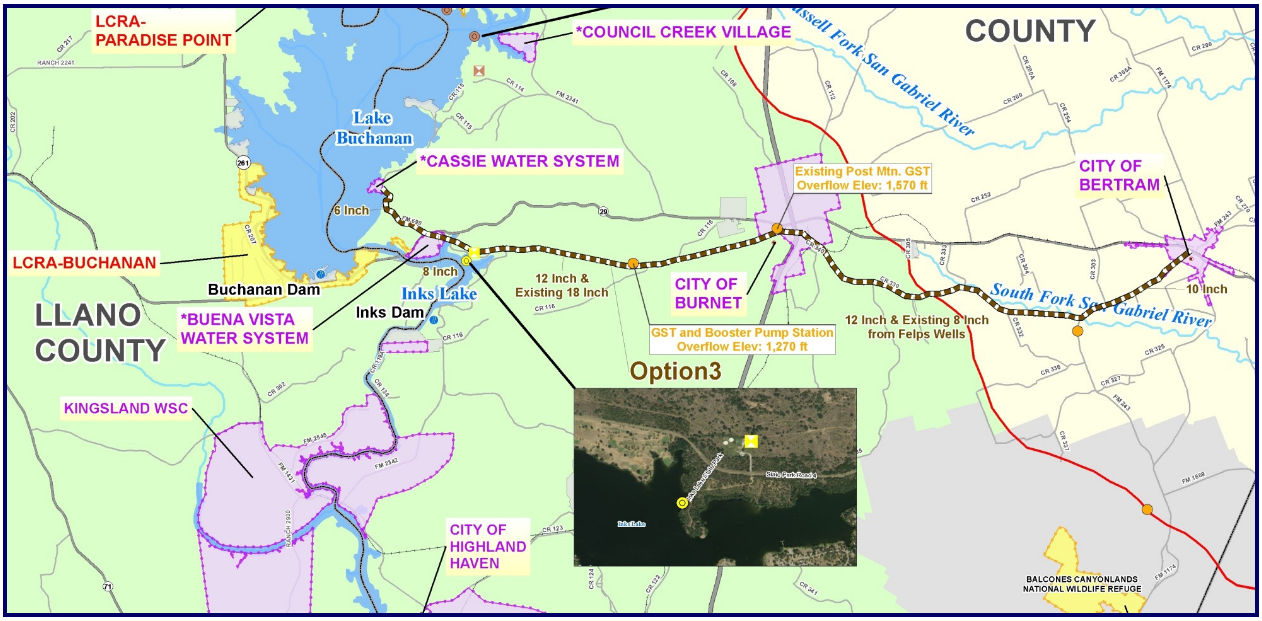

Figure 6-8: North Region – Option 3

North Option 4: Northern Burnet County Regional System

This alternative would represent the most extensive regionalization approach in the northern portion of the study area. As with Option 3, the City of Burnet's existing raw water intake, WTP and 18-inch transmission main would serve as the core of the initial system. Transmission mains would be extended west and northwest to the Buena Vista and Cassie Subdivision areas and east from the City of Burnet to the City of Bertram. However, the North Option 4 would also include a transmission main running northwest along FM 2341 from the north end of an existing 12-inch water main operated by the City of Burnet to the following entities:

- Council Creek Village
- Bonanza Beach Water System
- South Silver Creek (I, II and III)
- Burnet County MUD No. 2 (proposed intake and WTP for this development would not be constructed in this option)
- Northeast Lake Buchanan Developments
- Paradise Point Water System (via underwater pipeline crossing)

North Option 4 would also include a transmission main running south from Bertram's existing 8-inch transmission main to Whitewater Springs (reference Figure 6-9 below).

As with Option 3, when demands exceed the capacity of the City of Burnet's 18-inch transmission main, a second transmission main would be constructed along the route of the existing 18-inch transmission main to supplement the existing transmission main capacity from the WTP to the City of Burnet.

Note that LCRA's Buchanan Water System is not included in any of the regional alternatives. The system's intake is located on the dam itself, and the WTP is located on LCRA property associated with the dam. If LCRA sells the system with limitations on the use or expansion of the intake or the WTP, then there would be a strong incentive for the new owners to consider joining the regional approach (North Options 3 or 4). On the other hand, if the new owners are granted access to the existing intake on the Buchanan Dam and the right to expand its capacity, then supplying the Buena Vista area and Cassie Subdivision from the Lake Buchanan Water System could be an attractive option, especially since there is already an existing 8-inch LCRA water line running east across the bridge at Highway 29. These entities may want to explore this option once the sale of the LCRA systems has been finalized.

Also not included in the northern regional options are Kempner WSC and Chisholm Trail SUD as both have indicated they do not anticipate extensive development within the Burnet County portion of their service areas.

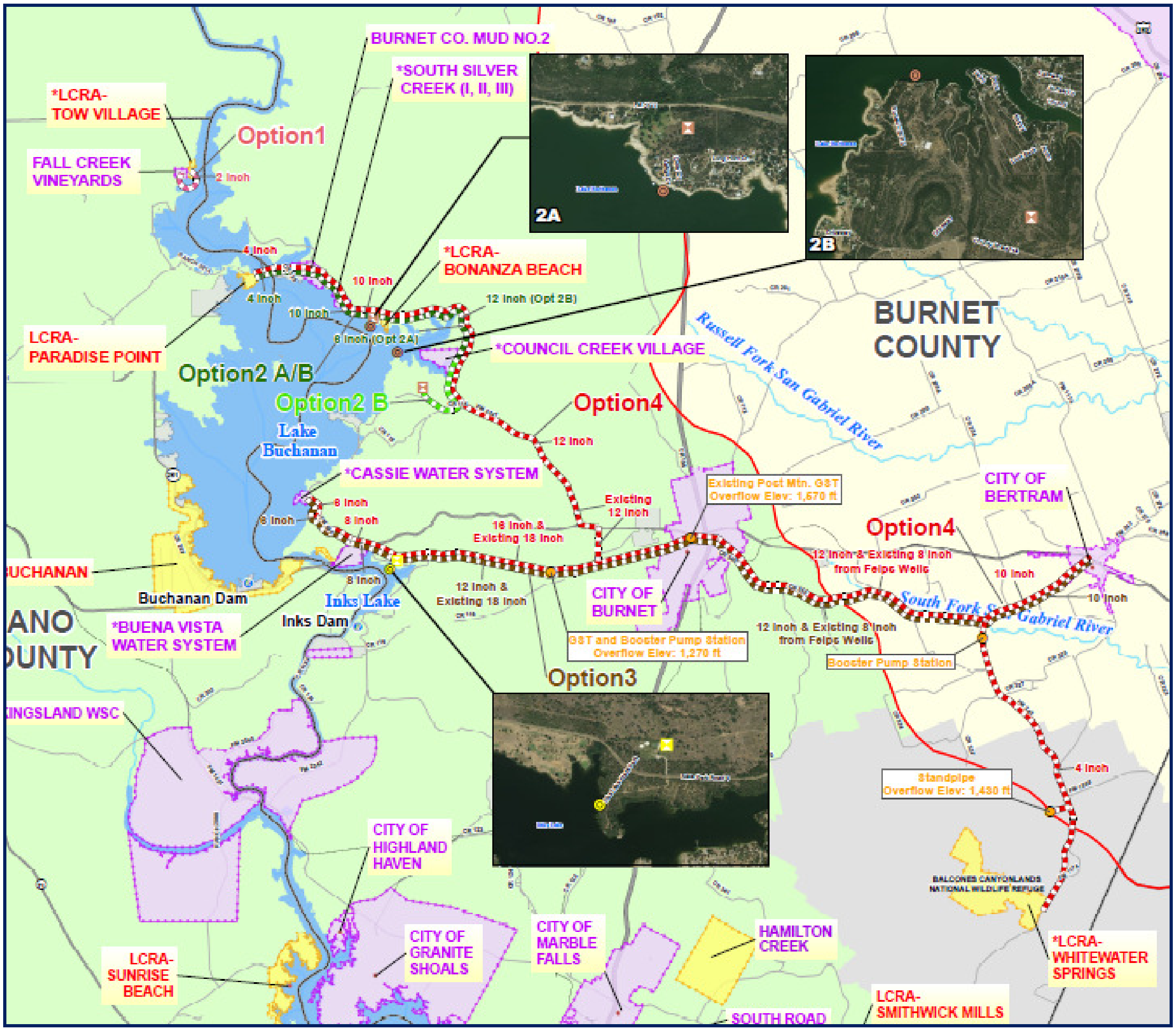

Figure 6-9: North Region – Option 4

6.4.2 Southern Regional Options

Based on the review of the existing systems in Quadrant 3 and feedback received from the project participants, several of the systems in this area are large enough to continue operating on their own and lack drivers to participate in a regional system. A few of the entities have indicated they do not wish to be served by another entity, or have already arranged service from adjacent, larger water systems. As a result, the alternatives considered during the detailed evaluation for the southern region (Quadrants 3 and 4 combined) of the study area are presented in Figure 6-10 (overview map of all southern regional options is included in Appendix F) and further described below.

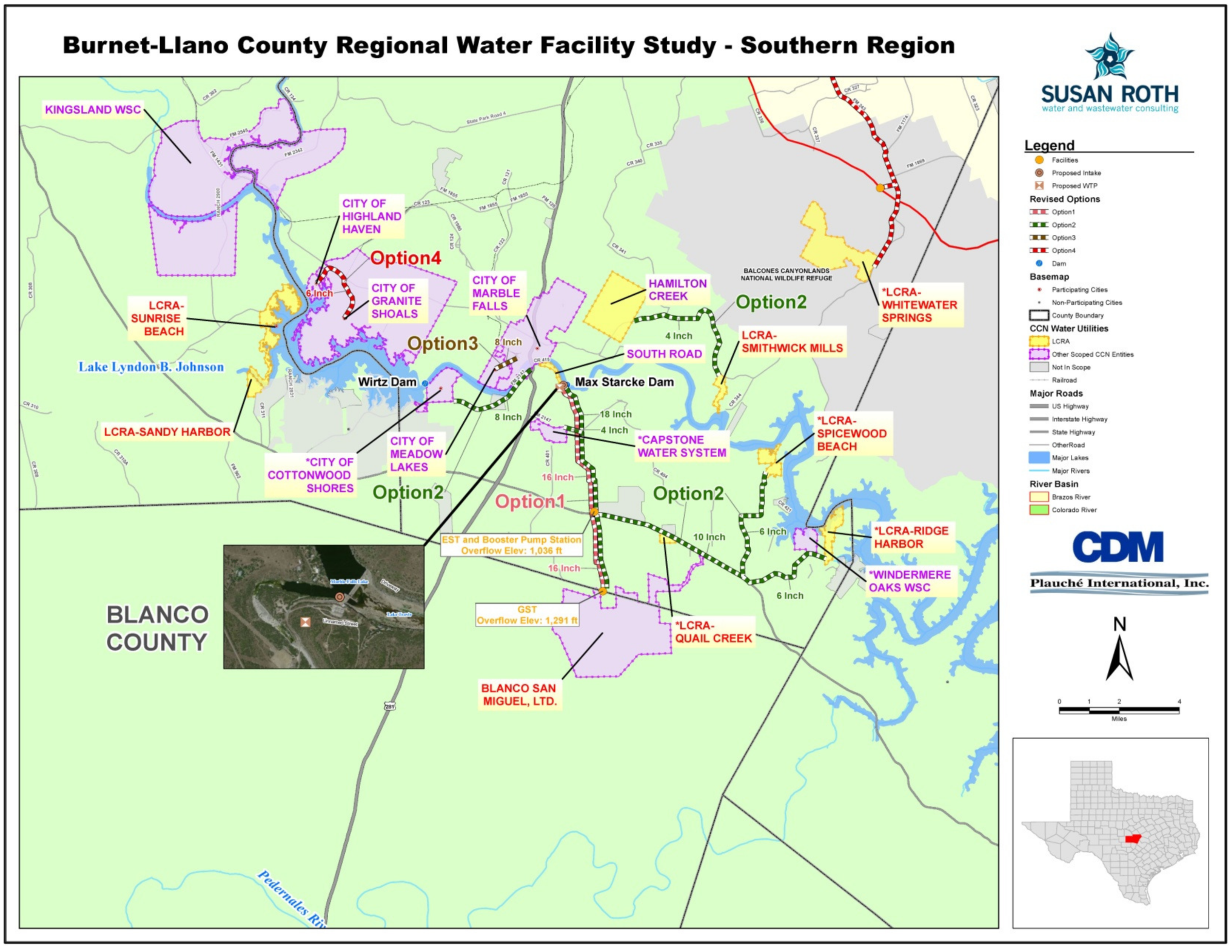

Figure 6-10: Southern Regional Options

South Option 1: Marble Falls / Blanco San Miguel Regional System

This alternative assumes that Blanco San Miguel would participate in a cost-sharing arrangement for the proposed Marble Falls intake and WTP, located upstream of the Max Starcke Dam. Also included in this option would be constructing a transmission main from the proposed WTP at the dam south to the property line of the proposed Blanco San Miguel development (refer to Figure 6-11).

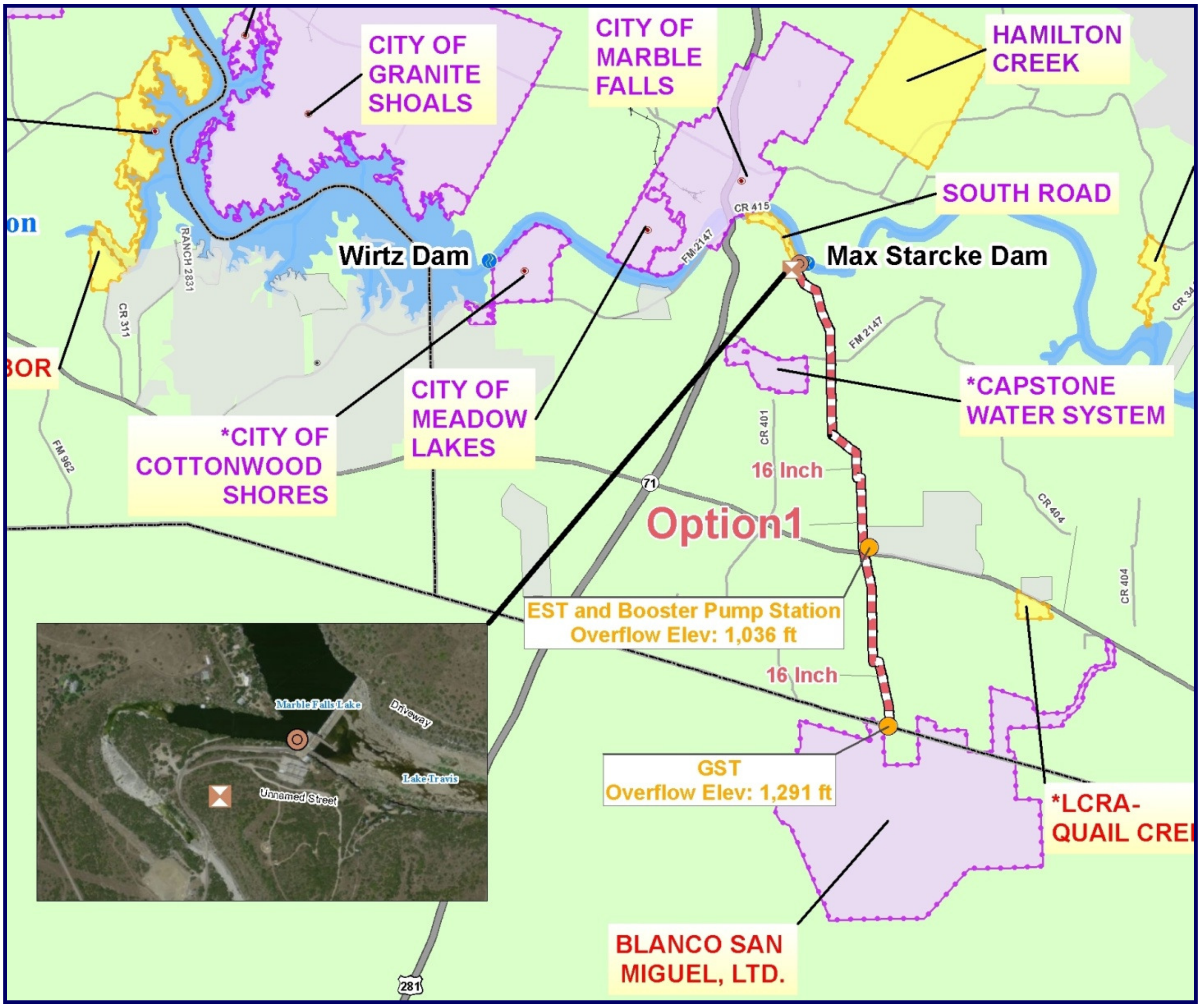

Figure 6-11: South Region – Option 1

South Option 2: Southeast Burnet County Regional System

This alternative represents complete regionalization in the southern portion of the study area. Similar to South Option 1, the proposed intake intake and WTP at the Max Starcke Dam would deliver treated surface water to Blanco San Miguel, but a transmission main would branch off the transmission main to Blanco San Miguel and run east along Highway 71 with pipelines to the participating entities along Lake Travis. This alternative also includes a transmission main along FM 2147 from Marble Falls' existing water main on south Highway 281 to Cottonwood Shores; a transmission main would be constructed along FM1174 to provide treated water from the Hamilton Creek area, which is currently served by the City of Marble Falls, to Smithwick Mills. The existing pipeline between Marble Falls and Hamilton Creek is a 2- and 3-inch line which would likely not have sufficient capacity to deliver additional water to Smithwick Mills. This line feeds a hill top tank in Hamilton Creek providing storage and pressure for the system. The participants served by this option include the following (refer to Figure 6-12):

- City of Marble Falls (including Hamilton Creek and South Road)
- City of Cottonwood Shores
- Capstone Water System
- Blanco San Miguel

- Quail Creek Water System
- Windermere Oaks WSC
- Ridge Harbor Water System
- Spicewood Beach Water System
- Smithwick Mills Water System

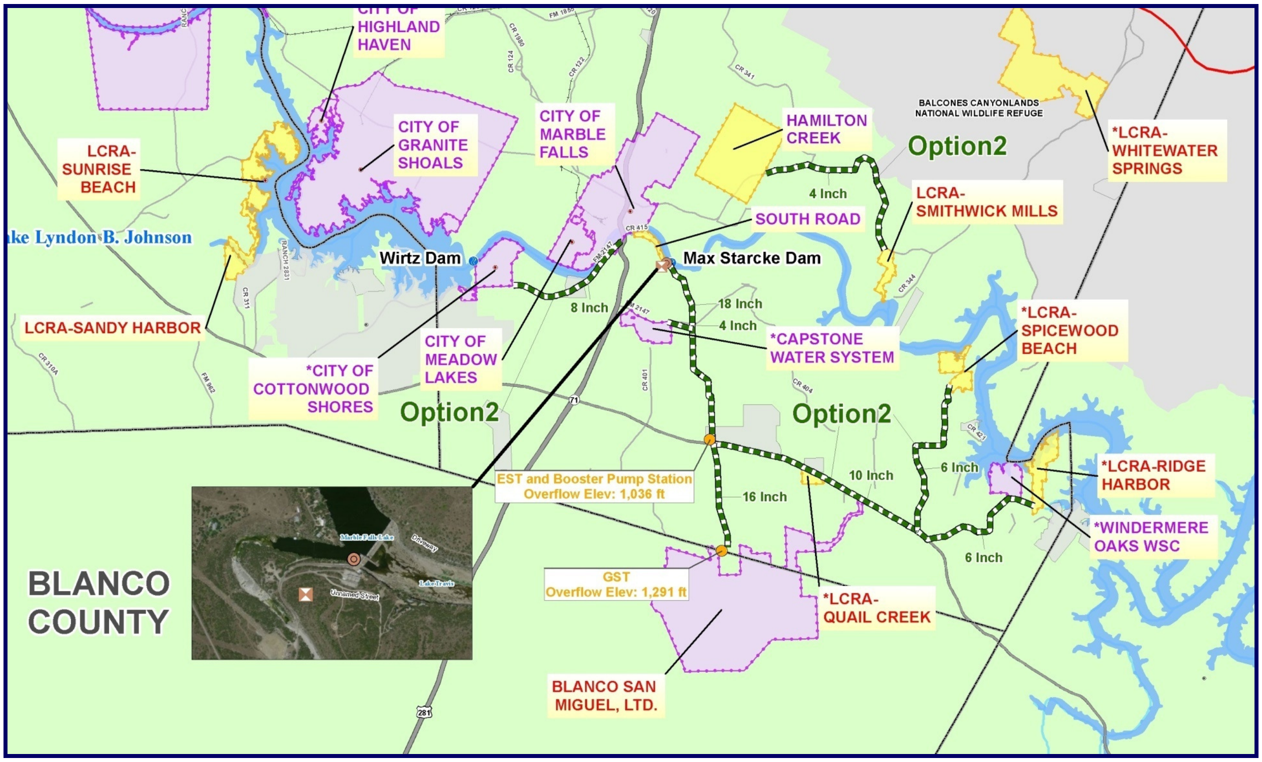

Figure 6-12: South Region – Option 2

South Option 3: City of Meadowlakes / City of Marble Falls Interconnect

The City of Meadowlakes will have excess treatment capacity through year 2040 and beyond. Meanwhile, the City of Marble Falls needs additional treated water by year 2018. A wholesale agreement between the two entities would allow the City of Marble Falls more time to develop and implement its proposed treatment plant capacity expansions, and/or allow the City to begin serving some of the entities listed in the Southeast Burnet County Regional System (South Option 2 as described above) prior to the construction of the proposed intake and WTP at Max Starcke Dam. Reference Figure 6-13 for a map of this option.

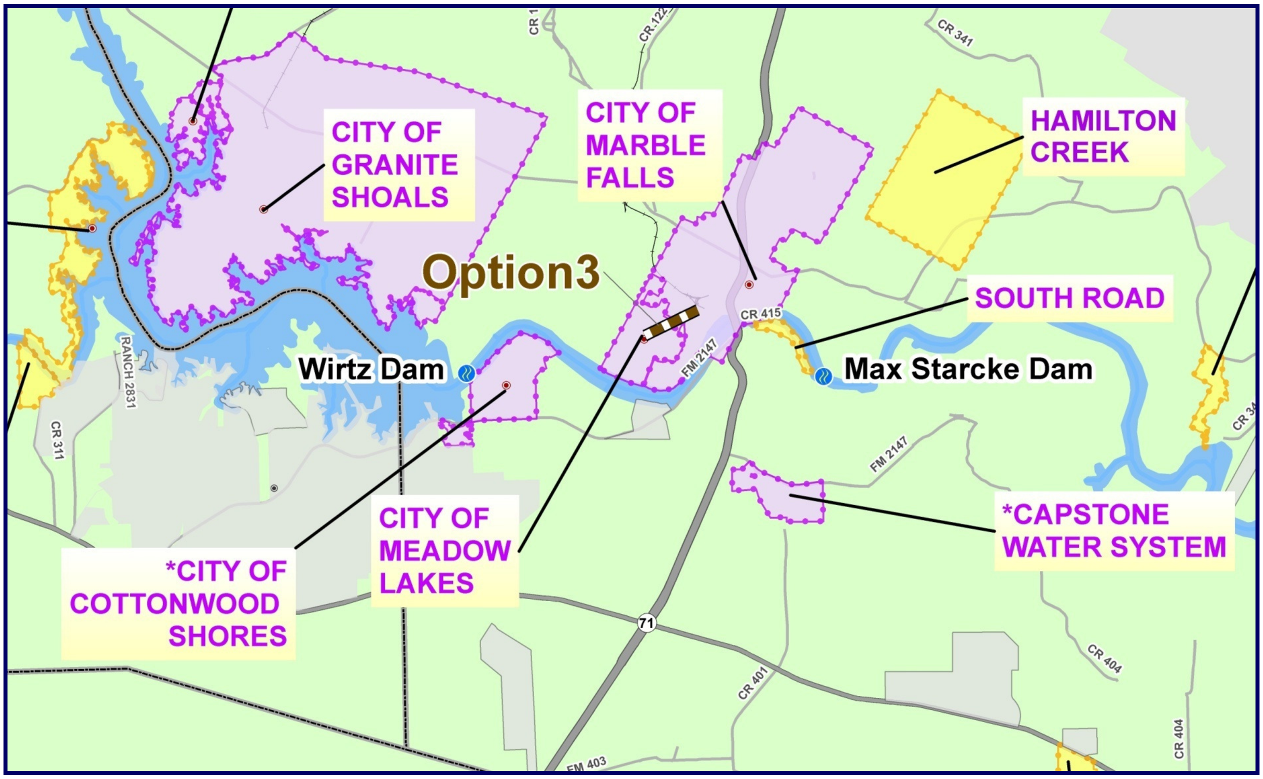

Figure 6-13: South Region – Option 3

South Option 4: City of Granite Shoals / City of Highland Haven Interconnect

The City of Highland Haven has already expressed interest in having an emergency interconnect for water service with the City of Granite Shoals. Option 4 considers the interconnect as a way for the City of Highland Haven to satisfy its 2040 demands without having to expand its wells and treatment facilities. Should the City of Highland Haven's demands exceed its current capacity, treated water would be purchased from the City of Granite Shoals through the interconnect. Should such an arrangement be considered, blending of treated groundwater and surface water may need to be investigated. Reference Figure 6-14 for an overview map of this option.

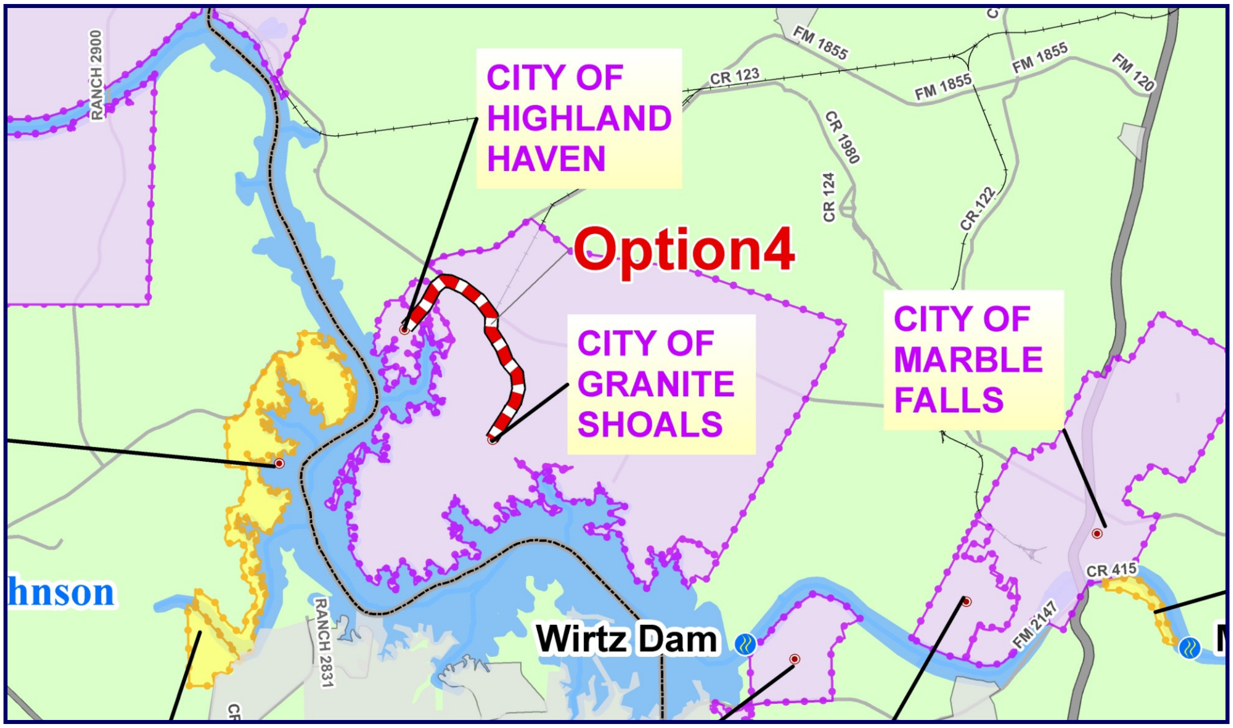

Figure 6-14: South Region – Option 4

6.5 Water Conservation and Drought Contingency Plans

Senate Bill 1 (SB-1), passed by the Texas Legislature in 1997, increased the number of entities required to submit water conservation and drought contingency plans. As part of a regionalization strategy, all involved entities would need to draft and adopt Water Conservation and Drought Contingency Plans under the conditions of SB-1. In addition, the TWDB requires project participants receiving grant funding through the Regional Water/Wastewater Facilities Planning Grant Program to prepare and implement water conservation and drought contingency plans. These plans must meet all minimum requirements outlined by the Texas Commission on Environmental Quality (TCEQ).

Many of the project participants currently using treated surface water already have water conservation and drought contingency plans in place. Sample templates for preparing water conservation and drought contingency plans are provided in Appendix G and H for reference. These templates were provided by the Texas Water Development Board and have been used by previous participants of TWDB planning studies as a guide.

7.0 REGIONAL WATER INTAKE AND TREATMENT ALTERNATIVES

7.1 Methodology

The Roth Team performed a regional intake and water treatment evaluation to determine recommendations for type of intake structures, type of water treatment process to implement, and location of the intake structures and water treatment plants for the regional system alternatives. In addition to the intake and water treatment evaluations, we performed a water blending analysis so that we can understand the impact of blending surface and ground water sources.

7.2 Intake Evaluation

The intake evaluation included assessing types of intake structures as well as evaluating intake location alternatives. As part of the intake alternative evaluations, we assessed both the expansion of existing intakes and the construction of new regional intakes.

7.2.1 <u>Types of Intake Structures</u>

We assessed three types of intake structures that would be appropriate for the Burnet-Llano County water facility study: floating barge, inclined can, and wet well.

7.2.1.1 Floating Barge

A floating barge intake structure has vertical turbine raw water intake pumps installed on a barge, which allows the intake structure to float up and down with the water surface elevation changes. The barge is also anchored to the bottom of the lake to control its location in the water. The raw water discharge piping and power supply for the pumps are flexible so they adjust to the water surface fluctuations. Figure 7-1 shows a photograph of a floating barge intake structure.

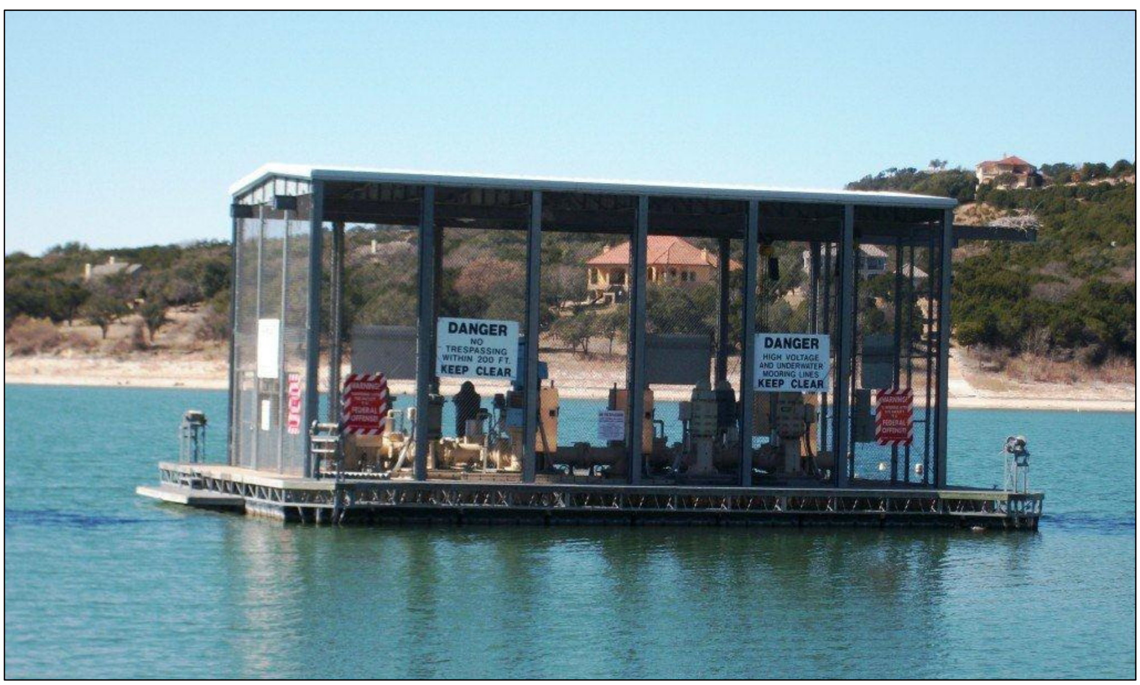

Figure 7-1: Photograph of Floating Barge Intake Structure

The advantages and disadvantages of the floating barge intake structure are summarized below in Table 7-1:

Table 7-1: Advantage/Disadvantage Summary for Floating Barge Intake Structure

Advantages	Disadvantages
1. Relatively low capital cost 2. Accommodates lake level fluctuations 3. Easy to construct 4. Accommodates multiple intakes 5. Minimal environmental impact	1. Unstable and prone to tipping 2. Limited access and maintenance must occur via boat 3. Aesthetic issues and boating impediment 4. Flexible discharge piping support problems 5. Noise complaints

7.2.1.2 Inclined Can

An inclined can intake structure has submersible vertical turbine pumps installed in rigid pump casings, one casing per pump. The vertical turbine pumps are fastened to a roller assembly so they can be set into the rigid pump casings. The rigid pump casings are installed in the lake at a constant slope from the edge of the shore into the lake until the desired depth is reached. The pump casing system has multiple intake locations at different elevations so that the system can pump raw water as the lake water surface elevation flocculates. Figure 7-2 shows a photograph of an inclined can intake structure. Table 7-2 summarizes the advantages and disadvantages of the inclined can intake structure.

Figure 7-2: Photograph of Inclined Can Intake Structure

Table 7-2: Advantage/Disadvantage Summary for Inclined Can Intake Structure

Advantages	Disadvantages
1. No boating impediment 2. Stable and not prone to tipping 3. Improved aesthetics 4. No noise complaints 5. Can accommodate multiple intake levels 6. Lake level fluctuations do not require relocation 7. Moderate environmental impact caused by casing foundation supports on lake bottom	1. Moderate capital cost 2. Construction requires constant slope (+/-) 3. Moderately difficult maintenance access 4. Maintenance intensive when constructed on shallow slopes due to long pump casing lengths

7.2.1.3 Wet Well

A wet well intake structure consists of one main wet well constructed on the edge of the lake with multiple vertical turbine pumps installed in the wet well. The water flows into the wet well from the lake via gravity flow through a piping system that extends into the lake. The wet well piping system typically has multiple intake pipes that are located at varying elevations with isolation valves or gates so raw water can be supplied to the pumps at different elevations as the lake water surface elevation flocculates or due to water quality purposes. If noise nuisances are a concern, the raw water pumping units can be installed using submersible motors. Figure 7-3 shows a photograph of a wet well intake structure, and Figure 7-4 shows a drawing of another wet well intake structure.

Figure 7-3: Photograph of Wet Well Intake Structure

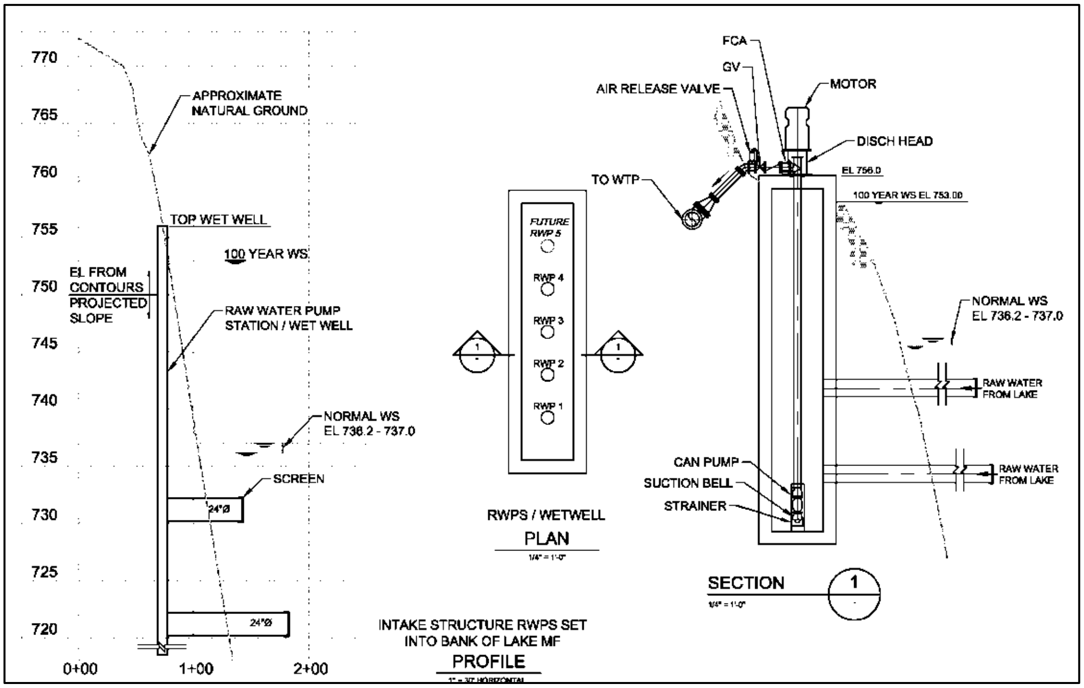

Figure 7-4: Drawing of Wet Well Intake Structure

The advantages and disadvantages of the wet well intake structure are presented in Table 7-3.

Table 7-3: Advantage/Disadvantage Summary for Wet Well Intake Structure

Advantages	Disadvantages
1. Accommodates deepest lake level withdrawal 2. Very stable and no boating impediment except under extreme conditions 3. Good maintenance access 4. Best aesthetics 5. Accommodating multiple intakes 6. Lake level fluctuations do not require relocation	1. Highest capital cost 2. Most difficult construction technique 3. Some noise complaints if submersible motors are not used 4. Highest environmental impact

7.2.1.4 Intake Location Analysis

In order to determine appropriate intake alternatives, the Roth Team evaluated the historical lake data for Lake Travis, Lake Buchanan, Inks Lake, and Lake Marble Falls. Also, we assessed expansion of existing intakes as well as construction of new regional intakes.

Historical Lake Data

Historical lake data for Lake Travis, Lake Buchanan, Inks Lake, and Lake Marble Falls were collected from the LCRA database. Table 7-4 summarizes the historical data for these lakes.

Table 7-4: LCRA Historical Lake Data*

Lake	Historical High		Historical Low		Normal Operating Range	Type
	Elevation (ft above MSL)	Date	Elevation (ft above MSL)	Date		
Lake Travis	710.4	Dec. 1991	614.2	Aug. 1951	≤ 681	Variable
Lake Buchanan	1021.4	Dec. 1991	983.7	Sept. 1952	May–Oct ≤ 1018 Nov-Apr ≤ 1020	Variable
Inks Lake	902.8	July 1938	877.1	Dec. 1983	886.9-887.7	Relatively Constant**
Lake Marble Falls	756.3	Sept. 1952	715.0	Oct. 1983	736.2-737.0	Relatively Constant**

** Data collected from the LCRA database (www.lcra.org) on July 2011.*
***These lakes are defined as "pass-through lakes" by the LCRA.*
Note: MSL refers to Mean Sea Level

Raw water intake structures that are constructed on relatively constant level lakes are considered more reliable than intake structures constructed on variable level lakes because the water surface elevation remains constant and, unless extraordinary conditions exist (e.g., LCRA lower the lake levels to perform maintenance), drought conditions do not cause the water surface to drop below the lowest intake point of the intake structure. Accordingly, intake structures constructed on Inks Lake and Marble Falls (relatively constant level) are more likely to provide reliable water than intake structures constructed on Lake Travis and Lake Buchanan (whose water level is variable). In any case, if a lake's water surface elevation falls below the intake point, it is difficult to pump raw water to the water treatment plant to produce potable water. In order to increase reliability, the Roth Team recommends installing the lowest intake point of the raw water pump station below the historical low water surface elevation of a lake.

In order to assess the reliability of Lake Travis and Lake Buchanan as potential surface water sources for a regional system, the Roth Team performed a lake level frequency analysis on these two variable level lakes. Our analysis consisted of using LCRA's historical data for both Lake Travis and Lake Buchanan to determine the percent exceedance for various lake levels. Figure 7-5 shows the lake frequency chart for Lake Buchanan, and Figure 7-6 shows the lake level frequency chart for Lake Travis. Figure 7-6 shows that a Lake Travis intake elevation of 623 ft-MSL would provide water 97% of the time. If an intake is to be constructed on one of these variable frequency lakes, we recommend that the intake elevation be located at the level associated with 99.99% exceedance and 10 feet of head over lowest intake inlet. Thus, for Lake Buchanan, the recommended intake elevation is 973.8 ft-MSL or below, and for Lake Travis, the recommended intake elevation is 604.4 ft-MSL or below.

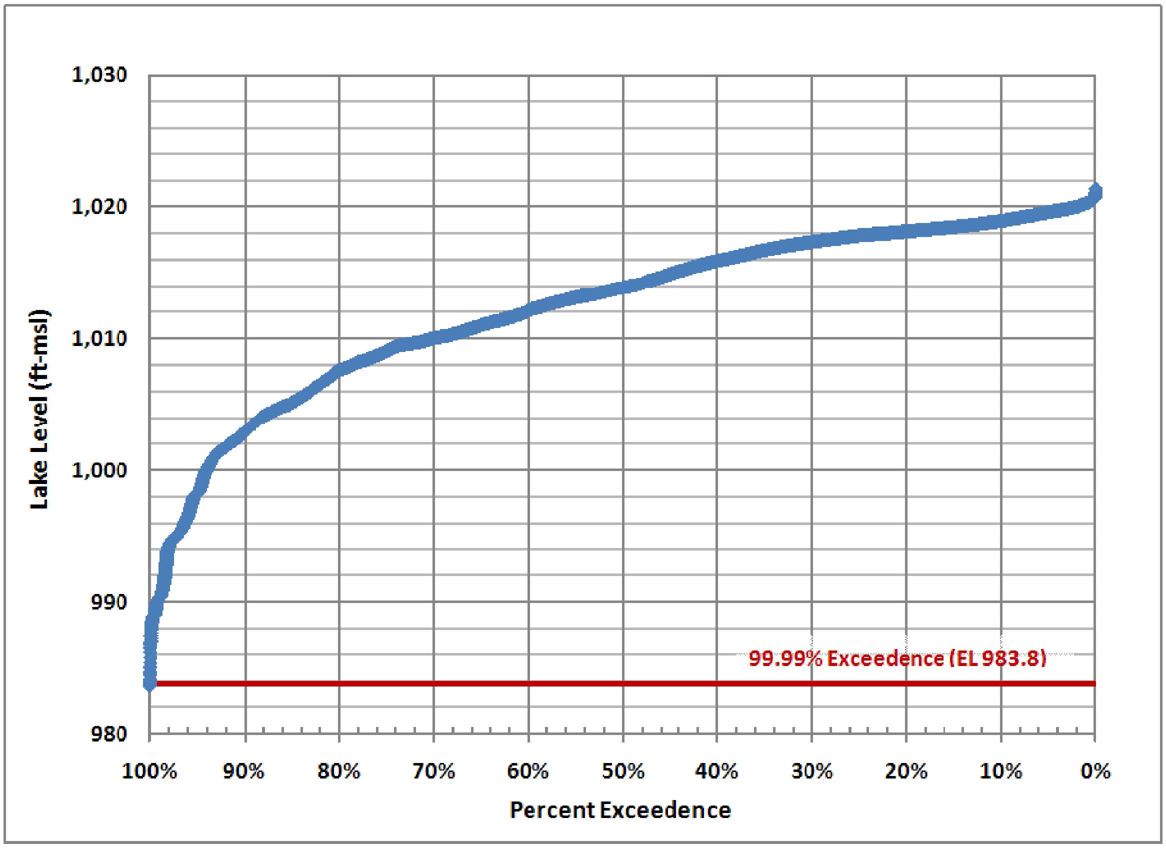

Figure 7-5: Lake Level Frequency for Lake Buchanan ***(*data provided by LCRA)***

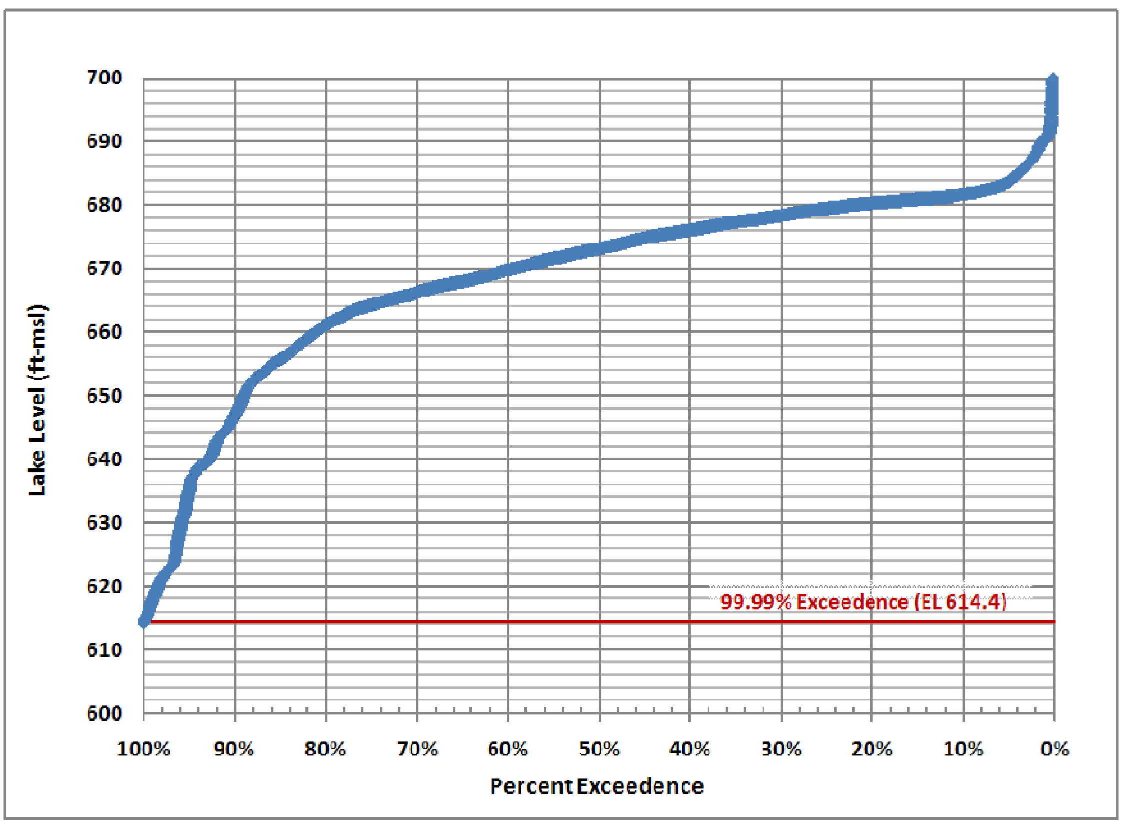

Figure 7-6: Lake Level Frequency for Lake Travis (*data provided by LCRA)

As noted above, the lake frequency analysis was based on historical data; however, the implementation of the *2011 TWDB Region K Water Plan* may impact the lake frequency analysis, which in turn could have an effect on the intake structure design recommendations.

7.2.1.5 Expansion of Existing Intakes

The expansion evaluation of existing intake structures consisted of locating existing intakes and determining whether these sites have expansion potential and/or determine whether these sites can accommodate a regional water system. Appendix B contains the LCRA Municipal/Irrigation Surface Water Contract Location Map for the Highland Lakes, which identifies all recorded surface water contracts along Lake Buchanan, Inks Lake, Lake LBJ, Lake Marble Falls, and Lake Travis. In addition to locating the existing intake structures, the lake bottom bathometry contour maps were reviewed for each intake location. Lake contour maps for Lake Buchanan, Inks Lake, Lake LBJ, Lake Marble Falls, and Lake Travis are available on LCRA's website (www.lcra.org).

Based on the bathometry contour map for Upper Lake Travis, the 99.99% exceedance elevation of 614.4 ft-MSL, and the historical low water surface elevation of 614.2 ft-MSL, we do not recommend the upper reaches of this lake for an intake location. This lake is narrow with significant contour changes over a short distance. Although the bathometry contours range in the upper part of the lake from 680 ft-MSL to 610 ft-MSL, several locations on the lake only go down to bathometry contour elevation of 630 ft-MSL, and other locations only go down to bathometry contour elevation 660 ft-MSL. Additionally, an intake structure located on Lake Travis would require extensive transmission main lengths and high pumping costs to a potential regional water system located upstream. Accordingly, we did not evaluate possible expansions to existing intakes structures that were located on Lake Travis.

The bathometry contours for Inks Lake vary from 890 ft-MSL to 830 ft-MSL. The upstream section of the lake is shallower compared to the downstream section of the lake; therefore, the mid-section to downstream section of the lake would provide a more reliable source of water for an intake structure. The City of Burnet's existing intake structure for the City of Burnet Water Treatment Plant (WTP) is located on Inks Lake, and the water bathometry contour elevation ranges from 890 ft-MSL at the shore to 860 ft-MSL at the center of the lake. Since the bathometry contour elevation of 860 ft-MSL is below the historical low water surface elevation of 877.1 ft-MSL, the existing intake structure for the City of Burnet is a preferred location for a regional system. As a result, the Roth Team recommends that the City of Burnet's intake structure be expanded for the regional system.

For the Northern and Southern regional alternatives analysis on Lake Buchanan and Lake Marble Falls, respectively, there were no existing intake structures located in a central location for the regional distribution system; therefore, the construction of new intake structures were evaluated instead, which is discussed in the following section.

7.2.1.6 New Regional Intakes

As mentioned above, the City of Burnet has an intake structure located on a pass-through lake on Inks Lake, and we do not recommend constructing intake structures on the upper reaches of Lake Travis due to water reliability concerns related to variable level lakes. Accordingly, the Roth Team evaluated possible locations for constructing new intake structures for regional systems on both Lake Marble Falls and Lake Buchanan.

Based on information provided by the City of Marble Falls, their proposed intake structure will be located on Lake Marble Falls, directly upstream of the Max Starcke Dam. The minimum bathometry contour elevation at this location is 690 ft-MSL, which is notably below the historical low water surface elevation of 715.0 ft-MSL. Therefore, the Roth Team is in agreement that this proposed intake structure location will provide a reliable water source.

The bathometry contours for Lake Buchanan vary from 1020 ft-MSL to 920 ft-MSL, which is 100 feet of elevation difference. Based on the bathometry contour information and the 99.99% exceedance frequency elevation of 983.4 ft-MSL, the location of the intake structure plays a significant part in whether or not the lake will provide a reliable water source. Additionally, a proposed intake structure needs to be centrally located within a proposed regional distribution system to make it economically viable. Accordingly, we evaluated possible intake locations on the north-east portion of Lake Buchanan where the following criteria could be met: (1) the water bathometry contour elevation would be below 973.8 ft-MSL and (2) the intake structure meets the requirements of Texas Commission on Environmental Quality (TCEQ) and Texas Administrative Code (TAC), subchapter 290.41 in terms of location to other existing infrastructure. Section 8.0 contains detailed information on the recommended intake options for Lake Buchanan.

Burnet County MUD No. 2 is proposing to install their intake structure on the north portion of Lake Buchanan at the edge of Beaver Creek Cove. This location is north-west of the locations proposed by the Roth Team. Based on the bathometry map for Lake Buchanan, the minimum bathometry contour at the proposed Burnet County Mud No. 2 intake location is 980 ft-MSL; however, we do not recommend installing the lowest intake point for an intake structure at the bottom of the lake. Moreover, raw water pumping units typically require static water head above the impeller to satisfy the net positive suction head (NPSH) requirements so they can operate effectively. Therefore, the minimum water surface elevation above the pump impeller would be approximately 990 ft-MSL (i.e., 980 ft-MSL plus 10 ft). Figure 7-5 shows that 990 ft-MSL would provide water 99.2% of the time. As a result, the Roth Team did not recommend this location for the regional water system intake location because it did not meet the 99.99% criteria.

7.2.2 Recommendations on Intake Type and Locations

The Roth Team used the following evaluation criteria for making recommendations on raw water intake structure types and locations:

1. **Reliability and Water Quality.** Intake structure should be located and designed to provide a reliable water source so that the community will have water available during drought conditions. Additionally, the water source must have good water quality that meets TCEQ requirements.
2. **Community and Environmental Impacts**. Intake structure locations and designs should minimize the impact on the community and environment. These impacts can range from aesthetic, to noise concerns, to affecting endangered species and habitat.
3. **Regulatory Requirements**. Intake structures should be located and designed so that they are in compliance with all federal and state regulatory requirements.
4. **Cost**. Intake structure locations and designs should be selected to minimize initial construction capital costs as well as long term operation and maintenance costs. In order to minimize these costs, we recommend constructing the intake structure near the water treatment plant and distribution system as well as locating it on accessible terrain for ease of construction and maintenance.

Based on the evaluation criteria and advantage/disadvantage comparison described in Section 7.2, we recommend installing wet well intake structures where possible. In terms of reliability and water quality, this type of intake accommodates deepest lake level withdrawal and does not require relocation due to lake level fluctuations. Also, based on the options assessed, it is the best in terms of aesthetics. Additionally, since wet well intake structures are located on shore, they are more accessible, which reduces maintenance costs.

As a result, the Roth Team recommends the consideration of the following intake locations:

- Expand the City of Burnet intake structure on Inks Lake.
- Construct a new intake structure on the north-east side of Lake Buchanan.

- Construct a new intake structure on Lake Marble Falls upstream of Max Starcke Dam.

These three options provide a reliable water source that satisfy water quality and regulatory requirements as well as provide cost effective alternatives. Section 8.0 of this report will discuss the regional options in more detail, including the location of the intake structures. Section 9.0 of this report will describe the economic assessment of the intake alternatives.

7.3 Water Treatment Evaluation

The water treatment evaluation included assessing water treatment processes as well as evaluating treatment site locations. As part of the water treatment alternative evaluations, the Roth Team assessed both the expansion of existing water treatment plants and the construction new regional water treatment plants.

7.3.1 Water Treatment Processes Evaluation Suitable for Available Water Sources

As part of the water treatment process evaluation, we assessed the process used at existing facilities and treatment processes suitable for the available water sources for the regional systems.

7.3.1.1 Processes Used at Existing Facilities

The overview map included in Appendix A shows each entity's water source and the disinfection scheme. Refer to Section 5.0 for a detailed description of the existing water treatment processes for the various entities.

7.3.1.2 Water Treatment Process for Surface Water Sources

The Roth Team considered two water treatment processes for treating the surface waters of Burnet-Llano Counties - conventional treatment and membrane treatment. Conventional treatment consists of rapid mix, flocculation, sedimentation, and filtration. This type of treatment process is reliable and provides ease of operation and maintenance. Membrane treatment is a newer technology that can treat water with a smaller footprint compared to the conventional treatment processes. However, it is also more intensive in terms of operation and maintenance.

In order to provide a regional system that is reliable and that has ease of maintenance and operation, we recommend that the new treatment plant should implement a conventional treatment process. For the regional system alternatives, the City of Burnet's water treatment plant is the only water treatment plant that we recommend expanding in addition to a minimal expansion of the Granite Shoals water treatment plant. The existing water treatment plant for the City of Burnet utilizes a conventional treatment process; therefore, we recommend that the expansion should also utilize a conventional treatment process in order to have similar technologies onsite.

Section 8.0 of this report provides detailed information on the water treatment plant locations for the regional alternatives, and Section 9.0 provides cost description for the expansion of the City of Burnet water treatment plant and for construction of the new water treatment plants for the regional system alternatives.

7.3.1.3 Water Treatment Process for Groundwater Source

For the regional system alternatives, all water treatment processes evaluated are for surface water sources, except for North Option 1 (Tow Village / Fall Creek Vineyards System). Refer to Section 8.0 for a more in depth description of this alternative. For this regional alternative, the water source will be groundwater. The wells were not constructed as public drinking water supply wells and no water quality data has been provided. The owners of Fall Creek have expressed an interest in using their wells to supply groundwater to a joint treatment facility that would provide drinking water to both Tow Village and themselves. The proposed treatment plant would need to include reverse osmosis

(RO) or another type of treatment, such as Water Remediation Technologies, Inc. (WRT) Z-88 media.

7.3.2 Treatment Sites

7.3.2.1 Expansion of Existing Facilities

As mentioned in Section 7.3.1.2, the City of Burnet WTP is the only water treatment plant that we recommend expanding for the regional system alternatives. In order to reduce capital cost and for ease of operation and maintenance, we recommend that the expansion of this facility be integrated into the existing facility at the plant site (existing site has undeveloped land available on three sides of the property).

7.3.2.2 New Water Treatment Plant Sites

We recommend constructing new water treatment plants for the regional system alternatives near the proposed intake structures and near a road for accessibility. Refer to Section 8.0 for more detailed information on the location of the proposed water treatment plants.

7.4 Water Quality Blending Issues

The City of Burnet currently uses treated surface water from Inks Lake as its main water supply. In addition, the City has a number of wells used as backup in case of emergencies. With the increased water demands of the future and the consideration of a regionalized system, it is a possibility that the City will supply a mixture of its well water and treated surface water from the City of Burnet. The disinfection technology for the surface WTP is chloramines and for the wells is free chlorine. Blending of these two waters with differing disinfection technology will likely result in taste and odor problems and the potential loss of disinfectant residual.

A change to the mix of existing distribution water sources may precipitate a potential change in water quality. The change may cause a need for managing the water quality released into the distribution system, which has acclimated to a specific treated water quality over many years.

Many utilities set aesthetic water quality goals/parameters that may be disrupted when changing the distribution water source and that are important to the chemical and biological stability of the finished water quality as it travels through the distribution system.

While these goals may differ from utility to utility, in general, utilities seek to provide water that minimizes the following potential issues:

- Taste and odor complaints
- Finished water color or formation of color in the distribution system
- Nitrification in the distribution system
- Corrosion or upset of existing protective scale on pipelines

Additionally, a desktop analysis on different distribution water blends was conducted on the City of Burnet's finished surface water from Inks Lake and on groundwater from the Ellenburger-San Saba wells located nearby. This analysis calculated the required possible chemical dosages for the new system water; a summary of the disinfection mixture and water quality issues is presented below.

7.4.1 Disinfection Mixtures Issues

Blending chloramines with the chlorinated water in the distribution system has the potential for formation of undesireable tastes and odors. Monochloramine is the predominant and desirable form of chloramine. It is produced at chlorine to ammonia ratios of 3:1 to 5:1. In general when chlorinated water blends with chloraminated water, the chlorine to ammonia ratio will increase. At ratios greater than 5:1, the formation of dichloramine and trichloramine occurs. These compounds are known to cause taste and odor problems. Another water quality concern could occur if the chlorine to ammonia ratio is too high. Breakpoint chlorination can occur, leaving minimal, if any, chlorine residual. This can be a more serious problem than taste and odor issues.

When considering mixing waters with differing disinfection processes, there are a few options to consider. These alternatives are chloramine conversion and breakpoint chlorination. A third option, partial chloramines conversion, was considered but with only two wells to be converted, the option was almost the same as chloramines conversion so the option was eliminated. Each of the remaining two options is discussed in subsequent sections.

7.4.1.1 Chloramine Conversion

Chloramine conversion would convert the residual disinfectant from free chlorine to chloramines. This is the most direct alternative for eliminating the potential water quality problems associated with blending waters with a chloramine residual and waters with a free chlorine residual. It would minimize the potential tastes and odors associated with blending, and reduce the disinfection byproducts that are formed by the reaction of free chlorine with organic matter in the surface water supply.

Chloramine conversion would also provide for a longer lasting residual than the current free chlorine residual. The overall water quality would not change significantly. However, the potential for nitrification within the distribution system piping and storage tanks would exist. Nitrification can result in loss of residual disinfectant. The switch to chloramine disinfection would reduce the disinfection byproduct (DBP) formation. This conversion would require adding ammonia storage and feed facilities at the existing well sites that currently chlorinate.

7.4.1.2 Breakpoint Chlorination

Breakpoint chlorination would maintain the current free chlorine residual disinfectant and use breakpoint chlorination to remove chloramine from the water and provide free chlorine residual. This alternative would require adding additional free chlorine to the water to a point where the combined chlorine residual is removed and a free chlorine residual remains. Additional free chlorine would be required to obtain a chlorine residual for water in the distribution system.

The breakpoint chlorination reaction requires from 10 to 20 minutes so selection of the injection location is an important consideration. Finding this optimal location could mean a new chlorination facility must be constructed. Additionally, this alternative would require facilities/assets associated with the feeding of sodium hypochlorite.

With breakpoint chlorination no significant changes to the system water quality would occur. The advantages of the breakpoint chlorination alternative included the ability to maintain the current free chlorine residual disinfectant.

7.4.2 Water Quality Issues

Changes in distribution waters can significantly impact the water quality in the distribution system. Distribution system problems include microbiological, chemical, and aesthetic issues. These can be mitigated by maintaining stable water and avoiding long detention times and managing direction of flow and velocity. Utilities throughout the country are successfully blending treated water from both surface water systems and groundwater systems in their distribution systems, but the key is to know the distribution system. For this analysis, the focus was on producing a more stable water with chemical controls.

The primary goal of any chemical strategy designed to maintain distribution quality is to provide stable water, especially as measured by pH stability, as it is stored and travels through the distribution system. pH stability effects not only the corrosivity of the water, but disinfection by-product formation, maintenance of disinfection residuals, and taste and odor and color.

7.4.2.1 Test Methodology

The Rothberg, Tamburini & Winsor (RTW) Model for Corrosion Control and Process Chemistry (Version4.0) was used to estimate the chemical requirements for each blend of water to achieve a more stable water. With the analytical data provided by the City for use in a desk-top model, this water characteristic data was used to determine the required caustic (sodium hydroxide) and lime dosages to result in a Langelier Saturation Index (LSI) of greater than zero (targeted 0.2); a calcium carbonate precipitation potential (CCPP) of between 4 and 10 mg/L; a pH of 6.8-9.3; and an alkalinity greater than 40 mg/L.

The water quality characteristics for both the finished surface water and well water that were entered into the model and the blends considered are presented in Table 7-5.

Table 7-5: City of Burnet Water Quality Characteristics and Potential Blends

	Option 1	Option 2	Option 3	Option 4	Option 5
Blend Ratios					
City of Burnet Finished Surface Water (Inks Lake)	100%	0%	50%	25%	75%
Ellenburger Wells near City of Burnet	0%	100%	50%	75%	25%
City of Burnet Finished Water Quality Data					
Alkalinity, mg/L, as $CaCO_3$	130	130	130	130	130
pH	7.5	7.5	7.5	7.5	7.5
Temperature, deg C	28	28	28	28	28
TDS, mg/L	300	300	300	300	300
Hardness, mg/L	169	169	169	169	169
Ca, mg/L, as $CaCO_3$	36.4	36.4	36.4	36.4	36.4
Ellenburger Wells near City of Burnet – Finished Water Quality Data					
Alkalinity, mg/L, as $CaCO_3$	333	333	333	333	333
pH	7.3	7.3	7.3	7.3	7.3
Temperature, deg C	15	15	15	15	15
TDS, mg/L	500	500	500	500	500
Hardness, mg/L	399	399	399	399	399
Ca, mg/L, as $CaCO_3$	64	64	64	64	64
Blended Finished Water Quality Data (Calculated)					
Alkalinity, mg/L, as $CaCO_3$	130	333	232	282	181
pH	7.5	7.3	7.4	7.4	7.5
Temperature, deg C	28	15	21.5	18.25	24.75
TDS, mg/L	300	500	400	450	350
Hardness, mg/L	169	399	284	342	227
Ca, mg/L, as CaC03	36	64	50	57	43

7.4.2.2 Test Results

Based on the water characteristics entered into the RTW Model, the results are as shown in Table 7-6. As is apparent, the dosages of lime required are less than caustic to reach an LSI of 0.2 mg/L. The CCPP is also higher with the lime dosages but the pH values are lower than those for caustic addition. For the LSI values that are not 0.20 mg/L, additional chemical had to be added to allow the CCPP to be within the desired range; this in turn raised or lowered the LSI.

The blend of 75 percent treated surface water and 25 percent well water was the least aggressive requiring caustic addition of 13.6 mg/L caustic as a 50 percent solution resulting in a LSI of approximately 0.23 and a precipitation potential of approximately 4.00 mg/L. The 100 percent well water was the most aggressive requiring caustic addition of 35.0 mg/L as a 50 percent solution resulting in a LSI of approximately 0.20 and precipitation potential of 8.56 mg/L.

Table 7-6: City of Burnet Water Quality Test Results

	Option 1	Option 2	Option 3	Option 4	Option 5
Blend Ratios					
City of Burnet Finished Surface Water (Inks Lake)	100%	0%	50%	25%	75%
Ellenburger Wells near City of Burnet	0%	100%	50%	75%	25%
Prior to Addition of Caustic or Lime					
LSI	-0.49	-0.26	-0.31	-0.22	-0.33
CCPP, mg/L	-9.01	-16.82	-12.21	-10.98	-8.78
Model Results with Caustic Added					
Caustic added, mg/L as 50 percent solution	12.8	35.0	20.0	22.0	13.6
LSI with Caustic added	0.35	0.20	0.20	0.20	0.23
CCPP with Caustic added, mg/L	4.02	8.56	4.97	6.49	4.00
pH with Caustic added	8.31	7.73	7.89	7.80	8.64
Alkalinity with Caustic added, mg/L	138	355	245	296	190
Model Results with Lime Added					
Lime added, mg/L as 50 percent solution	10.8	26.2	16.2	17.4	11.1
LSI with Lime added	0.34	0.19	0.20	0.20	0.21
CCPP with Lime added, mg/L	4.01	9.87	5.63	7.50	4.01
pH with Lime added	8.22	7.62	7.80	7.72	7.95
Alkalinity with Lime added, mg/L	137	351	243	294	188

7.4.2.3 Regulatory Drivers

Aside from the desired water quality characteristics, there are regulatory drivers for distribution systems, both state and federal regulations that drive the treatment requirements and include the following:

- Stage 1 Disinfectants/Disinfection Byproducts Rule (DBPR): Stage 1 DBPR includes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for chlorine, chloramines and chlorine dioxide; MCLGs and MCLs for trihalomethanes, haloacetic acids, bromate and chlorite; and treatment technique requirements for DBP precursors.

- Stage 2 Disinfectants/Disinfection Byproducts Rule (DBPR): The Stage 2 DBPR revised the distribution system compliance requirements. The revised distribution sampling points are determined through an initial distribution system evaluation (IDSE) consisting of one year of monitoring, about every 60 days, at eight sampling sites for each water treatment plant (in addition to the Stage 1 DBPR compliance monitoring sites). Systems with sufficiently low DBPs (TTHM and concentrations less than 0.040 mg/L and 0.030 mg/L, respectively) in all samples taken in the previous 2 years may be exempt from IDSE monitoring.

Prior to any changes in the distribution systems, these regulations and all others that apply need to be consulted.

7.4.2.4 Additional Considerations

Prior to any decision about blending of distribution water, more specific studies should be conducted. Chlorine demand tests of the blended source waters prior to startup of the pipeline would also be advised to better target feed requirements. Other key factors to consider are:

- Water stability requirements are unique to each distribution system.
- For systems that have unlined cast iron pipe, stability is essential to avoid “red” water events, loss of disinfectant residual and bacterial regrowth. Cement mortar and concrete lined pipe will also be negatively impacted by corrosive waters.
- An impact on water quality can occur when pipelines and storage tanks are oversized increasing water age and contact time with pipeline materials. Long detention times contribute significantly to water quality problems.
- Conduct an asset review of piping and plumbing materials in their system including household plumbing, and the presence of any scale or corrosion.
- Conduct system-wide water quality monitoring to identify any problem areas, to include monitoring for coliform, heterotrophic plate counts, disinfection residual, temperature, pH, and color.
- Prevention of deterioration of distribution system water quality depends on good operations and maintenance procedures. pH variations of more than 0.5 units/week should be avoided. For systems with a high potential of problems, the pH change should be even lower, 0.1 to 0.2 pH units/week.
- Changes in quality should be small and made slowly to avoid system upsets and quality problems. The greater the change in quality, the longer it will take for the distribution system to re-equilibrate.
- Utilities with a high potential for problems should practice controlled blending of waters in the distribution system.
- Different dosages of pH adjustment chemicals (lime or caustic) may be needed to achieve LSI or CCPP targets based on the distribution water characteristics and blends. The 75 percent treated surface water-25 percent well water blend will need less than the 25 percent treated surface water-75 percent well water blend.

7.5 Intake Structure and Water Treatment Recommendations

In summary, the recommendations regarding intake structures, water treatment and water quality blending are presented below:

Intake Structures

- Construct wet well type intake structures where possible.
- The intake structures should be located on the lake where the intake is below the historical low water surface elevation for lakes with a relatively constant level.

- The intake structures should be located on the lake where the intake is 10 feet below the 99.99% frequency water surface elevation for variable level lakes.

Water Treatment

- Conventional treatment process should be implemented for surface water treatment.
- The treatment facilities should be located as close as possible to the intake structure (for surface water) to minimize the raw water detention time and potential taste and odor issues.
- The treatment facilities should be adjacent to a road for chemical delivery, sludge hauling, and emergency access.

Water Quality Blending

- When blending surface water from Inks Lake with groundwater from the Ellenburger-San Saba aquifer, pH adjustment chemicals (lime or caustic) will likely be needed to achieve LSI or CCPP targets based on the distribution water characteristics and blend ratios.
- The blend of 75 percent treated surface water and 25 percent well water was the least aggressive requiring caustic addition of 13.6 mg/L caustic as a 50 percent solution resulting in a LSI of approximately 0.23 and a precipitation potential of approximately 4.00 mg/L.

8.0 DESCRIPTION OF FINAL REGIONAL ALTERNATIVES

This section of the report describes the system components that would be needed for each option and how the planning criteria recommended in Section 4 were used to size the component.

8.1 Northern Regional Alternatives

Four regional options were evaluated in the northern portion of the study area; two intake locations were considered for North Option 2. The northern regional options are shown in Figures 6-5 through 6-9 in Section 6.4.1. Reference Appendix E for an overview map of all the northern regional alternatives.

8.1.1 North Option 1: Tow Village / Fall Creek Vineyards System

This regional option assumes that Fall Creek would provide treated groundwater to Tow Village (reference Figure 6-6). The Roth Team assumes that the proposed water treatment plant would be located within 1000-feet of Tow Village's existing distribution system. A 4-inch transmission main would connect the Regional WTP to Tow Village's existing distribution system. The regional facilities would include a clearwell and high service pumps at the WTP.

As with all the regional options described below, we assumed that the North Option 1 would provide wholesale service to each participating entity, and that each entity would continue to be responsible for operating, maintaining and expanding its distribution system in compliance with TAC 290.45, including local storage, to provide retail service to its customers.

8.1.2 North Option 2A: NE Lake Buchanan Regional Alternative (Intake near Bonanza Beach)

In this regional option, the Roth Team assumed that Burnet County MUD No. 2 would forego building its own raw water intake and pump station at Beaver Creek, and would instead participate in a regional system with an raw water intake and pump station west of Bonanza Beach (reference Figure 6-7).

A raw water intake and pump station near Bonanza Beach offers access to a deeper part of the lake, thus increasing reliability during periods of drought. Based on the LCRA Lake Buchanan bathometry map, the lowest contour near the intake structure is 960 ft-MSL, which is 23.7 feet below the historical low water surface elevation for the lake. In the year 2015, the raw water intake and pump station would be constructed and designed with a firm capacity of 0.89 MGD. The raw water pump station would be expanded incrementally with the water treatment plant to an ultimate firm capacity of 1.67 MGD.

Raw water will be pumped from the intake structure to the water treatment plant via a 10-inch raw water pipeline. The proposed water treatment plant shall be located north of the intake structure adjacent to roadway FM 2341. The raw water pipeline will be sized to meet the year 2040 water demand of 1.67 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be constructed and designed for a capacity of 0.89 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 1.67 MGD in order to meet the year 2040 water demand for this option.

A high service pump station will be constructed at the water treatment plant, and it will pump finished water from the water treatment plant to the regional transmission main and then the participating distribution systems. This pump station will be initially designed with a firm capacity of 0.89 MGD, and then, it will be expanded incrementally with the water treatment plant to an ultimate firm capacity of 1.67 MGD.

A 6-inch regional transmission main would be constructed south along FM 2341 to Council Creek Village, and a 10-inch transmission main would be constructed northwest along FM 2341 to South

Silver Creek (I, II and III), and then on to Burnet County MUD No. 2. A 6-inch line off the 10-inch line would serve other northeast Lake Buchanan developments. An extension of this 10-inch transmission main would provide treated water to Paradise Point via a 4-inch underwater crossing of Lake Buchanan.

The regional transmission mains would deliver water to each participant's existing distribution system or into their existing water storage tanks. A 50,000 gallon regional storage tank is recommended for pressure maintenance and to improve pump operating conditions. The Roth Team assumed that a ground storage tank could be located on one of the hills on the northeast side of FM 2341 so that the tank could serve as the elevated storage that is needed for pressure maintenance in the regional transmission main.

8.1.3 North Option 2B: NE Lake Buchanan Regional Alternative (Intake Southwest of Council Creek Village)

As with Option 2A above, it has been assumed that Burnet County MUD No. 2 would forego constructing its own raw water intake and pump station, and would instead participate in a regional system with an intake southwest of Council Creek Village (reference Figure 6-7).

This raw water intake and pump station would be located in a relatively undeveloped part of the lake's eastern shore that offers access to an even deeper part of the lake. Based on the LCRA Lake Buchanan bathometry map, the lowest contour near the intake structure location is 950 ft-MSL, which is 33.7 feet below the historical low water surface elevation for the lake. In the year 2015, the raw water intake and pump station will be constructed with a firm capacity of 0.89 MGD. The pump station will be expanded incrementally with the water treatment plant to its year 2040 build-out firm capacity of 1.67 MGD.

Raw water will be pumped from the intake structure to the water treatment plant via a 10-inch raw water pipeline. The water treatment plant shall be located north of the intake structure adjacent to CR 114. The raw water pipeline will be sized to meet the year 2040 water demand of 1.67 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be constructed and designed for a capacity of 0.89 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 1.67 MGD in order to meet the year 2040 water demand for this option.

A high service pump station will be constructed at the water treatment plant, and it will pump finished water from the water treatment plant to the regional transmission main and then the participating distribution systems. This pump station will be initially designed with a firm capacity of 0.89 MGD, and expanded incrementally with the water treatment plant to an ultimate firm capacity of 1.67 MGD.

A 12-inch regional transmission main would be constructed east along an easement to FM 2341 at the southern edge of Council Creek Village. The 12-inch main would extend to the delivery point to Council Creek Village, where it would be reduced to a 10-inch transmission main extending northwest along FM 2341 to Bonanza Beach, South Silver Creek (I, II and III), and Burnet County MUD No. 2 with a branch to other northeast Lake Buchanan developments. An extension would provide treated water to Paradise Point via a 4-inch underwater crossing of Lake Buchanan. The regional transmission mains would deliver water to each participant's existing distribution system or into their existing water storage tanks. As in Option 2A, a 50,000 gallon regional storage tank is recommended for pressure maintenance and to improve pump operating conditions.

8.1.4 North Option 3: Burnet, Bertram, Buena Vista, and Cassie

In this regional option, the City of Burnet's existing raw water intake, WTP and 18-inch transmission main would remain in service and continue to provide treated water to the City of Burnet. However, we assumed that currently unused capacity in that existing transmission main would be made available to transport treated surface water for Bertram in the short term (reference Figure 6-8).

This option also assumes that the City of Bertram would maintain its Felps well field (capacity of approximately 650 GPM) but would meet future water demands with treated surface water from the regional system. It is assumed that the Buena Vista and the Cassie Subdivision would abandon their existing wells, intakes and treatment facilities, but would continue to operate, maintain and expand their local storage, pumping and distribution facilities as needed to provide retail service in their respective service areas.

Since the existing intake structure for the City of Burnet provides a reliable water source, this structure will be used as the intake for the regional system. The existing raw water pump station will be expanded to a firm capacity of 4.58 MGD in year 2015, and expanded incrementally with the water treatment plant to an ultimate firm capacity of 8.72 MGD. Based on the LCRA bathometry map for Inks Lake, the minimum contour by the existing intake structure is 860 ft-MSL, which is 17.1 feet below the historical low water surface elevation of 877.1 ft-MSL for Inks Lake. The Roth Team recommends that the lowest intake point for the pump station be located below elevation 867.1 ft-MSL, which is 10 ft below the historical low water surface elevation.

Raw water will be pumped from the intake structure to the water treatment. The water treatment plant is located north of the intake structure, adjacent to State Park Road 4. The existing raw water pipeline (16-inch) will remain in service, plus a new 18-inch raw water pipeline will be installed in 2015 to meet both Bertram's and Burnet's water demand through year 2040. The new raw water pipeline will be sized to meet the year 2040 water demand of 8.72 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be expanded to a capacity of 4.58 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 8.72 MGD in order to meet the year 2040 water demand for this option.

The high service pump station at the water treatment plant that pumps finished water from the water treatment plant through the distribution system will be expanded incrementally with the water treatment plant. This pump station will initially be expanded to a firm capacity of 4.58 MGD in year 2015; then, it will be expanded to an ultimate firm capacity of 8.72 MGD.

In this option, the first regional transmission facilities to be constructed would be an 8-inch water transmission main from the existing City of Burnet WTP generally west and parallel to Highway 29 to the Buena Vista area, and a 6-inch extension of that transmission main north along Ranch Road 690 to the Cassie Subdivision. Neither a booster station nor a regional tank would be required as the transmission main could be fed off the existing 18-inch City of Burnet main headed east towards Burnet. A pressure-reducing valve would be required to avoid excessive pressures in the proposed 6 and 8-inch transmission mains.

As mentioned above, excess capacity in Burnet's existing 18-inch transmission main would temporarily be used to transport treated surface water for Bertram, but this would not be initiated until year 2019, when Bertram will need additional treated water beyond the capacity of the Felps well field. Just prior to that date, a 10-inch and 12-inch regional transmission main would be constructed from Burnet to Bertram, either parallel to Bertram's existing 8-inch line from the Felps well field or along Highway 29. Treated surface water for Bertram would be pumped from the WTP through the existing 18-inch transmission main to Burnet; the treated water would then flow by gravity from Burnet to Bertram via the proposed 10-inch and 12-inch regional transmission main, assuming Burnet would be in favor of using its existing Post Mountain tanks (1570 ft-MSL overflow elevation) to balance the system.

Based on the information provided by the City of Burnet on its existing 18-inch line, it appears that the capacity may be limited to about 2,400 GPM due to the elevation difference between the WTP and the Post Mountain tanks in Burnet and the friction losses in the pipe. At that flow rate, velocities in the 18-inch pipe would be approximately 3.0 fps. It has been assumed that the capacity of the line could be increased to 4,000 GPM (line velocity at 5 fps) by constructing a 200,000-gallon ground storage tank and booster pump station about 3.1 miles east of the existing WTP. This would reduce the pressures and head on the pumps at the WTP. By increasing the capacity of the existing 18-inch to 4,000 GPM, both City of Burnet's and City of Bertram's maximum daily demand could be met until about year 2033.

In year 2034, the City of Burnet's demands plus City of Bertram's demands (above the 650 GPM supplied by the Felps wells) will exceed the capacity of the City of Burnet's 18-inch transmission main, even with the addition of the intermediate booster pump station. A 12-inch regional water transmission main, approximately 8.3 miles long, would be constructed in year 2032 or 2033 from the City of Burnet WTP to the City of Burnet to meet the demands out to year 2040. This water transmission main would be constructed parallel to the existing 18-inch transmission main and would be tied into the intermediate storage tank and booster pump station (whose capacity would be expanded by about 1000 GPM) to avoid excessive pressures in the pipe.

8.1.5 North Option 4: Northern Burnet County Regional System

This option would include all of the aspects of the North Option 3 above, but would also serve the entities along the northeast side of Lake Buchanan (those served by Options 2A or 2B) and Whitewater Springs located south of the City of Bertram. As in Option 3, the City of Burnet's existing raw water intake, WTP and 18-inch transmission main would remain in service and continue to provide treated water to the City of Burnet, and unused capacity in the 18-inch transmission main would be made available to transport treated surface water for the City of Bertram (and Whitewater Springs) in the short term. Also, as with Option 3, the City of Bertram would maintain its Felps well field. All the other systems participating in this option would abandon their existing wells, intakes and treatment facilities, but would continue to operate, maintain and expand their local storage, pumping and distribution facilities as needed to provide retail service in their respective service areas.

Since the existing intake structure for the City of Burnet provides a reliable water source, this structure will be used as the raw water intake for the regional system. The existing raw water pump station would be expanded to a firm capacity of 5.54 MGD in year 2015, and expanded incrementally with the water treatment plant to an ultimate firm capacity of 10.52 MGD. Based on the LCRA bathometry map for Inks Lake, the minimum contour by the existing intake structure is 860 ft-MSL, which is 17.1 feet below the historical low water surface elevation of 877.1 ft-MSL for Inks Lake. The Roth Team recommends that the lowest intake point for the pump station be located below elevation 867.1 ft-MSL, which is 10 ft below the historical low water surface elevation.

Raw water will be pumped from the raw water intake structure to the water treatment plant. The water treatment plant is located north of the intake structure, adjacent to State Park Road 4. The existing raw water pipeline (16-inch) will remain in service, and a new 20-inch raw water pipeline will be installed. The raw water pipeline will be sized to meet the year 2040 water demand of 10.52 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be expanded to a capacity of 5.54 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 10.52 MGD in order to meet the year 2040 water demand for this option.

The high service pump station at the water treatment plant that pumps finished water from the water treatment plant through the distribution system will be expanded incrementally with the water treatment plant. This pump station will initially be expanded to a firm capacity of 5.54 MGD in year 2015, and then, it will be expanded to an ultimate firm capacity of 10.52 MGD.

The development of the regional water transmission mains would generally follow the pattern for Option 3, but the improvements would need to occur sooner due to the additional demands of the added participants. One of the first regional water transmission facilities to be constructed would be the 8-inch main from the existing City of Burnet WTP to the Buena Vista area, together with the 6-inch extension of that transmission main north to the Cassie Subdivision. As in Option 3, a booster station or regional tank would not be required, but a pressure reducing valve would be installed on the connection to the existing 18-inch City of Burnet water transmission main to avoid excessive pressures in the proposed 6-inch and 8-inch water transmission mains.

The other water transmission main that would be constructed initially would be a 12-inch main running northwest along FM 2341 to Council Creek Village and the other participating entities on the northeast shore of Lake Buchanan. The diameter of this main would be reduced to 10-inch at Council Creek Village and then to 4-inch for the lake crossing required to serve Paradise Point. We assumed that this water transmission main could be connected to the City of Burnet's existing 12-inch main that extends about 1-mile north from Highway 29; however, a complete analysis would need to be conducted to confirm the demands on that line. Excess capacity in Burnet's existing 18-inch transmission main would temporarily be used to transport treated surface water to the City of Burnet for the City of Bertram and Whitewater Springs, and also for the entities on the northeast side of Lake Buchanan.

To serve Whitewater Springs, a 4-inch branch transmission main and small booster pump station would be constructed off the City of Bertram's existing 8-inch line from the Felps well field. This system would require a 30,000-gallon standpipe on the divide between the Brazos and Colorado River basins. The additional demand from Whitewater Springs would accelerate the proposed construction of the surface water supply transmission main from the City of Burnet to the City of Bertram to year 2016.

As in Option 3, it has been assumed that the capacity of the City of Burnet's existing 18-inch line from their WTP to Burnet could be increased to 4000-GPM (line velocity at 5 fps) by constructing a 200,000-gallon ground storage tank and booster pump station about 3.1 miles east of the WTP. By increasing the capacity of the existing 18-inch to 4000-GPM, the maximum daily demand of the City of Burnet, the City of Bertram, Whitewater Springs, and the entities on the northeast side of Lake Buchanan could be met until year 2026.

In about year 2027, the projected demands will exceed the capacity of the City of Burnet's 18-inch water transmission main, including the intermediate booster pump station, and an 8.3-mile, 16-inch regional transmission main would be constructed prior to that date from the water treatment plant to the City of Burnet to meet the demands out to year 2040. As in Option 3, this water transmission main would be constructed parallel to the existing 18-inch water transmission main and would be tied into the intermediate storage tank and booster pump station (capacity would be expanded by 2248 GPM) to avoid excessive pressures in the pipe.

8.2 Southern Regional Options

Four regional options were selected for evaluation in the southern part of the study area. The southern regional options are shown in Figures 6.10 through 6.14 in Section 6.4.2. Reference Appendix F for an overview map of all the southern regional alternatives.

South Options 1 and 2 are both based on the City of Marble Falls' plan to construct a new raw water intake and pump station and new water treatment plant upstream of Max Starcke Dam, southeast of the City. Both options include water transmission facilities to deliver water to the Highway 71 area south of Marble Falls and east of Highway 281. These facilities would include a water transmission main, intermediate elevated storage tank and booster pump station. South Option 1 would serve Blanco San Miguel, whereas South Option 2 would provide service to Blanco San Miguel, as well as participant entities southeast along Highway 71 and along the upper parts of Lake Travis. Service to the City of Cottonwood Shores and to Smithwick Mills, via other parts of the Marble Falls distribution system, is also included in South Option 2.

South Option 3 proposes an interconnection between the Cities of Meadowlakes and Marble Falls, which would allow the City of Marble Falls to purchase treated water from the City of Meadowlakes. In South Option 4, a similar arrangement would allow the City of Granite Shoals system to supply treated water to the City of Highland Haven.

8.2.1 South Option 1: Marble Falls / Blanco San Miguel Regional System:

For South Option 1, the City of Marble Falls' existing raw water pump station and treatment plant will remain in service and has a capacity of 3.80 MGD. This option assumes that Blanco San Miguel would participate in the proposed raw water intake pump station and water treatment plant that the City of Marble Falls plans to construct upstream of the Max Starcke Dam. For comparison purposes, the Roth Team determined that the raw water intake and pump station, water treatment plant, and high service pump station would be expanded incrementally from year 2015 to year 2040 based on the water demands for this option. Also, for comparison reasons, we determined that the raw water pipeline between the intake structure and water treatment plant would be designed to meet year 2040 water demand and would be installed in year 2015.

As discussed in Section 7.0, Lake Marble Falls directly upstream of the Max Starcke Dam provides a reliable water source; therefore, we are in agreement with the City of Marble Falls pertaining to the proposed intake structure location. The Roth Team determined that the proposed raw water intake and pump station would be installed with a firm capacity of 0.66 MGD in year 2015, and would be expanded incrementally with the water treatment plant to a firm capacity of 8.07 MGD to meet the 2040 demand.

Raw water will be pumped from the intake structure to the new water treatment plant via a 24-inch raw water pipeline. Based on the information provided by the City of Marble Falls, the proposed water treatment plant would be located southwest of the Max Starcke Dam. The new raw water pipeline will be sized to meet the year 2040 water demand of 8.07 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be designed for a capacity of 0.66 MGD. Ultimately, the water treatment plant, as well as the raw water intake and pump station, will be expanded to a capacity of 8.07 MGD.

The high service pump station at the water treatment plant that pumps finished water from the water treatment plant into the transmission main will be expanded incrementally with the water treatment plant. This pump station will be installed with firm capacity of 0.66 MGD in year 2015, and expanded to an ultimate firm capacity of 8.07 MGD.

The water transmission facilities under this option would include a water transmission main, two storage tanks and booster pump station. A proposed 16-inch transmission main, approximately 4.7 miles long, would run south from the proposed water treatment plant along easements to Highway 71 about 3.8 miles east of the Highway 71/281 intersection. An intermediate 75,000-gallon elevated storage tank and 2500-GPM booster pump station would be located at this point. The booster pumps would then deliver treated surface water via a 2.7-mile extension of the 16-inch transmission main to a regional storage tank built near the Burnet/Blanco County line. Blanco San Miguel would be responsible for constructing a pumping station at this location to deliver treated water to their development.

8.2.2 South Option 2: Southeast Burnet County Regional System

For South Option 2, the City of Marble Falls' existing raw water pump station and treatment plant will remain in service and has a capacity of 3.80 MGD. This option represents an extensive regionalization approach to the southeastern part of the study area. It includes the facilities in South Option 1, but sized for the additional entities to be served. A water transmission main would branch off the water transmission main from the proposed WTP to Blanco San Miguel and run east along Highway 71, with branches to the participating entities along Lake Travis.

This alternative also includes a water transmission main along FM 2147 from Marble Falls' existing water main on south Highway 281 to Cottonwood Shores, and a transmission main along FM 1174 to provide treated water to Smithwick Mills from the Hamilton Creek area, which is currently served by the City of Marble Falls. It has been assumed that the existing connections between Marble Falls and Hamilton Creek have sufficient capacity to meet the additional demand from Smithwick Mills.

This alternative assumes that the proposed raw water intake and pump station and water treatment plant that the City of Marble Falls is pursuing upstream of Max Starcke Dam will be constructed. In order to compare southern region options, the Roth Team determined that the raw water pump station, water treatment plant, and high service pump station would be expanded incrementally from the year 2015 to year 2035 based on the water demands for this option. Also, for comparison reasons, we determined that the raw water pipeline between the intake structure and water treatment plant would be designed to be meet year 2040 water demand and installed in year 2015.

As discussed in Section 7.0, Lake Marble Falls directly upstream of the Max Starcke Dam provides a reliable water source; therefore, we are in agreement with the City of Marble Falls regarding the proposed intake structure location. The Roth Team determined that the raw water intake and pump station would be installed with a firm capacity of 2.10 MGD in year 2015, and expanded incrementally with the water treatment plant to a firm capacity of 9.96 MGD.

The raw water will be pumped from the intake structure to the new water treatment plant via a 24-inch raw water pipeline. Based on the information provided by the City of Marble Falls, the water treatment plant is located southwest of the Max Starcke Dam. The new raw water pipeline will be sized to meet the year 2040 water demand of 9.96 MGD; however, the water treatment plant will be expanded incrementally. In year 2015, the water treatment plant will be designed for a capacity of 2.10 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 9.96 MGD.

The high service pump station at the water treatment plant that pumps finished water from the water treatment plant into the transmission main will be expanded incrementally with the water treatment plant. This pump station will be installed with firm capacity of 2.10 MGD in year 2015, and then, it will be expanded to an ultimate firm capacity of 9.96 MGD.

The water transmission main described in South Option 1 above would follow the same route but would be 18-inches in diameter from the planned water treatment plant at Max Starcke Dam to the intermediate elevated storage tank and booster pump station at Highway 71. A small line could provide treated surface water to Capstone should they express interest at some point in the future.

The intermediate storage and booster pumping facilities would also be larger due to the demands of the additional entities served. The elevated storage tank would have a capacity of 100,000-gallons and the booster pump station would have a capacity of 3,200 GPM. The water transmission main from Highway 71 south to the county line would be the same size (16-inch) as in South Option 1. However, the ground storage tank at the county line would be larger (100,000 gallons) since the booster pumps at Highway 71 are larger due to the increased service provided in this option.

Downstream (southeast) of the intermediate booster pump station, a 10-inch line branching off the water transmission main would extend 2.6 miles southeast along Highway 71 to Quail Creek and then another 2.7 miles to the Spicewood turnoff (Texas Spur 191). At that point, one 6-inch water transmission main would extend west to Windermere Oaks WSC and another 6-inch water transmission main would extend north to Spicewood Beach. We assumed that each of these entities would abandon their intakes (or wells) and treatment facilities, and that the treated water from the Max Starcke Dam intake and water treatment plant would be delivered to the local storage tanks for each of these entities.

This option also includes an 8-inch regional water transmission main that would extend 3.1 miles along West FM 2147 from the City of Marble Falls' distribution lines along Highway 281 to the southeastern corner of the Cottonwood Shores system. We assumed that the City of Cottonwood Shores would abandon its existing WTP, which is reported to be in poor operating condition, but would continue to maintain and operate its storage tanks, high service pumping, and pressure maintenance facilities.

Finally, this option includes a 4-inch regional water transmission main extending 5.1 miles along FM 1431 from Hamilton Creek, which is currently served by the City of Marble Falls, to the entrance to

Smithwick Mills. A more detailed analysis would be required to verify that the lines supplying Hamilton Creek with treated water from the City of Marble Falls, and the lines within Hamilton Creek, have sufficient capacity to also handle the anticipated maximum day demand of Smithwick Mills (48 GPM in year 2040).

In summary, the participants served by Southern Option 2 would include the following (in addition to the City of Marble Falls, which already serves Hamilton Creek and South Road):

- Capstone Water System
- Blanco San Miguel
- Quail Creek Water System
- Windermere Oaks WSC
- Ridge Harbor Water System
- Spicewood Beach Water System
- City of Cottonwood Shores
- Smithwick Mills Water System

8.2.3 South Option 3: City of Meadowlakes / City of Marble Falls Interconnect

The City of Meadowlakes has approximately 880 existing connections and expects to be fully built-out at 960 connections by year 2020. Based on the unit maximum day demand of 0.6 GPM per connection, a treatment capacity of about 576 GPM (0.83 MGD) would be adequate to serve Meadowlakes' water demands out to year 2040.

The existing WTP serving the City of Meadowlakes has a capacity of 1400 GPM (2 MGD), or a capacity of about 824 GPM (1.17 MGD) more than will be required to meet its year 2040 demand. Even allowing that Meadowlakes' unit maximum day demand may be 20% higher than the 0.6 GPM unit maximum day demand used in this study, the City would still have about 700 GPM, or 1 MGD, of water treatment plant capacity in excess of its needs.

Meanwhile, the City of Marble Falls needs additional treated water beginning in year 2018, based on the current capacity of its WTP, which is reported to be 2640 GPM (3.80 MGD). A wholesale agreement between the two entities would allow the City of Marble Falls additional time to develop and implement its proposed treatment plant capacity expansions, and/or allow the City of Marble Falls to begin serving some of the entities listed in the Southeast Burnet County Regional System (South Option 2 as described above) prior to the construction of the proposed Max Starcke Dam raw water intake and water treatment plant.

A detailed survey and analysis of the piping networks of the two cities is beyond the scope of this planning study, but it has been assumed that 2,000 feet of 8-inch line would be ample to connect the two systems, since they are located adjacent to each other. It has also been assumed that the City of Meadowlakes' existing pumping facilities would already have enough capacity to deliver water to the City of Marble Falls.

As discussed in Section 7.0, Lake Marble Falls directly upstream of the Max Starcke Dam provides a reliable water source; therefore, we are in agreement with Marble Falls about the proposed intake structure location. In order to make comparison between regional options, it was assumed that the raw water intake and pump station be designed with a firm capacity of 0.78 MGD in year 2025, and expanded incrementally with the water treatment plant.

Raw water will be pumped from the intake structure to the water treatment plant via a 16-inch raw water pipeline. The water treatment plant is located southwest of the Max Starcke Dam. The raw water pipeline will be sized to meet the year 2040 water demand of 3.23 MGD; however, the water treatment plant will be expanded incrementally. In year 2025, the water treatment plant will be designed for a capacity of 0.78 MGD. Ultimately, the water treatment plant, as well as the raw water pump station, will be expanded to a capacity of 3.23 MGD in order to meet the year 2040 water demand for this option.

The high service pump station at the water treatment plant that pumps finished water from the water treatment plant through the distribution system will be expanded incrementally with the water treatment plant. This pump station will be installed with firm capacity of 0.78 MGD in year 2025, and then, it will be expanded to an ultimate firm capacity of 3.23 MGD.

8.2.4 South Option 4: City of Granite Shoals / City of Highland Haven Interconnect

The City of Highland Haven has already expressed interest in an emergency interconnect with the City of Granite Shoals system. South Option 4 considers an arrangement in which the interconnect would serve not only as an emergency interconnect, but would also enable the City of Highland Haven to obtain the additional treated water needed to meet its year 2040 demands from the City of Granite Shoals. In this case, the City of Highland Haven would not need to expand its existing groundwater supply system.

The existing capacity of the City of Highland Haven water system is 0.50 MGD and their year 2040 maximum day demand is estimated at 0.38 MGD. Thus, their existing system has sufficient capacity to meet their 2040 water demands.

The current capacity of the City of Granite Shoals water treatment plant is reported to be 3.07 MGD (2130 GPM). This is sufficient capacity to serve the City of Granite Shoals needs to year 2037, or almost through the planning period for this study. The City of Granite Shoals' existing raw water pump station would be expanded to a firm capacity of 3.18 MGD in year 2035 in order to meet the year 2040 water demands. The raw water will be pumped from the intake structure to the existing Granite Shoals water treatment plant via the existing 16-inch raw water pipeline. In addition to the raw water pump station, the water treatment plant would also be expanded in year 2035 in order to meet the year 2040 water demand of 3.18 MGD. The booster pump station at the water treatment plant that pumps finished water from the water treatment plant through the distribution system will also be expanded in year 2035 by 0.11 MGD.

To interconnect the two systems, a 6-inch transmission main would be required from the City of Granite Shoals WTP, extending 1.9 miles generally to the northwest to a connection point on the City of Highland Haven system. Since the two entities are adjacent to each other, the length of this line might be reduced on further analysis of the two systems.

Prior to implementing this option, a blending study would need to be conducted to determine if both ground water and treated surface water can be safely blended in the Highland Haven system, and to identify what treatment changes may be necessary.

8.2.5 Summary

Each of the regional options has been described in detail in this section including the types and sizes of the regional facilities. In Section 9.0, the costs for constructing and operating the facilities associated with each option are presented, along with comparisons for each of the entities served.

9.0 COST ESTIMATES AND EVALUATION

9.1 Cost Estimating Process

The Roth Team performed an economical analysis on each of the regional options described in Section 8.0. This economical analysis allowed us to rank the options and determine which option was the least cost option for the project participants. After the project participants select a regional system to pursue, the Roth Team recommends that a complete financial analysis be performed by a financial analyst before securing funds for the project(s).

The Roth Team considered three categories for each option's cost analysis: capital costs for water treatment, annual operations and maintenance (O&M) costs for the entire system, and capital costs for the transmission facilities. The water treatment cost analysis includes costs for the raw water intake and pumps, raw water piping and water treatment options and consists of both capital costs and O&M costs combined and calculated to provide a present-worth cost per 1,000 gallons of treated water. The steps to this process for each option included the following:

- Step 1: Determine the water demand required for each five-year increment or phase.
- Step 2: Compare the water demands to the capacity available. The incremental cost estimate is based on the additional capacity needed to meet the demand.
- Step 3: Calculate capital costs and determine in which phase these costs will be incurred.
- Step 4: Complete a present-worth analysis of the capital costs based on 2011 dollars.
- Step 5: Calculate annual O&M costs.
- Step 6: Complete a present-worth analysis of the O&M costs based on 2011 dollars.
- Step 7: Using the combined present-worth values for the capital and O&M costs and the total average-day water demands for the 25-year period from 2015 to 2040, calculate a cost per 1,000 gallons of treated water. This total cost will be based on 2011 dollars and will offer a cost basis on which to compare all options.

For the regional transmission facilities, the Roth Team calculated the costs attributable to each entity based on each entity's share of the total capacity of that component. Regional transmission facilities consist primarily of the pipelines but also include booster pumping stations and storage tanks required for the operation of the regional transmission lines.

9.2 Demand Determinations

Prior to beginning the cost analysis, the Roth Team compared the water demands versus the current treatment capacity of each entity. Due either to size, condition of the facilities or lack of necessity, not all of the entities' current treatment facilities will be kept in service should the regional option be chosen. Based on input from project participants, the Roth Team assumed that the water treatment facilities of the following entities would be decommissioned:

Northern Region

- Tow Village Water System
- Paradise Point Water System
- South Silver Creek (I, II, III)
- Bonanza Beach Water System
- Council Creek Village
- Cassie Subdivision
- Buena Vista Water System

- Whitewater Springs Water System

Southern Region

- City of Cottonwood Shores
- Quail Creek Water System
- Windermere Oaks WSC
- Ridge Harbor Water System
- Smithwick Mills Water System
- Spicewood Beach Water System

The Roth Team calculated the maximum and average day demands of each regional water system option by taking into account the above-referenced facilities to be decommissioned and the projected demand increase for each five-year period from 2015 to 2040. Table 9-1 shows the Northern Region's maximum and average day demands of each regional water system option for 2015 thru 2040.

Table 9-1: Maximum & Average Day Demands for Northern Regional Options

Year	2015	2020	2025	2030	2035	2040
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
North Option 1						
Max Day Demand (MGD)	0.03	0.03	0.03	0.03	0.04	0.04
Avg. Day Demand (MGD)	0.02	0.02	0.02	0.02	0.02	0.02
North Option 2						
Max Day Demand (MGD)	0.63	0.89	1.15	1.41	1.62	1.67
Avg. Day Demand (MGD)	0.32	0.45	0.58	0.71	0.81	0.84
North Option 3						
Max Day Demand (MGD)	3.86	4.58	5.41	6.48	7.55	8.72
Avg. Day Demand (MGD)	1.93	2.29	2.71	3.24	3.78	4.36
North Option 4						
Max Day Demand (MGD)	4.55	5.54	6.64	7.98	9.27	10.52
Avg. Day Demand (MGD)	2.28	2.77	3.32	3.99	4.64	5.26

Table 9-2 shows the Southern Region's maximum and average day demands of each regional water system option for 2015 thru 2040.

Table 9-2: Maximum & Average Day Demands for Southern Regional Options

Year	2015	2020	2025	2030	2035	2040
	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
South Option 1						
Max Day Demand (MGD)	3.47	4.46	5.89	7.69	9.70	11.87
Avg. Day Demand (MGD)	1.74	2.23	2.95	3.85	4.85	5.94
South Option 2						
Max Day Demand (MGD)	4.82	5.90	7.43	9.33	11.47	13.76
Avg. Day Demand (MGD)	2.41	2.95	3.72	4.67	5.74	6.88
South Option 3						
Max Day Demand (MGD)	4.17	4.84	5.67	6.60	7.75	9.05
Avg. Day Demand (MGD)	2.09	2.42	2.84	3.30	3.82	4.53
South Option 4						
Max Day Demand (MGD)	1.94	2.14	2.36	2.61	2.88	3.18
Avg. Day Demand (MGD)	0.97	1.07	1.18	1.31	1.44	1.59

Table 9-3 shows the existing capacities of the regional systems that will remain in service for each option proposed in the Northern and Southern Regions.

Table 9-3: Regional Options & Existing Capacity to Remain in Service

Region	2011 Capacity (MGD)
North Option 1	0
North Option 2	0
North Option 3	3.82
North Option 4	3.82
South Option 1	3.80
South Option 2	3.80
South Option 3	5.82
South Option 4	3.07

The Roth Team assumed that WTP construction would be completed in 5 year increments and be sized sufficiently to accommodate the max day demand of the next 5 year period. In other words, we assumed that if a particular option's 2015 and 2020 max day demand was 3 MGD and 4.5 MGD, respectively, then the WTP facility would be sized to accommodate 4.5 MGD in 2015. In our calculation, we also incorporated the existing capacity of the regional system. For example, the total design capacity for the North Option 3 would be the max day demand in 2040 of 8.72 MGD minus the system's existing capacity of 3.82 MGD, or 4.90 MGD.

9.3 Capital Costs for Water Treatment

The Roth Team performed a capital cost analysis for water treatment that included the following cost categories for each of the options:

- Raw water intake and raw water pump station (RWPS);
- Raw water pipeline; and,
- Water treatment facilities (i.e., rapid mix basins, flocculator basins, sedimentation basins, high-rate filters, chemical storage and feed facilities, solids handling facilities, ground storage reservoirs, and distribution pump stations, electrical and administration facilities, etc.).

As it was not within the scope of this project to determine the exact treatment process, raw water pump station or piping design required for each option, we used planning level unit costs that were based on industry standards and our experience in lieu of a more specific engineering design. Our capital cost analysis also incorporated when the costs would be incurred (i.e., whether it was through a phased cost outlay approach or in one lump sum at the beginning of the project).
Our water treatment capital cost analysis also included the following:

- 15-percent contingency
- 20-percent professional services fee, which can include costs for surveying, legal services, engineering services, financial advisors, etc.

Our water treatment cost analysis did not incorporate the following elements as we assumed that these would be determined in subsequent phases of a future project upon selection of a regional option:

- Any non-capacity increasing upgrades (such as regulatory driven upgrades) required on project participant's existing systems water treatment facilities (i.e., existing treatment plants, raw water pump stations, pipelines, and high service pump stations, etc.);
- Any upgrades or expansions required on project participant's existing distributions system (i.e., existing elevated or ground storage reservoirs, pump stations and distribution pipelines, etc.); and
- Land acquisition or easement costs.

Prior to performing a financial analysis on selected options, the Roth Team recommends that a condition assessment of the key existing facilities be conducted to determine if additional costs for repair are needed. The methodology used to determine the capital costs is described in the sections below.

9.3.1 Raw Water Intake/Pump Station

Once we determined how much additional capacity would be needed at each phased 5 year interval, we estimated planning, design, and construction costs of the raw water intake and pump station of the regional options. As described in a previous section, we assumed that this construction would be completed in 5 year increments and be sized sufficiently to accommodate the max day demand of the next 5 year period.

Capital costs for the raw water intake and pump station were based on a planning level unit cost per gallon of water. Section 7.0 describes the various types of raw water intakes and pump stations that are available for this project. Based on our experience and industry standards, the Roth Team used $0.20/GPD of capacity for all sizes. As an example, North Option 3 in 2015 needs a 0.76 MGD expansion, which has a capital cost for the raw water pump station and intake of $152,000. For North Option 1, we assumed that it continued to use ground water as the source water, so we assumed no capital cost for a raw water pump station or intake included in this option's costs.

9.3.2 Raw Water Pipeline

The costs for the raw water pipeline include the costs of installing the pipeline to convey raw water from the raw water pump station to the WTP. For this analysis, the Roth Team assumed that the new pipeline would be sized to accommodate the additional capacity needed only, as the current raw water pipelines (those systems remaining in service) would also remain in service. Unlike the raw water intake and pump stations, the installation of the raw water pipeline would not be phased. Instead, we assumed that the cost to accommodate any future flows would be incurred at the earliest phase in which additional capacity was needed. The new raw water pipelines for our analysis were based on the following assumptions:

- Pipeline diameter was based on a maximum velocity of 5.0 feet per second (fps).
- Pipeline alignment for existing WTPs would follow the path of the existing pipelines, where applicable.
- Pipeline alignment for new WTPs would run from the recommended location of the new raw water intake structure to the new location of the WTP.
- Pipeline lengths ranged from 860 to nearly 6,000 ft and alignments were not based on a detailed study on the topography and soil conditions surrounding each of the intake structures as this was not part of the scope.

Based on our experience and industry standards, a planning level unit cost of $9/in-ft was used to calculate raw water pipeline capital costs. South Option 4 already has an existing 16-inch, 1,000-ft long raw water pipeline that can accommodate the 2040 max daily demand for this option, so there was no capital cost for a new pipeline included in this option's costs. Conversely, North Option 3, required an additional 4.9 MGD, or 7.58 cubic foot per second (cfs) of raw water that would be needed. At a velocity of 4.29 fps, an 18-inch diameter pipe would be optimal. Using a length of approximately 1,500 ft, the cost for this pipeline would be $249,200. Since additional capacity is required in Phase I (2015) for this option, the entire cost of the pipeline would be incurred at this time.

9.3.3 Water Treatment

Similar to the raw water intake and pump station, we estimated planning, design, and construction costs of the new plant expansions of the regional options based on how much additional capacity would be needed at each phased 5 year interval. As described in a previous section, we assumed that WTP construction would be completed in 5 year increments and be sized sufficiently to accommodate the max day demand of the next 5 year period. For example, North Option 3 has a 2020 max day demand of 4.58 MGD, and an existing capacity in 2015 of 3.82 MGD, which requires an expansion of 0.76 MGD. Since the 2020 upgrades need to be completed by 2015, we assumed that the capital costs for construction would be incurred in 2015. Similarly, the same option has a 2025 max day demand of 5.41 MGD; since the capacity in 2020 would be 4.58 MGD, another expansion of 0.83 MGD would be required in 2020. Since the 2025 upgrades need to be completed by 2020, we assumed that the capital costs for construction would be incurred in 2020.

As discussed above, the Roth Team used planning level unit costs that were based on industry standards and our experience. Table 9-4 shows the treatment costs based on a cost per gallon per day of treated water, using a sliding scale.

Table 9-4: Water Treatment Plant Planning Level Capital Cost Basis

Capacity	Cost per GPD of Capacity
Less than 0.5 MGD	$4.00
0.5 to 1.0 MGD	$3.50
1.0 to 2.0 MGD	$3.25
2 to 3 MGD	$3.00
3 to 6 MGD	$2.75
6 MGD or larger	$2.50

Based the required plant expansion and the unit costs contained in Table 9-4, we determined a capital cost for water treatment for each phase. In the previous example, North Option 3 needed an additional capacity of 0.76 MGD in 2015 at $3.50/GPD of capacity for a total of $2.66 million.

North Option 1 assumes the use of groundwater and Water Remediation Technologies, Inc. (WRT) Z-88 media as a treatment method (discussed in Section 7.0). For this analysis, we assumed this process would cost $4.00 per gallon per day of capacity based on the "*Draft Feasibility Report Feasibility Analysis of Water Supply for Small Public Water Systems*" from Council Creek Village for the Texas Commission on Environmental Quality in August 2010.

9.3.4 Present-Worth Analysis

After the phased capital costs of construction were determined, the Roth Team conducted a present-worth value (PV) analysis to convert the phased costs of each option into one sum based on 2011 dollars. The equation used for the PV analysis was:

$$pv*(1+rate)^{nper}+pmt(1+rate*type)*\left(\frac{(1+rate)^{nper}-1}{rate}\right)+fv=0$$

Where,

- **PV** is the present value, or present-worth value. The present value is the total amount that a series of future amounts is worth now. For this analysis, capital that would be needed at a later date for future expansions is calculated into a present-worth value so to have a common ground on which to compare the different options. The total capital costs and O&M costs for 2015 through 2040 were calculated into a PV based on the value of a dollar in 2011.

- **Rate** is the interest rate per period. For this analysis, an effective interest rate of 3.5% was used. The effective interest rate takes into account the inflation of the 2011 dollar to the future year, as well as the discount rate of calculating the 2011 dollar value from a future cost.

- **Nper** is the total number of payment periods. This would be the number of years between the future date in which the money is needed and 2011. For example, in the year 2015, the Nper would be 2015 minus 2011, or four years.

- **Pmt** is the payment made each period and cannot change over the life of the investment annuity. The capital need for the construction costs would be provided to the entities in one lump sum at the beginning of each phase at this required future date, so this value would be zero.

- **Fv** is the future value, or a cash balance you want to attain after the last payment is made. This future value is the capital costs need for each of the five-year intervals. For North Option 3, for the year 2015, this value would be $2.94 million.

- **Type** indicates when payments are due. If payments are due at the end of the period, the value is zero. If the payments are due at the beginning of the period, the value is 1. For this analysis, the lump sum payment would be required at the first year of the five-year phase, so the value would be one.

9.4 Operations and Maintenance Costs for Entire System

The Roth Team also considered operation and maintenance (O&M) costs in our economic cost analysis, which are important elements to consider when determining which regional option would be the least cost for the entities. Our O&M cost analysis included the following cost types:

- Labor,
- Chemicals,
- Power consumption, and
- Maintenance and spare parts.

Our estimated O&M costs did not include labor costs for existing employees, only additional employees that would be needed for the water treatment expansions. All calculations, including power and chemicals, are based on the total average daily flows of the existing WTPs and the expansions that were needed to meet the regional water demands for each option. The methodology used to determine each of these O&M costs is discussed in the subsequent sections.

9.4.1 Labor

The Roth Team estimated labor costs based on the additional WTP operators and mechanical maintenance personnel that were needed to operate the expanded WTPs. The number of full-time equivalents (FTEs) needed was figured on the size of the WTPs, which was based on our experience and industry standards. Table 9-5 shows the number of FTEs per MGD of treated water.

Table 9-5: Operation and Maintenance Personnel Planning Level Assumptions

Capacity	Full Time Equivalents (FTEs)
Less than 0.5 MGD	1.5
0.5 to 1.0 MGD	2
1.0 to 2.0 MGD	3
2.0 to 8.0 MGD	4

Again, our labor costs that were used in our analysis did not take into account any current employees the entities may have working in connection with their water treatment operations. For options showing half an employee, this figure considers that one full-time maintenance employee will spend half his/her time working on maintenance for the water treatment assets and half the time working for other City departments. We assumed that each FTE worked 2,080 hours a year at salary rate of $37 an hour.

9.4.2 Chemicals

Since a treatment process study and preliminary designs of the regional options were not part of this scope, chemical costs were based on standard chemicals and dosages used at equivalent facilities on the Highland Lakes. Table 9-6 presents the chemical details.

Table 9-6: Chemical Characteristics and Planning Level Cost Basis

Chemical	Density (lbs/gal)	Concentration (%)	Avg. Dosage Rate (mg/L)	Cost
Alum	11.1	49	20.0	$0.09/lb bulk $0.33/lb drum
Fluoride (H_2SiF_6)	10.17	18.2	0.7	$3.75/gallon truckload $7.30/gal for 1,100 gal
Polymer	9.40	50	1.0	$0.85/lb
Potassium Permangenate ($KMnO_4$)	8.51	3.0	1.0	$3.71/dry lb for 1 container $3.33/dry lb for 2/3 containers $3/dry lb for 4 or more containers
Sodium Hypochlorite	9.56	8.5	5.0	$0.89/gal
Sodium Hypochlorite	10.01	12.5	5.0	$0.89/gal
Liquid Ammonium Sulfate (LAS)	10.19	9.8	1.25	$0.10/lb bulk $0.36/lb drum

The Roth Team estimated chemical consumption costs using the estimated average dosage rate and the average daily flow for each regional option. As stated before, our estimated chemical costs assumes the cost for chemicals at the existing treatment plants and any new or plant expansions that are necessary to meet the demand. The O&M costs for chemicals account for a minimum of 15-day on-site chemical supply. Where the quantities called for it, bulk costs as opposed to drum costs were used.

9.4.3 Power

The greatest source of power consumption comes from the electricity needed for pumping operations. For this analysis, the Roth Team assessed raw water and finished water pumping as well as miscellaneous power needed for WTP operations. We calculated costs based on an electricity cost of $0.12/kWh and average daily flows. The required pump head was based on the following for each regional option:

- **Raw Water Pumping.** Pumping from the lake to the WTP. Static head calculated from the water intake elevation in the lake to the estimated hydraulic grade line and the WTP. The headloss in the pipeline itself was considered but was determined to be minor compared to the static head.

- **WTP Operations**. Pumping within the WTP itself. We assumed that pumping throughout the plant is 10 percent of the raw water pumping costs.

- **Finished Water Pumping.** Pumping the finished water from the WTP to the high point in the pipeline or elevated storage tank (EST) elevation in the proposed option's distribution system. Although some portions of the distribution system may require booster pumps stations as noted in the distribution system alternatives, the cost of the electricity to pump from the WTP to the booster station and then to the EST versus the cost of the electricity to pump from the WTP to the EST would be equivalent.

The Roth Team assumed that the firm capacity of all pumps would be capable of handling the max day demands; however, power costs were based on the total average daily flow required. As previously stated, our estimated power costs includes the power consumption by all pumps that are part of the new system and existing systems that would not be decommissioned upon construction of a regional option.

9.4.4 Maintenance/Spare Parts

Based on our experience and industry standards, the Roth Team assumed that the monthly cost of maintenance and spare parts would be 10-percent of the monthly O&M budget. One additional additive was for Northern Region Option 1. As described earlier, this option would include the water treatment process of WRT Z-88. This process would add an additional O&M cost of approximately $4,500 per month, based on the Council Creek Village study previously cited.

9.4.5 Present-Worth Analysis

As part of our present-worth analysis, the Roth Team included the above-described annual O&M costs in our economic cost analysis for each regional option. Once we estimated the 2015 O&M costs for each option as described above, we projected these cost forward for each five-year period based on the projected water demand growth rates. Accordingly, the 2015 O&M costs were increased each year through 2040. After an annual O&M cost for each year was calculated, we performed a present-worth analysis using the same equation and methodology described in Section 9.3.4 to determine a total O&M cost for the 25-year period for each regional option (not assuming the options to be implemented prior to 2015).

9.5 Capital Costs for Transmission Facilities

Although most of the regional transmission mains proposed for each option will be constructed early in the planning process, a few, such as the Burnet to Bertram transmission main in North Options 3 and 4, will be built later during the planning process. In these cases, the present worth for the future transmission main has been calculated using the same assumptions as for the intake and WTP improvements.

9.6 Total Cost Calculations

The Roth Team's total cost calculation includes both water treatment costs and transmission facility costs. The total cost for the water treatment processes includes the capital costs for the raw water intake and pump station, raw water piping, and water treatment plant construction; and O&M costs for the entire system, reported as a cost per 1,000 gallons. The total cost for the transmission facilities include the capital cost for the pipeline, booster pump stations (as applicable), and elevated storage tank construction, reported as a cost per connection and a cost per 1,000 gallons. Below is the methodology used to calculate each of these total costs, as well as criteria used for each individual option.

9.6.1 Intake, Raw Water Pump Station and Water Treatment Plant Costs

The Roth Team calculated a unit cost per 1,000 gallons for each regional option by dividing the combined capital and O&M costs present-worth values with the total volume of finished water that would be treated between 2015 and 2040. We estimated the total volume of finished water by taking the population/water connection growth rates and average daily demands for each year from 2015 to 2040 and converting them to annual demands. The annual demands were summed to compute the total demand for the 25-year period. Dividing the total present-worth value by the total demand (in 1,000 gallons) provides a cost per 1,000 gallons for each option.

Table 9-7 presents the total raw water pump station, raw water pipeline and WTP costs for the Northern Regional options without distribution system transmission mains, booster pump stations and elevated storage tanks.

Table 9-7: Northern Regional Options RW/WTP Costs

	N Opt 1	N Opt 2A	N Opt 2B	N Opt 3	N Opt 4
Capital Costs					
RWPS/Intake	$0	$334,000	$334,000	$980,000	$1,340,000
RW Pipe	$0	$108,100	$534,600	$249,200	$276,900
WTP/Distribution Pump Station	$160,000	$6,235,000	$6,235,000	$16,322,500	$22,755,000
Professional Services (20%)	$32,000	$1,335,420	$1,420,800	$3,510,400	$4,678,380
Contingency (15%)	$24,000	$1,001,565	$1,065,540	$2,632,800	$3,508,800
Phase Capital Costs for RW/WTP	$216,000	$9,014,085	$9,589,900	$23,694,900	$31,579,100
2011 Present Worth of Capital Costs	$169,300	$6,737,400	$7,239,100	$14,701,200	$20,596,800
2011 Present Worth of O&M Costs	$3,095,900	$4,256,300	$4,256,300	$13,442,500	$16,775,000
2011 Present Worth Cost	**$3,265,200**	**$10,993,700**	**$11,495,400**	**$28,143,700**	**$37,371,800**
Total Avg Day Demand, 2015-2040 (MG)	**157**	**5,886**	**5,886**	**28,758**	**35,040**
Present Worth Cost/1,000 Gals	**$20.80**	**$1.87**	**$1.95**	**$0.98**	**$1.07**

Notes:
1) O&M costs include complete system operating costs not just expansion operating costs, operating at average daily demand.
2) Land acquisition and easement costs are not included.
3) North Option 1 assumes ground water source and use of Water Remediation Technologies, Inc. (WRT) Z-88.
4) Assumes 3.5 percent effective interest rate.

Table 9-8 presents the total raw water pump station, raw water pipeline and WTP costs for the Southern Regional options without distribution system transmission mains, booster pump stations and elevated storage tanks.

Table 9-8: Southern Regional Options RW/WTP Costs

	S Opt 1	S Opt 2	S Opt 3	S Opt 4
Capital Costs				
RWPS/Intake	$1,614,000	$1,992,000	$646,000	$22,000
RW Pipe	$185,800	$185,800	$123,900	$0
WTP/Distribution Pump Station	$25,347,500	$30,737,500	$8,075,000	$440,000
Professional Services (20%)	$5,429,500	$6,583,100	$1,769,000	$92,500
Contingency (15%)	$4,072,100	$4,937,300	$1,326,800	$69,400
Phase Capital Costs for RW/WTP	$36,648,900	$44,435,700	$11,940,700	$624,000
2011 Present Worth of Capital Costs	$21,780,000	$27,961,500	$6,115,500	$273,200
2011 Present Worth of O&M Costs	$17,994,400	$19,339,059	$11,722,225	$6,449,522
2011 Present Worth Cost	**$39,774,400**	**$47,300,559**	**$17,837,800**	**$6,722,800**
Total Avg Day Demand, 2015-2040 (MG)	**33,711**	**41,316**	**29,923**	**11,919**
Present Worth Cost/1,000 Gals	**$1.18**	**$1.14**	**$0.60**	**$0.56**

Notes:
1) O&M costs include complete system operating costs not just expansion operating costs, operating at average daily demand.
2) Land acquisition and easement costs are not included.
3) Assumes 3.5 percent effective interest rate.

9.6.2 Transmission Facilities Costs

With respect to cost sharing for the regional transmission facilities, the Roth Team divided transmission mains into segments with the segment boundaries corresponding to a delivery point to one or more of the participating entities. Thus, each segment serves a specific number of entities, each of which are participating in the construction of that segment in proportion to the ratio of that entity's 2040 maximum day demand to the total 2040 demand carried by that segment. Those entities with the largest demands will have the highest cost participation for each segment.

Those entities farthest out on the transmission mains will generally have the largest overall cost participation for the transmission facilities, since they will be participating in the most segments. These outlying entities must often pay for the full costs of the last segment.

The Roth Team calculated cost participation for booster pumping stations in the same way as for transmission mains, that is, in proportion to the ratio of that entity's 2040 maximum day demand to the total 2040 demand that is to be pumped by that station.

Cost participation for regional storage tanks also follows this methodology, except that regional storage tanks provide benefit to any entity on a particular transmission main. Thus, even entities upstream of a storage tank have been included in the cost participation for the tank because they receive a benefit from the pressure maintenance function of the tank whether they are upstream or downstream.

The unit costs for furnishing and installing various diameters of pipe in limestone and soils found in eastern Burnet County are given in Table 9-9. These unit costs represent total estimated construction costs and include miscellaneous items such as erosion control, safety fencing, seeding, traffic control, etc. Professional services, contingencies, and easement costs are not included. Table 9-10 includes unit construction costs for pipelines installed in northwestern Burnet County and Llano County, where granite is more likely to be encountered. In addition, typical costs for booster pumping stations, ground storage tanks, and elevated storage tanks are also included.

Table 9-9: Unit Construction Costs (Soil Condition #1)

Ductile Iron (DI): Construction in Limestone Rock & Soil (Eastern Burnet County)	Unit	Unit Cost
4 inch DI	LF	$52.00
6 inch DI	LF	$62.00
8 inch DI	LF	$77.00
10 inch DI	LF	$92.00
12 inch DI	LF	$107.00
14 inch DI	LF	$122.00
16 inch DI	LF	$133.00
18 inch DI	LF	$144.00
20 inch DI	LF	$155.00

Table 9-10: Unit Construction Costs (Soil Condition #2)

Ductile Iron (DI): Construction in Granite & Soil (Northwestern Burnet County & Llano County)	Unit	Unit Cost
4 inch DI	LF	$62.40
6 inch DI	LF	$74.40
8 inch DI	LF	$92.40
10 inch DI	LF	$110.40
12 inch DI	LF	$128.40
14 inch DI	LF	$146.40
16 inch DI	LF	$159.60
18 inch DI	LF	$172.80
20 inch DI	LF	$186.00

With regards to transmission system costs, first, the Roth Team figured each entity's share by dividing the transmission system's cost by the number of that entity's customers that will receive service from the regional system. This method provides a cost per connection, which can vary widely with the smallest entities farthest out on the system having the highest per connection costs for transmission systems. In most cases, we used the total number of connections, both existing and future customers to calculate per connection costs, since both will receive service from the new facilities. There are some exceptions and these are noted in preceding sections.

To estimate the cost per 1,000 gallons of water delivered, the Roth Team divided the per connection cost for each entity by the annual demand summed for the 25-year planning period for that entity (not assuming the options to be implemented prior to 2015).

9.6.3 North Option 1: Tow Village/Fall Creek Vineyards

The Roth Team's analysis for North Option 1 assumes that groundwater will continue to be used, and that the existing wells on the Fall Creek property will remain in service. Therefore, no costs for new wells or a raw water pump station, intake and piping were included in the capital costs. Also, we assumed that the Fall Creek system will cover the 2040 demands of Fall Creek, so costs are exclusively for the additional Tow Village demands.

As described in Section 8.0, this option considers using the treatment process WRT Z-88 based on the "*Draft Feasibility Report Feasibility Analysis of Water Supply for Small Public Water Systems*" from Council Creek Village for the Texas Commission on Environmental Quality in August 2010. If this option is considered, we recommend that a study of WRT technology in conjunction with Tow Village be conducted.

The Roth Team assumed a treatment capital cost of $4.00/GPD of capacity. Should this option be implemented, the existing Tow Village wells would be decommissioned, requiring the new system to meet a 2040 max day demand of 0.04 MGD and average day demand of 0.02 MGD. In a phased approach, the required capacity in Phase 1 (2015) would be 0.03 MGD max, with a 0.01 MGD expansion in Phase 4 (2030). Table 9-7 presents the RW/WTP costs for North Option 1 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Aside from the standard O&M costs used in all options, North Option 1 had an additional monthly cost added associated with the WRT Z-88 treatment process. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-11 presents the O&M costs for North Option 1.

Table 9-11: North Option 1 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$9,000
Chemical ($/mo)	$300
Power ($/mo)	$300
Maintenance/Spare Parts ($/mo)	$960
Misc Costs ($/mo)	$4,600
2015 Total ($/mo)	$15,200
2015 Total ($/yr)	$182,400
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$3,095,900

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 1.0 percent.

Labor costs include one full-time WTP operator and one full-time mechanical maintenance technician working half-time on water treatment issues, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-12 presents the estimated chemical usages for North Option 1.

Table 9-12: North Option 1 - Chemical Usages

Chemical	Monthly Usage
Alum	0 gal
NaOCl	0.52 gal
LAS	0.16 gal
Fluoride	0.05 gal
Polymer	0 gal
$K(MnO_4)$	0 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-13 presents the pump heads and criteria used to determine these heads for North Option 1.

Table 9-13: North Option 1 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 2 Firm: 1	20	61	1	4	Ground Water EL = 974 ft WTP EL = 1035 ft
Finished water	Total: 2 Firm: 1	20	5	1	1	WTP EL = 1035 ft High Point EL = 1040 ft
Internal plant	-	-	-	-	0.04	10 percent of raw water pumping

The estimated cost of the regional transmission system is $84,000, all of which would be attributable to Tow Village since we assumed that the WTP would be located near an existing well on the Fall Creek Vineyard property. This would be equivalent to about $1,915 per existing and future connection to the Tow Village water system, or to about $0.54 per 1000 gallons of water delivered to customers over the 25 year planning period (not assuming the options to be implemented prior to 2015).

9.6.4 North Option 2A: Northeast Lake Buchanan Regional Alternative with Intake near Bonanza Beach

The Roth Team's analysis for North Option 2A included Paradise Point, Burnet Co. MUD No. 2, South Silver Creek (I, II, III), Bonanza Beach, Council Creek Village, and other northeast Lake Buchanan developments. There are two sub-options as described in Section 8.0. The water treatment processes for both these sub-options are similar, so capital costs and O&M costs would be the same except for pipe and pumping costs. The difference would be in the location of the intake and the WTP. For Option 2A, the intake would be near Bonanza Beach, having a raw water pipeline length of approximately 1,200 ft.

Should this option be implemented, the Paradise Point, South Silver Creek (I, II, III), Bonanza Beach and Council Creek Village wells or intakes and water treatment facilities would be decommissioned, requiring the new system to meet a 2040 max day demand of 1.67 MGD and average day demand of 0.835 MGD. In a phased approach, the required capacity in Phase 1 (2015) would be 0.89 MGD max, with 0.26 MGD expansion in Phase 2 (2020), 0.26 MGD expansion in Phase 3 (2025), 0.21 MGD expansion in Phase 4 (2030) and 0.05 MGD in Phase 5 (2035). Upgrades to the raw water pump station would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-7 presents the RW/WTP costs for North Option 2A without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10-percent of the total labor, chemical and power costs. Table 9-14 presents the O&M costs for North Option 2A.

Table 9-14: North Option 2A – O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$9,000
Chemical ($/mo)	$2,400
Power ($/mo)	$1,600
Maintenance/Spare Parts ($/mo)	$1,300
2015 Total ($/mo)	$14,300
2015 Total ($/yr)	$171,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$4,256,300

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 4.2 percent.

Labor costs include one full-time WTP operator and one full-time mechanical maintenance technician working half-time on water treatment issues, as determined using Table 9-4. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-5. Table 9-15 presents the estimated chemical usages for North Option 2A.

Table 9-15: North Option 2A - Chemical Usages

Chemical	Monthly Usage
Alum	10 gal
NaOCl	11 gal
LAS	3 gal
Fluoride	1 gal
Polymer	1 gal
$K(MnO_4)$	3 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal Plant, and finished water pumping. Table 9-16 presents the pump heads and criteria used to determine these heads for North Option 2A.

Table 9-16: North Option 2A - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 2 Firm: 1	220	120	8	148	Intake EL = 960 ft WTP EL = 1080 ft
Finished water	Total: 2 Firm: 1	220	220	15	272	WTP EL = 1080 ft EST EL = 1300 ft
Internal plant	-	-	-	-	14.8	10 percent of raw water pumping

The Roth Team estimated transmission system costs at $6.09 million and we assumed that the transmission mains and tank would be constructed in the 2011 to 2015 time frame. After calculating the present-worth of the transmission system costs and the participation costs for each transmission main segment, per connection costs ranged from $119 for Bonanza Beach to $13,657 for Paradise Point. Each entity's per connection costs and estimated cost per 1000 gallons are presented below in Table 9-17.

Table 9-17: North Option 2A – Transmission System Costs (PW in 2011 Dollars)

Entity	Connections Served	Cost per Connection	Cost per 1000 gallons
Council Creek V.	170	$10,965	$2.96
Bonanza Beach	71	$119	$0.03
S. Silver Creek	98	$778	$0.21
Burnet MUD 2	252	$1,291	$0.57
NE Lake Buchanan Developments	1188	$1,396	$0.59
Paradise Point	158	$13,657	$3.64

9.6.5 North Option 2B: Northeast Lake Buchanan Regional Alternative with Intake East of Council Creek Village

For North Option 2B, a regional system would serve Paradise Point, Burnet Co. MUD No. 2, South Silver Creek (I, II, III), Bonanza Beach, Council Creek Village, and other northeast Lake Buchanan developments. As previously noted for North Option 2, there are two sub-options as described in Section 8.0. The water treatment processes for both these sub-options are the same, so capital costs and O&M costs would be the same except for pipe and pumping costs. The difference would be in the location of the intake and the WTP. For Option 2B, the intake would be east of Council Creek Village, having a raw water pipeline length of approximately 6,000 ft.

Should this option be implemented, the Paradise Point, South Silver Creek (I, II, III), Bonanza Beach and Council Creek Village wells or intake and water treatment facilities would be decommissioned, requiring the new system to meet a 2040 max day demand of 1.67 MGD and average day demand of 0.835 MGD. In a phased approach, the required capacity in Phase 1 (2015) would be 0.89 MGD max, with 0.26 MGD expansion in Phase 2 (2020), 0.26 MGD expansion in Phase 3 (2025), 0.21 MGD expansion in Phase 4 (2030) and 0.05 MGD in Phase 5 (2035). Upgrades to the raw water pump station would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-7 presents the RW/WTP costs for North Option 2B without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10-percent of the total labor, chemical and power costs. Table 9-18 presents the O&M costs for North Option 2B.

Table 9-18: North Option 2B - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$9,000
Chemical ($/mo)	$2,400
Power ($/mo)	$1,600
Maintenance/Spare Parts ($/mo)	$1,300
2015 Total ($/mo)	$14,300
2015 Total ($/yr)	$171,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$4,256,300

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 4.2 percent.

Labor costs include one full-time WTP operator and one full-time mechanical maintenance technician working half-time on water treatment issues, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-19 presents the estimated chemical usages for North Option 2B.

Table 9-19: North Option 2B - Chemical Usages

Chemical	Monthly Usage
Alum	10 gal
NaOCl	11 gal
LAS	3 gal
Fluoride	1 gal
Polymer	1 gal
$K(MnO_4)$	3 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-20 presents the pump heads and criteria used to determine these heads for North Option 2B.

Table 9-20: North Option 2B - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 2 Firm: 1	220	240	17	297	Intake EL = 950 ft WTP EL = 1190 ft
Finished water	Total: 2 Firm: 1	220	110	8	136	WTP EL = 1190 ft EST EL = 1300 ft
Internal plant	-	-	-	-	29.7	10 percent of raw water pumping

The Roth Team estimated transmission system capital costs at $7.97 million and we assumed that the transmission mains and tank would be constructed in the 2011 to 2015 time frame. After calculating the present-worth of the transmission system costs and the participation costs for each transmission main segment, per connection costs ranged from $796 for Council Creek Village to $15,297 for Paradise Point. Each entity's per connection costs and estimated cost per 1000 gallons are presented below in Table 9-21.

Table 9-21: North Option 2B – Transmission System Costs (PW in 2011 Dollars)

Entity	Connections Served	Cost per Connection	Cost per 1000 gallons
Council Creek Village	170	$796	$0.21
Bonanza Beach	71	$2,356	$0.67
S. Silver Creek	98	$3,015	$0.81
Burnet MUD 2	252	$3,444	$1.51
NE Lake Buchanan Developments	1188	$3,444	$1.44
Paradise Point	158	$15,297	$4.07

9.6.6 Northern Region Option 3: Burnet, Bertram, Buena Vista, and Cassie

In the analysis for North Option 3, the Roth Team assumed that the existing City of Bertram wells and the City of Burnet WTP would stay in service; the City of Burnet's WTP would be expanded to serve the City of Burnet, City of Bertram, Buena Vista area and Cassie Subdivision. Also, this option assumed that the current raw water intake location would be utilized; however, the raw water pump station and raw water pipeline would need to be expanded to accommodate the new max day demands. Additionally, we assumed that the new raw water pipeline would follow a similar profile as the existing pipeline; thus, the length of the new raw water pipeline would be approximately 1,550 ft.

Should this option be implemented, the Cassie Subdivision and Buena Vista Water System WTPs would be decommissioned, requiring the new system to meet a 2040 max demand of 8.72 MGD and average day demand of 4.36 MGD. The initial capacity prior to any new construction would be 3.82 MGD, so in a phased approach, the additional capacity added in Phase 1 (2015) would be 0.76 MGD max, in Phase 2 (2020) would be 0.83 MGD, in Phase 3 (2025) would be 1.07 MGD, in Phase 4 (2030) would be 1.07 MGD, and in Phase 5 (2035) would be 1.17 MGD. Upgrades to the raw water pump station would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-7 presents the RW/WTP costs for North Option 3 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10-percent of the total labor, chemical and power costs. Table 9-22 presents the O&M costs for North Option 3.

Table 9-22: North Option 3 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$17,900
Chemical ($/mo)	$8,700
Power ($/mo)	$18,600
Maintenance/Spare Parts ($/mo)	$4,600
2015 Total ($/mo)	$49,800
2015 Total ($/yr)	$597,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$13,442,500

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 3.4 percent.

Labor costs include two full-time WTP operators and one full-time mechanical maintenance technician, as determined using Table 9-5. Chemical costs were calculated based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-23 presents the estimated chemical usages for North Option 3.

Table 9-23: North Option 3 - Chemical Usages

Chemical	Monthly Usage
Alum	59 gal
NaOCl	68 gal
LAS	20 gal
Fluoride	6 gal
Polymer	3 gal
$K(MnO_4)$	16 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-24 presents the pump heads and criteria used to determine these heads for North Option 3.

Table 9-24: North Option 3 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 3 Firm: 2	675	130	55	984	Intake EL = 860 ft WTP EL = 990 ft
Finished water	Total: 5 Firm: 4	340	580	250	4,392	WTP EL = 990 ft Storage Tank EL = 1570 ft
Internal plant	-	-	-	-	98.4	10 percent of raw water pumping

The Roth Team estimated transmission system costs for this option at $18.5 million (Present Worth=$13.7 million). We assumed that the transmission mains serving the Buena Vista and Cassie areas would be constructed in the 2011 to 2015 time frame. However, the transmission main from Burnet to Bertram would not be constructed until the 2016 to 2020 time frame, and the additional 12-inch transmission main from the Burnet WTP to Burnet would not be needed until the 2026 to 2030 time frame. After calculating the present-worth of the transmission system costs and the participation costs for each transmission main segment, per connection costs ranged from $2,077 for the Buena Vista area to $7,654 for the City of Bertram. Each entity's per connection costs and estimated cost per 1000 gallons delivered are given in Table 9-25 below. Note: the cost shown for Burnet and Bertram do not apply to customers that can be served by these entities' existing capacity. Thus, the numbers of customers shown in the table are for the customers served by the proposed transmission facilities. For Buena Vista and Cassie, we assumed that both existing and new customers will be served by the proposed regional transmission system.

Table 9-25: North Option 3 – Transmission System Costs (PW in 2011 Dollars)

Entity	Connections Served	Cost per Connection	Cost per 1000 gallons
City of Bertram	1,351 over those served by current capacity	$7,654	$3.88
City of Burnet	308 over those served by current capacity	$2,559	$1.30
Cassie Subdivision	294	$6,195	$1.72
Buena Vista area	389	$2,077	$0.64

9.6.7 North Option 4: Northern Burnet County Regional System

In the analysis for North Option 4, we assumed that the existing City of Bertram wells and the City of Burnet WTP would stay in service; the City of Burnet WTP would be expanded to serve the City of Burnet, Paradise Point, Burnet Co. MUD No. 2, South Silver Creek (I, II, III), Bonanza Beach, Council Creek Village, Cassie Subdivision, the Buena Vista area, City of Bertram, and Whitewater Springs. Also, this option assumes that City of Burnet's existing raw water intake location would still be used; however, the raw water pump station and raw water pipeline would need to be expanded to accommodate the new max day demands. Also, we assumed that the new raw water pipeline would follow a similar profile as the existing pipeline; thus, the length of the new raw water pipeline would be approximately 1,550 ft.

Should this option be implemented, the Paradise Point, South Silver Creek (I, II, III), Bonanza Beach, Council Creek Village, Cassie and Buena Vista Water Systems would be decommissioned, requiring the new system to meet a 2040 maximum demand of 10.52 MGD and average day demand of 5.26 MGD. The initial capacity prior to any new construction would be 3.82 MGD, so in a phased approach, the additional capacity added in Phase 1 (2015) would be 1.72 MGD max, in Phase 2 (2020) would be 1.1 MGD, in Phase 3 (2025) would be 1.34 MGD, in Phase 4 (2030) would be 1.29 MGD, and in Phase 5 (2035) would be 1.25 MGD. Upgrades to the raw water pump station would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-7 presents the RW/WTP costs for North Option 4 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-26 presents the O&M costs for North Option 4.

Table 9-26: North Option 4 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$23,800
Chemical ($/mo)	$10,300
Power ($/mo)	$21,700
Maintenance/Spare Parts ($/mo)	$5,600
2015 Total ($/mo)	$61,400
2015 Total ($/yr)	$736,800
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$16,775,000

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 3.5 percent.

Labor costs include two full-time WTP operators and one full-time mechanical maintenance technician, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-27 presents the estimated chemical usages for North Option 4.

Table 9-27: North Option 4 - Chemical Usages

Chemical	Monthly Usage
Alum	70 gal
NaOCl	80 gal
LAS	24 gal
Fluoride	7 gal
Polymer	4 gal
$K(MnO_4)$	19 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. This analysis looked at raw water pumping, internal plant and finished water pumping. Table 9-28 presents the pump heads and criteria used to determine these heads for North Option 4.

Table 9-28: North Option 4 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 3 Firm: 2	790	130	65	1,160	Intake EL = 860 ft WTP EL = 990 ft
Finished water	Total: 6 Firm: 5	320	580	295	5,177	WTP EL = 990 ft Storage Tank EL = 1570 ft
Internal plant	-	-	-	-	116	10 percent of raw water pumping

For Northern Regional Option 4, the Roth Team estimated transmission system costs to have a present worth of $34.8 million (Present Worth=$29.2 million). As with Option 3, the transmission mains serving the Buena Vista and Cassie areas would be constructed in the 2011 to 2015 time frame, as would the transmission main serving the entities on the northeast side of Lake Buchanan. The booster pump station, 4-inch transmission main and standpipe that would serve Whitewater Springs would also be constructing prior to 2015. However, the transmission main from Burnet to Bertram would not be constructed until the 2016 to 2020 time frame, and the additional 16-inch transmission main from the Burnet WTP to Burnet would not be needed until the 2026 to 2030 time frame. After calculating the present-worth of the transmission system costs and the participation costs for each transmission main segment, per connection costs ranged from $1,743 for the Burnet to $27,685 for Whitewater Springs. Per connection costs were high for both Whitewater Springs and Paradise Point because these entities are both located at the outer limits of the regional system.

Each entity's per connection costs and the estimated cost per 1000 gallons are given in the table below. As with Option 3, the costs shown for Burnet and Bertram do not apply to customers that can be served by these entities' existing capacity. Thus, the numbers of customers shown in Table 9-29 are for the customers served by the proposed transmission facilities. For all the other entities included in this option, we assumed that both existing and new customers will be served by the proposed regional transmission system.

Table 9-29: North Option 4 – Transmission System Costs (PW in 2011 Dollars)

Entity	Connections Served	Cost per Connection	Cost per 1000 gallons
City of Bertram	1,351 over those served by current capacity	$6,660	$3.38
Whitewater Springs	150	$27,685	$9.49
City of Burnet	308 over those served by current capacity	$1,743	$0.88
Council Creek V.	170	$3,315	$0.89
Bonanza Beach	71	$4,876	$1.38
S. Silver Creek	98	$5,535	$1.50
Burnet MUD 2	252	$5,964	$2.89
NE Lake Buchanan Developments	1188	$5,964	$2.50
Paradise Point	158	$17,817	$4.74
Cassie Subdivision	294	$6,176	$1.71
Buena Vista area	389	$2,077	$0.64

9.6.8 South Option 1: Marble Falls/Blanco San Miguel Regional System

In the analysis for South Option 1, we assumed that the existing City of Marble Falls WTP would stay in service, continuing to serve Marble Falls, South Road and Hamilton Creek; a new WTP would be constructed to serve the City of Marble Falls and Blanco San Miguel development. The existing raw water intake location would still be utilized, and a new raw water intake and pipeline would need to be constructed to accommodate the new WTP. For this option, the proposed intake would be near Max Starcke Dam, and the length of the new raw water pipeline would be approximately 860 ft.

The Marble Falls WTPs capacity would be required to meet a 2040 max demand of 11.87 MGD and average day demand of 5.94 MGD. The existing capacity prior to any new construction would be 3.80 MGD, so in a phased approach, the additional capacity added in Phase 1 (2015) would be 0.66 MGD max, in Phase 2 (2020) would be 1.43 MGD, in Phase 3 (2025) would be 1.80 MGD, in Phase 4 (2030) would be 2.01 MGD, and in Phase 5 (2035) would be 2.17 MGD. The new raw water intake and pump station phased construction would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-8 presents the RW/WTP costs for South Option 1 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-30 presents the O&M costs for South Option 1.

Table 9-30: South Option 1 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$17,900
Chemical ($/mo)	$7,900
Power ($/mo)	$15,800
Maintenance/Spare Parts ($/mo)	$4,200
2015 Total ($/mo)	$45,800
2015 Total ($/yr)	$49,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$17,994,400

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 6.4 percent.

Labor costs include two full-time WTP operators and one full-time mechanical maintenance technician, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-31 presents the estimated chemical usages for South Option 1.

Table 9-31: South Option 1 - Chemical Usages

Chemical	Monthly Usage
Alum	53 gal
NaOCl	61 gal
LAS	18 gal
Fluoride	5 gal
Polymer	3 gal
$K(MnO_4)$	14 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-32 presents the pump heads and criteria used to determine these heads for South Option 1.

Table 9-32: South Option 1 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 2 Firm: 1	1,210	110	45	749	Intake EL = 690 ft WTP EL = 800 ft
Finished water	Total: 4 Firm: 3	405	560	215	3,812	WTP EL = 800 ft High Pt EL = 1360 ft
Internal plant	-	-	-	-	409	10 percent of raw water pumping

The Roth Team estimated transmission system costs at $9.28 million, all of which would be attributable to Blanco San Miguel since the proposed transmission main would only provide service to them under this option. This would be equivalent to about $2,200 per future connection for the assumed 4,220 connections to the Blanco San Miguel system. The transmission system component would add about $1.09 per 1000 gallons to the water rate. Both values are present-worth costs in 2011 dollars.

9.6.9 South Option 2: Southeast Burnet County Regional System

In the analysis for South Option 2, the Roth Team assumed that the existing City of Marble Falls WTP would stay in service and continue to serve Marble Falls, South Road and Hamilton Creek; a new WTP would be constructed to serve the City of Marble Falls, Smithwick Mills, City of Cottonwood Shores, City of Meadowlakes, Capstone Water System, Blanco San Miguel, Quail Creek, Windermere Oaks WSC, Ridge Harbor, and Spicewood Beach. The existing raw water intake location for the City of Marble Falls would still be utilized, and a new raw water intake and pipeline would need to be constructed to accommodate the new WTP. For this option, the proposed intake would be near Max Starcke Dam, and the length of the new raw water pipeline would be approximately 860 ft.

Should this option be implemented, the intakes or wells and water treatment facilities of the City of Cottonwood Shores, Quail Creek, Windermere Oaks WSC, Ridge Harbor, Smithwick Mills and Spicewood Beach systems would be decommissioned, requiring the new system to meet a 2040 max demand of 13.76 MGD and average day demand of 6.88 MGD. The existing capacity prior to any new construction would be 3.80 MGD, so in a phased approach, the additional capacity added in Phase 1 (2015) would be 2.10 MGD max, in Phase 2 (2020) would be 1.53 MGD, in Phase 3 (2025) would be 1.90 MGD, in Phase 4 (2030) would be 2.14 MGD, and in Phase 5 (2035) would be 2.29 MGD. The new raw water intake and pump station phased construction would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-8 presents the RW/WTP costs for South Option 2 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-33 presents the O&M costs for South Option 2.

Table 9-33: South Option 2- O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$23,800
Chemical ($/mo)	$10,800
Power ($/mo)	$14,300
Maintenance/Spare Parts ($/mo)	$4,900
2015 Total ($/mo)	$53,800
2015 Total ($/yr)	$645,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$19,339,100

(1) Present-worth value assumes an effective interest rate of 3.5 percent and annual demand growth rate of 5.7 percent.

Labor costs include two full-time WTP operators and two full-time mechanical maintenance technicians, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-34 presents the estimated chemical usages for South Option 2.

Table 9-34: South Option 2 - Chemical Usages

Chemical	Monthly Usage
Alum	74 gal
NaOCl	84 gal
LAS	25 gal
Fluoride	8 gal
Polymer	4 gal
$K(MnO_4)$	20 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-35 presents the pump heads and criteria used to determine these heads for South Option 2.

Table 9-35: South Option 2 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 3 Firm: 2	840	110	60	1,040	Intake EL = 690 ft WTP EL = 800 ft
Finished water	Total: 5 Firm: 4	420	327	175	3,092	WTP EL = 800 ft High Pt EL = 1127 ft
Internal plant	-	-	-	-	104	10 percent of raw water pumping

The Roth Team estimated South Option 2 transmission system costs at $20.3 million, with the largest portion of the cost for the transmission mains to Blanco San Miguel and then southwest along Highway 71 to the upper Lake Travis participants. Additionally, we assumed that the transmission mains and tank would be constructed in the 2011 to 2015 time frame. After calculating the participation costs for each transmission main segment, per connection costs ranged from $361 for Capstone to $39,737 for Smithwick Mills. Each entity's per connection costs and estimated cost per 1000 gallons are presented below in Table 9-36.

Table 9-36: South Option 2 – Transmission System Costs (PW in 2011 Dollars)

Entity	Connections Served	Cost per Connection	Cost per 1000 gallons
Capstone	136	$361	$0.15
Blanco San Miguel	4220	$2,005	$1.00
Quail Creek	44	$2,898	$0.77
Windermere Oaks	268	$6,898	$1.86
Ridge Harbor	315	$7,695	$2.49
Spicewood Beach	508	$5,009	$1.35
Cottonwood Shores	971	$1,766	$0.56
Smithwick Mills	80	$39,737	$11.05

9.6.10 South Option 3: City of Meadowlakes/City of Marble Falls Interconnect

The City of Meadowlakes WTP has a surplus of water capacity that could be provided to the City of Marble Falls under a contract to offset Marble Falls' capacity deficits and allow for an expansion of the existing WTP and construction of the proposed WTP to be delayed to a later timeframe. However, the total demand for Marble Falls will still require that a new WTP be constructed in order to meet the demands through 2040. This option must then account for an interconnecting pipeline between the two cities (discussed in the transmission section below), as well as a new City of Marble Falls WTP. The existing WTP and raw water intake location for the City of Marble Falls would still be utilized, and a new raw water intake and pipeline would need to be constructed to accommodate the new WTP. For this option, the proposed intake would be near Max Starcke Dam, and the length of the new raw water pipeline would be approximately 860 ft.

Should this option be implemented, the system would be required to meet a 2040 max demand of 9.05 MGD and average day demand of 4.53 MGD. The existing capacity of the City of Meadowlakes and City of Marble Falls WTPs combined (prior to any new construction) is be 5.82 MGD; so in a phased approach, the additional capacity added in Phase 3 (2025) would be 0.78 MGD, in Phase 4 (2030) would be 1.15 MGD, and in Phase 5 (2035) would be 1.30 MGD. The new raw water intake and pump station phased construction would also need to take place at the same timeframes to meet the same max day demands as the WTP. Table 9-8 presents the RW/WTP costs for South Option 3 without distribution system transmission mains, booster pump stations and elevated storage tanks. All costs connected with South Option 3 do not include the costs required to purchase the water under contract from the City of Meadowlakes.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-37 presents the O&M costs for South Option 3.

Table 9-37: South Option 3 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$17,900
Chemical ($/mo)	$9,500
Power ($/mo)	$12,500
Maintenance/Spare Parts ($/mo)	$4,000
2015 Total ($/mo)	$43,900
2015 Total ($/yr)	$526,800
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$11,772,300

(1) Present-worth value assumes an interest rate of 3.5 percent and annual demand growth rate of 3.4 percent.

Labor costs include two full-time WTP operators and two full-time mechanical maintenance technicians, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-38 presents the estimated chemical usages for South Option 3.

Table 9-38: South Option 3 - Chemical Usages

Chemical	Monthly Usage
Alum	64 gal
NaOCl	73 gal
LAS	22 gal
Fluoride	7 gal
Polymer	4 gal
$K(MnO_4)$	17 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-39 presents the pump heads and criteria used to determine these heads for South Option 3.

Table 9-39: South Option 3 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 4 Firm: 3	485	110	55	900	Intake EL = 690 ft WTP EL = 800 ft
Finished water	Total: 4 Firm: 3	485	327	150	2,675	WTP EL = 800 ft EST EL = 1127 ft overflow
Internal plant	-	-	-	-	90.0	10 percent of raw water pumping

The estimated present-worth cost of an 8-inch interconnecting transmission system is $208,000, all of which would be attributable to the City of Marble Falls. The 8-inch line, together with the excess plant capacity of 1.0 MGD, would be capable of serving about 1,165 new connections in Marble Falls (or to entities which would receive treated water from Marble Falls). Thus, the transmission main costs would be equivalent to about $178 per connection for those additional 1,165 connections to the Marble Falls system; the cost of water delivered to those connections is estimated at $0.09 per 1000 gallons.

9.6.11 South Option 4: City of Granite Shoals/City of Highland Haven

In the analysis for South Option 4, we assumed that the existing City of Highland Haven wells would continue to be used, and the City of Granite Shoals WTP would stay in service and be expanded to serve the City of Granite Shoals; an interconnect from Granite Shoals to Highland Haven would be constructed for emergency water needs. The existing raw water intake location for the City of Granite Shoals would still be utilized; however, the raw water pump station would need to be expanded to accommodate the new max day demands. The existing 16-inch, approximately 1,000-foot long raw water pipeline is large enough to accommodate the 2040 max daily demand, while maintaining an approximate 4 fps velocity, so a new pipeline is not included in the costs.

The expanded Granite Shoals WTP would be required to meet a 2040 max demand of 3.18 MGD and average day demand of 1.59 MGD. The existing capacity of the City of Granite Shoals WTP (prior to any new construction) is 3.07 MGD; so in a phased approach, the additional capacity added in Phase 5 (2035) would be 0.11 MGD. Upgrades to the raw water pump station would also need to take place at the same timeframe to meet the same max day demands as the WTP. Table 9-8 presents the RW/WTP costs for South Option 4 without distribution system transmission mains, booster pump stations and elevated storage tanks.

O&M costs for 2015 are based on the analysis outlined in Section 9.4. Maintenance and spare parts are assumed to be 10 percent of the total labor, chemical and power costs. Table 9-40 presents the O&M costs for South Option 4.

Table 9-40: South Option 4 - O&M Costs

Item	O&M Costs
Labor - WTP Operator and Mechanical Maintenance Technician ($/mo)	$17,900
Chemical ($/mo)	$4,600
Power ($/mo)	$3,200
Maintenance/Spare Parts ($/mo)	$2,600
2015 Total ($/mo)	$28,300
2015 Total ($/yr)	$339,600
Total 2011 Present Worth of O&M Costs for 2015-2040 (1)	$6,449,600

(1) Present-worth value assumes an interest rate of 3.5 percent and annual demand growth rate of 2.0 percent.

Labor costs include two full-time WTP operators and one full-time mechanical maintenance technician, as determined using Table 9-5. We calculated chemical costs based on average daily flows in 2015 and average dosages presented in Table 9-6. Table 9-41 presents the estimated chemical usages for South Option 4.

Table 9-41: South Option 4 - Chemical Usages

Chemical	Monthly Usage
Alum	30 gal
NaOCl	34 gal
LAS	10 gal
Fluoride	3 gal
Polymer	2 gal
$K(MnO_4)$	8 lb

The greatest source of power consumption from a water treatment standpoint is the electricity required for pumping. Our analysis considered raw water, internal plant and finished water pumping. Table 9-42 presents the pump heads and criteria used to determine these heads for South Option 4.

Table 9-42: South Option 4 - Pumping Criteria

Pumping Type	Number of pumps	Pump Capacity (GPM)	Pump Head (ft)	Hp	Kilowatt Hours per Day	Assumptions
Raw water	Total: 2 Firm: 1	680	160	35	609	Intake EL = 690 ft WTP EL = 850 ft
Finished water	Total: 3 Firm: 2	340	60	20	228	WTP EL = 850 ft High Pt EL = 910 ft
Internal plant	-	-	-	-	60.9	10 percent of raw water pumping

The estimated present-worth cost of a 6-inch interconnecting transmission system is $1,000,000 all of which would be attributable to the City of Highland Haven. The 6-inch line would be built in the 2011 to 2015 time frame and would be capable of meeting the maximum day demands of Highland Haven's existing and future connections out to 2040 (approximately 440 connections in all). The transmission main costs would be equivalent to about $2,283 per existing and future connection (for the interconnecting transmission main component); the cost of water delivered to those connections is estimated at $0.52 per 1000 gallons.

9.7 Evaluation of Regional Options for Each Participant

Most of the participants in this study have been included in one or more regional options. In this section, the cost associated with participating in the regional options are presented and evaluated. Table 9-43 presents the economic evaluation for each entity for each option, which can be used to rank the options and help select the best option for each entity.

In addition to the regional options presented in this report, each entity also has the option of continuing to develop its water supply needs independently of other systems. While the scope of the study did not allow for the preparation of a "stand-alone" option for each participant, preliminary stand-alone options were developed for a few of the participants in order for those entities to more clearly judge the benefits and costs of participating in a regional system. These cases will be mentioned in the discussion that follows.

9.7.1 Entities Using Hickory Aquifer Groundwater

For entities using groundwater located in the Hickory aquifer, a treatment process will have to be used in order for these systems to meet state and federal regulations. A study for Council Creek Village, *TCEQ Draft Feasibility Analysis of Water Supply for Small Public Water Systems (August 2010),* was used as the basis for treatment alternatives in this area. From this analysis, it appears that this treatment process can be far less economical than using conventional water treatment processes. The Roth Team recommends evaluating both the use of reverse osmosis (RO) technology, since it is a proven technology, as well as the WRT Z-88 technology proposed in the TCEQ report for Council Creek Village.

When using RO technology, O&M costs tend to be much higher than other processes due to the higher feed pressures required and concentrate disposal (i.e., transportation costs, hazardous landfill fees, etc). Based on the TCEQ report for Council Creek Village, capital costs for an RO system for were approximately $7.00 to 8.00 per GPD of capacity. Additionally, typical O&M costs for RO systems are $0.50-$0.65 per 1,000 gallons treated water; however, this cost does not include the cost for disposal of the waste stream, which makes the cost of RO much higher than conventional treatment.

Table 9-43: Summary of Project Costs by Option and Entity (1)

Northern Region	Option 1 Treatment ($/1000 gal)	Option 1 Transmission ($/1000 gal)	Option 1 Total ($/1000 gal)	Option 2A Treatment ($/1000 gal)	Option 2A Transmission ($/1000 gal)	Option 2A Total ($/1000 gal)	Option 2B Treatment ($/1000 gal)	Option 2B Transmission ($/1000 gal)	Option 2B Total ($/1000 gal)	Option 3 Treatment ($/1000 gal)	Option 3 Transmission ($/1000 gal)	Option 3 Total ($/1000 gal)	Option 4 Treatment ($/1000 gal)	Option 4 Transmission ($/1000 gal)	Option 4 Total ($/1000 gal)
Tow Village	$20.80	$0.54	$21.34	-	-	-	-	-		-	-	-	-	-	-
Fall Creek Vineyards	$20.80		$20.80	-	-	-	-	-		-	-	-	-	-	-
Paradise Point	-	-	-	$1.87	$3.64	$5.51	$1.95	$4.07	$6.02	-	-	-	$1.07	$4.74	$5.81
Burnet Co. MUD No. 2	-	-	-	$1.87	$0.57	$2.44	$1.95	$1.51	$3.46	-	-	-	$1.07	$2.89	$3.96
South Silver Creek (I, II, III)	-	-	-	$1.87	$0.21	$2.08	$1.95	$0.81	$2.76	-	-	-	$1.07	$1.50	$2.57
Bonanza Beach	-	-	-	$1.87	$0.03	$1.90	$1.95	$0.67	$2.62	-	-	-	$1.07	$1.38	$2.45
Council Creek Village	-	-	-	$1.87	$2.96	$4.83	$1.95	$0.21	$2.16	-	-	-	$1.07	$0.89	$1.96
Cassie Subdivision	-	-	-	-	-	-	-	-	-	$0.98	$1.72	$2.70	$1.07	$1.71	$2.78
Buena Vista Water System	-	-	-	-	-	-	-	-	-	$0.98	$0.64	$1.62	$1.07	$0.64	$1.71
City of Burnet	-	-	-	-	-	-	-	-	-	$0.98	$1.30	$2.28	$1.07	$0.88	$1.95
City of Bertram	-	-	-	-	-	-	-	-	-	$0.98	$3.88	$4.86	$1.07	$3.38	$4.45
NE Lake Buchanan Develop.	-	-	-	$1.87	$0.59	$2.46	$1.95	$1.44	$3.39	-	-	-	$1.07	$2.50	$3.57
Whitewater Springs	-	-	-	-	-	-	-	-	-	-	-	-	$1.07	$9.49	$10.56

Southern Region	Option 1 Treatment ($/1000 gal)	Option 1 Transmission ($/1000 gal)	Option 1 Total ($/1000 gal)	Option 2 Treatment ($/1000 gal)	Option 2 Transmission ($/1000 gal)	Option 2 Total ($/1000 gal)	Option 3 Treatment ($/1000 gal)	Option 3 Transmission ($/1000 gal)	Option 3 Total ($/1000 gal)	Option 4 Treatment ($/1000 gal)	Option 4 Transmission ($/1000 gal)	Option 4 Total ($/1000 gal)
City of Highland Haven	-	-	-	-	-	-	-	-	-	$0.56	$0.62	$1.18
City of Granite Shoals	-	-	-	-	-	-	-	-	-	$0.52	$0.00	$0.52
City of Meadowlakes	-	-	-	-	-	-	$0.60	$0.00	$0.60	-	-	-
City of Cottonwood Shores	-	-	-	$1.14	$0.56	$1.70	-	-	-	-	-	-
City of Marble Falls(2)	$1.18	$0.00	$1.18	$1.14	$0.00	$1.14	$0.60	$0.09	$0.69	-	-	-
Hamilton Creek	$1.18	$0.00	$1.18	$1.14	$0.00	$1.14	$0.60	$0.00	$0.60	-	-	-
South Road	$1.18	$0.00	$1.18	$1.14	$0.00	$1.14	$0.60	$0.00	$0.60	-	-	-
Capstone Water System	-	-	-	$1.14	$0.15	$1.29	-	-	-	-	-	-
Quail Creek	-	-	-	$1.14	$0.77	$1.91	-	-	-	-	-	-
Blanco San Miguel	$1.18	$1.09	$2.27	$1.14	$1.00	$2.14	-	-	-	-	-	-
Smithwick Mills	-	-	-	$1.14	$11.05	$12.19	-	-	-	-	-	-
Spicewood Beach	-	-	-	$1.14	$1.35	$2.49	-	-	-	-	-	-
Ridge Harbor	-	-	-	$1.14	$2.49	$3.63	-	-	-	-	-	-
Windermere Oaks WSC	-	-	-	$1.14	$1.86	$3.00	-	-	-	-	-	-

(1) Costs ($/1000 gallons) were calculated by dividing the present-worth (PW) costs attributible to each entity by the projected average annual volume of treated water delivered to that entity over the period that infrastructure would be operational (Y 2015 to Y 2040).

(2) Does not include costs of contract to purchase water from the City of Meadowlakes.

Based on this analysis, it appears that any entities using this water source – Bonanza Beach, South Silver Creek (I, II, III) and Council Creek Village – would be better served using surface water. This can be accomplished through one of the Northern Regional options presented in this report.

9.7.2 City of Cottonwood Shores

Due to the current condition of the Cottonwood Shores WTP, the City would need to evaluate whether they wanted to participate in a regional option or possibly construct a new treatment facility. The cost of constructing a new facility to meet the City's 2040 max day demand - including water treatment, intake, raw water piping and O&M through 2040 – is presented below in Table 9-44. This cost estimate should be compared to the costs presented in Table 9-43 for South Option 2.

Table 9-44: Cottonwood Shores Stand-Alone Option Economic Analysis

Capital Costs	
RWPS/Intake	$168,000
RW Pipe	$108,000
WTP/Distribution Pump Station	$3,080,000
Professional Services (20%)	$671,200
Contingency (15%)	$503,400
Phase Capital Cost Totals	$4,530,600
2011 Present Worth of Capital Costs	$3,464,800
2011 Present Worth of O&M Costs	$2,939,900
Total 2011 Present Worth Cost	**$6,404,700**
Total Avg Day Demand, 2015-2040 (MG)	**3,139**
Total Present Worth Cost/1,000 Gals	**$2.04**

Notes:
1) O&M costs included complete system operating costs, operating at average daily demand.
2) Land acquisition and easement costs are not included.
3) Assumes 3.5 percent effective interest rate.

9.7.3 Cities of Burnet and Marble Falls

In both the northern and southern areas, the water systems of the Cities of Burnet and Marble Falls would serve as the core of several of the regional options being considered. These two cities will have to consider the impacts on their systems before taking on these roles. A detailed analysis is beyond the scope of this project, but it is certain that the Cities of Burnet and Marble Falls will benefit from economies of scale both in the construction of new intake and treatment facilities and in the operation and maintenance of these facilities. It is anticipated that the cost per 1000 gallons for treatment, and in Burnet's case for transmission as well, will be lower than if these cities chose not to participate in a regional system.

9.7.4 Buena Vista Water System

Due to the current condition of the Buena Vista WTP, whether or not the entity decides to pursue a regional option, a new facility would need to be constructed soon. Designed for 2040 max day demand, the cost of a new facility, including water treatment, intake, raw water piping and O&M through 2040, is presented below in Table 9-45. This cost estimate should be compared to the costs presented in Table 9-43 for North Options 3 and 4.

Table 9-45: Buena Vista Stand-Alone Option Economic Analysis

Capital Costs	
RWPS/Intake	$68,000
RW Pipe	$64,800
WTP/Distribution Pump Station	$1,360,000
Professional Services (20%)	$298,560
Contingency (15%)	$223,920
Phase Capital Cost Totals	$2,015,280
2011 Present Worth of Capital Costs	$1,584,000
2011 Present Worth of O&M Costs	$2,939,900
Total 2011 Present Worth Cost	**$4,523,900**
Total Avg Day Demand, 2015-2040 (MG)	**$1,305**
Total Present Worth Cost/1,000 Gals	**$3.47**

Notes:
1) O&M costs included complete system operating costs, operating at average daily demand.
2) Land acquisition and easement costs are not included.
3) Assumes 3.5 percent effective interest rate.

9.7.5 City of Bertram

The City of Bertram is also considering developing well fields northwest of Bertram. In discussions with City representatives and with Richard Bowers at the Central Texas Groundwater Conservation District, there appear to be possibilities of drilling and developing 60 GPM wells about 5 to 10 miles from Bertram. Assuming these wells would be in the 900-foot depth range, the drilling and development of these wells and the transmission mains required to transport this water to Bertram would cost about $8.3 million if the wells are about 10 miles from Bertram. Assuming the wells are drilled and developed as demands increase out to 2040, the projects would have a present worth of $6.4 million and the estimated cost per 1000 gallons would be $1.99. This does not include payments to the landowners for the purchase of groundwater.

If the wells can be developed five miles from Bertram, the same projects would have a present worth of $3.8 million and the estimated cost per 1000 gallons would be $1.18 (for all future connections). However, the evidence today suggests that it is unlikely that wells drilled within five miles of Bertram would produce in the range of 60 GPM. Wells in the Whitewater Springs area are only producing 25 GPM. Lower production wells would quickly drive the project costs up as wells would cost about $180,000 each, and there would be additional branch lines to collect the groundwater from each well. Since North Options 3 and 4 have costs of $3.04 to $3.29 per 1000 gallons, a stand-alone groundwater option appears to be more economical, provided that high production wells can be developed.

10.0 POTENTIAL FUNDING SOURCES

Funding sources for the Burnet-Llano County Regional Water System are dependent on the selected alternative and financial viability of each political entity within the study area. Also, the type of funding source selected to finance the engineering design and construction costs will depend on the organizational structure of the entity that owns and operates the regional system.

A number of potential funding sources exist for rural utilities, which typically provide service to less than 50,000 people. Both state and federal agencies offer grant and loan programs to assist rural communities in meeting their infrastructure needs. Most are available to "political subdivisions" such as counties, municipalities, school districts, special districts, or authorities of the state with some programs providing access to private individuals.

Grant funds are typically available to those entities that demonstrate financial need based on a median household income (MHI) value below 75 to 80 percent of the State's MHI value. The funds may be used for planning, design, and construction of water and wastewater construction projects. Some funds may be used to finance the consolidation or regionalization of neighboring water and wastewater utilities. Three Texas agencies that offer financial assistance for water and wastewater infrastructure are:

- **Texas Water Development Board (TWDB)** has several programs that offer loans at interest rates lower than the market offers to finance projects for public water and wastewater systems that facilitate compliance with state and federal regulations. Additional subsidies may be available for disadvantaged communities. Low interest rate loans with short and long-term finance options at tax exempt rates for water and wastewater projects give an added benefit by making construction purchases qualify for a sales tax exemption. Generally, the program targets customers with eligible water and wastewater projects for all political subdivisions of the state (at tax exempt rates).
- **Texas Department of Rural Affairs (TDRA, formerly ORCA)** is a Texas state agency with a focus on rural Texas by making state and federal resources accessible to rural communities. Funds from the U.S. Department of Housing and Urban Development Community Development Block Grants (CDBG) are administered by TDRA for small, rural communities with populations less than 50,000 that cannot directly receive federal grants. These communities are known as non-entitlement areas. One of the program objectives is to meet a need having a particular urgency, which represents an immediate threat to the health and safety of residents, principally for low- and moderate-income persons. At this time, the programs may be changing since the legislative session; the agency will become the Office of Rural Affairs at the Texas Department of Agriculture during the fall of 2011.
- **U.S. Department of Agriculture Rural Development Texas (Texas Rural Development)** coordinates federal assistance to rural Texas to help rural Americans improve their quality of life. The Rural Utilities Service (RUS) programs provide funding for water and wastewater disposal systems. The application process, eligibility requirements, and funding structure vary for each of these programs. There are many conditions that must be considered by each agency to determine eligibility and ranking of projects. The principal factors that affect this choice are population, percent of the population under the State MHI, health concerns, compliance with standards, Colonia status, and compatibility with regional and state plans.

In addition to Federal and State water/wastewater programs, funding sources may also originate from revenue bonds and developer participation towards the regional infrastructure of the system. An overview of all of these financing mechanisms is presented below.

10.1 Federal and State Infrastructure Programs

There are a variety of funding programs available to entities through Federal and State infrastructure programs. Depending on the type of organization that owns the proposed regional water facilities, funding is most likely to be obtained from programs administered by the TWDB, TDRA and/or USDA Rural Development. Information required by these agencies for initial applications may include financial analyses, records demonstrating health concerns, failing infrastructure, and financial need.

10.1.1 <u>TWDB Funding Options</u>

The programs offered by the TWDB include the Drinking Water State Revolving Fund (DWSRF), State Loan Program (Development Fund II), State Participation Fund, and Economically Distressed Areas Program (EDAP).

Drinking Water State Revolving Fund

The Drinking Water State Revolving Fund (DWSRF) provides loans at interest rates lower than the market to political subdivisions with the authority to own and operate a water system. The DWSRF also includes Disadvantaged Communities funds that provide even lower interest rates for those meeting the respective criteria.

The DWSRF offers fixed and variable rate loans at subsidized interest rates. The maximum repayment period for a DWSRF loan is 20 years from the completion of project construction. A cost-recovery loan origination charge of 1.85% is imposed to cover administrative costs of operating the DWSRF; however, an additional interest rate subsidy is offered to those financing the origination charge.

TWDB accepts Project Information Forms (PIFs) from prospective loan applicants to be included on the DWSRF Intended Use Plan (IUP) during the early part of each year. The Project Information Form describes the applicant's existing wastewater facilities, facility needs, the nature of the project being considered and project cost estimates. This information is used to rate each proposed project and place them in priority order on the IUP. Applicants eligible for funding through the DWSRF program are notified during the summer to attend a pre-application meeting and submit an application for financial assistance. Funds would be available the following year after previously submitting the Project Information Form.

State Loan Program (Development Fund II)

The State Loan Program is a diverse lending program directly from state funding sources. As it does not receive federal subsidies, it is more streamlined. The loans can incorporate more than one project under the umbrella of one loan. Political subdivisions of the state are eligible for tax exempt rates. Projects can include purchase of treatment plants, pumping facilities, lift stations, collection lines, and acquisitions. The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years, and the average financing period is approximately 20 years. The lending rate scale varies according to several factors, but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales.

The application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, and project information. The TWDB considers the needs of the area; benefits of the project; the relationship of the project to the overall state water needs and the State Water Plan; and the availability of all sources of revenue to the rural utility for the ultimate repayment of the loan. The board considers applications on a monthly basis.

Economically Distressed Areas Program

The EDAP Program was originally designed to assist areas along the U.S./Mexico border in areas that were economically distressed. In 2008, this program was extended to apply to the entire state so long as requirements are met. This program provides financial assistance through the provision of grants and loans to communities where present facilities are inadequate to meet resident's minimal needs. Eligible communities are those that have median household income less than 75 percent of the state household income.

The county where the project is located must adopt model rules for the regulation of subdivisions prior to application for financial assistance. If the applicant is a city, the city must also adopt Model Subdivision Rules of TWDB (31 TAC Chapter 364). The program funds design, construction, improvements, and acquisition, and includes measures to prevent future substandard development. The TWDB works with the applicant to find ways to leverage other state and federal financial resources. The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years, and the average financing period is 20 years. The lending rate scale varies according to several factors, but it is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal loss to the state. Most projects have a financial package with the majority of the project financed with grants; many recipients have received 100 percent grant funds.

10.1.2 TDRA Funding Options

The Texas Department of Rural Affairs (TDRA, previously ORCA) seeks to strengthen rural communities and assist them with community and economic development and healthcare by providing a variety of rural programs, services, and activities. Of their many programs and funds, the most appropriate programs related to drinking water are the Community Development (CD) Fund and Texas Small Towns Environment Program (STEP). These programs offer attractive funding packages to help make improvements to wastewater systems to mitigate potential health concerns.

Community Development Fund

The CD Fund is a competitive grant program for water and wastewater system improvements. Funds are distributed between 24 state planning regions where funds are allocated to address each region's utility priorities. Funds can be used for various types of public works projects, including wastewater system improvements. Cities with a population of less than 50,000 that are not eligible for direct CDBG funding from the U.S. Department of Housing and Urban Development are eligible. Funds are awarded on a competitive basis decided twice a year by regional review committees. Awards are no less than $75,000 and cannot exceed $800,000.

Texas Small Towns Environment Program

Under special occasions some communities are invited to participate in grant programs when self-help is a feasible method for completing a wastewater project, the community is committed to self-help, and the community has the capacity to complete the project. The purpose is to significantly reduce the cost of the project by using the communities' own human, material, and financial capital. Projects typically are repair, rehabilitation, improvements, service connections, and yard services. Reasonable associated administration and engineering cost can be funded. A letter of interest is first submitted, and after CDBG staff determines eligibility, an application may be submitted. Awards are only given twice per year on a priority basis so long as the project can be fully funded ($350,000 maximum award). Ranking criteria are project impact, local effort, past performance, percent of savings, and benefit to low to medium-income persons.

10.1.3 <u>USDA Rural Development Funding Options</u>

USDA Rural Development established a Revolving Fund Program (RFP) administered by the staff of the Water and Environment Program (WEP) to assist communities with water and wastewater systems. The purpose is to fund technical assistance and projects to help communities bring safe drinking water and sanitary, environmentally sound, waste disposal facilities to rural Americans in greatest need. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns with a population of 10,000 or less. Recipients must be public entities such as municipalities, counties, special purpose districts, Indian tribes, and corporations not operated for profit. Projects include all forms of infrastructure improvement, acquisition of land and water rights, and design fees. A request for a combination of grants and loans vary on a case by case basis, and some communities may have to wait though several funding cycles until funds become available.

Water and Wastewater Disposal Program

The major components of the RFP are loan, loan guarantees, and grant funding for water and waste disposal systems. Entities must demonstrate that they cannot obtain reasonable loans at market rates, but have the capacity to repay loans, pledge security, and operate the facilities. Grants can be up to 75 percent of the project costs, and loan guarantees can be up to 90 percent of eligible loss. Loans are not to exceed a 40-year repayment period, require tax or revenue pledges, and are offered at three rates:

- ***Poverty Rate*** - The lowest rate is the poverty interest rate of 4.5 percent. Loans must be used to upgrade or construct new facilities to meet health standards, and the MHI in the service area must be below the poverty line for a family of four or below 80 percent of the statewide MHI for non-metropolitan communities.
- ***Market Rate*** – Where the MHI in the service exceeds the state MHI, the rate is based on the average of the “Bond Buyer” 11-Bond Index over a four week period.
- ***Intermediate Rate*** – the average of the Poverty Rate and the Market Rate, but not to exceed seven percent.

10.2 Revenue Bonds

In addition to Federal and State water programs, a water utility may pledge future earnings to fund improvements to their water system through the issuance of revenue bonds. A revenue bond is a special type of municipal bond, and the income generated by the improvement or expansion of the water project would be used for repayment. Unlike general obligation bonds, only the revenues specified in the legal contract between the bond holder and bond issuer are required to be used for repayment of the principal and interest of the revenue bonds. Since the pledge of security is not as great as that of general obligation (G.O.) bonds, revenue bonds may carry a slightly higher interest rate than G.O. bonds.

10.3 Developer Participation

Developer participation typically occurs through two means: upfront capital contributions or payment of impact fees for a water/wastewater infrastructure project. Under a regional system where several political subdivisions are participating, a single independent organization or entity is recommended to manage and/or operate the regional system, such as a river authority or regional utility authority. River authorities, a regional utility authority, or other similar entities may require a developer to completely finance the entire cost of an infrastructure project and then turn it over to the utility to own and operate on their behalf. A utility may also require a developer to pledge capital towards an infrastructure project through an upfront cash payment or a letter of credit for the utility to drawdown on if needed to reduce the level of risk on the project.

The utility may also require that developers contribute toward the cost of new water/wastewater infrastructure through the payment of impact fees. The intent of this funding source is that the cost of new infrastructure serving new utility customers will not be subsidized by the existing utility rate payers. In essence, growth pays for growth.

11.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the results of this study indicate various findings to initiate a regional water system in the northern and southern regions of Burnet and Llano Counties. A brief summary for each of the regions are presented below.

11.1 Northern Region

Four regional options were identified in the northern part of the study area. These options included an evaluation of existing and new water treatment facilities, transmission mains and potential intake sites. In the northern region, the City of Burnet water treatment plant is the only water treatment plant that the Roth Team recommends expanding. Also, the Roth Team recommends the following intake locations in the northern region:

- Expand the City of Burnet intake structure on Inks Lake; and,
- Construct a new intake structure on the north-east side of Lake Buchanan.

These two options provide a reliable water source that satisfy water quality and regulatory requirements as well as provide cost effective alternatives. A summary of the northern regional options are detailed in Figures 6-5 through 6-9 in Section 6.4.1; reference Appendix E for an overview map of all the northern regional alternatives.

Northwest Lake Buchanan Entities

In conclusion, North Option 1 is the most expensive option, which results in a treatment cost approximately 10 times the treatment cost component of all the other options in this region. This treatment cost is over $20 per 1000 gallons for both entities involved, Tow Village and Fall Creek Vineyards. Unfortunately, Tow Village and Fall Creek Vineyards are located in a remote area from the other entities, which makes transmission main costs prohibitive in one of the other options. Although located adjacent to Lake Buchanan, Tow Village and Fall Creek Vineyards are at the very upstream end of the lake where the lake is shallow. Thus, surface water would not be a reliable source of water in times of drought. We understand that LCRA previously considered the options that were evaluated in the TCEQ study for Council Creek Village, *TCEQ Draft Feasibility Analysis of Water Supply for Small Public Water Systems (August 2010)*; however, TCEQ agreed that the options presented were not economically feasible for Tow Village. Participation in a regional system may become feasible and more cost-effective when additional developments occur on the northwest side of Lake Buchanan.

Northeast Lake Buchanan Entities

The entities located on the northeast side of Lake Buchanan have three regional options to consider: North Options 2A, 2B and 4. The costs to implement these options range between $1.90 and $3.96 per 1000 gallons, with some exceptions. One exception is Paradise Point, where the combination of being a small entity at the end of the regional transmission main and having to pay for the full cost of constructing a pipeline across the bottom of Lake Buchanan, results in costs exceeding $5.50 per 1000 gallons in all three options. North Option 2A offers the lowest costs to all the entities, except for service to Council Creek, where costs are estimated at $4.83 per 1000 gallons for North Option 2A but are estimated at $2.16 per 1000 gallons for North Option 2B and $1.96 per 1000 gallons for North Option 4. Thus, for all entities except Council Creek, North Option 2A offers the lowest cost; however, an intake located in the vicinity of Bonanza Beach is not as deep as having an intake southwest of Council Creek Village. In North Option 2B, the raw water intake and pump station would be located in a relatively undeveloped part of the lake's eastern shore that offers access to an even deeper part of the lake.

North Option 4 appears the most favorable alternative, especially since it does not require the development of a new intake site and water treatment facility. Although this option is less expensive than North Option 2B, it is more expensive than North Option 2A. Thus, if the City of Burnet is interested in participating in a regional system within a similar timeframe as the proposed developments along FM-2341, then those entities on the northeast side of Lake Buchanan may want to jointly pursue a regional system with the City of Burnet. Otherwise, constructing a smaller regional system based on a deeper intake located southwest of Council Creek (North Option 2B intake site) would provide additional reliability at a cost approximately 35% to 41% higher compared to the Option 2A intake location.

City of Bertram

North Options 3 and 4 offer the City of Bertram an alternative long-range plan to continuing its reliance on groundwater alone. Bertram's costs in both options range between $4.45 and $4.86 per 1000 gallons. Although these costs are higher than the costs for many of the other entities in the northern region, they may not be that much higher than the costs that Bertram may encounter in a stand-alone groundwater plan.

As noted in Chapter 9, the costs associated with developing new well fields approximately 10 miles from Bertram would result in costs of about $2.00 per 1000 gallons, not including O&M costs, easement costs, and payments to landowners for their groundwater resources. Under the stand-alone option, the City of Bertram would face the challenge of finding suitable well sites on land owned by individuals who would be willing to part with their groundwater resources. Thus, even though the Option 3 and 4 costs appear somewhat high, the Roth team recommends that the City of Bertram consider these options in addition to the stand-alone groundwater option, at least until sufficient groundwater resources can be identified and acquired.

Whitewater Springs

Whitewater Springs was included only in North Option 4 of the regional options. The cost for this water system to participate in that option would be quite expensive at $10.56 per 1000 gallons, which is primarily due to the transmission main costs. The Roth Team does not recommend this option and is in agreement with Whitewater's current efforts to develop additional groundwater resources.

City of Burnet

The City of Burnet’s water system serves as the core of several of the regional options being considered in the northern area. Burnet would benefit from the economies of scale if they participated in a regional system. It is anticipated that the cost per 1000 gallons for treatment, and in Burnet's case for transmission as well, will be lower than if the City chose not to participate in a regional system; the larger the regional system with more customer connections, the greater Burnet would benefit. For example, Burnet's costs under North Option 4 would be approximately $0.33 less per 1000 gallons compared with North Option 3.

11.2 Southern Region

Four regional options were selected for evaluation in the southern part of the study area. These options included an evaluation of existing and new water treatment facilities, transmission mains and potential intake sites. In the southern region, the City of Marble Falls water treatment plant is the only water treatment plant that the Roth Team recommends expanding in addition to a minimal expansion of the Granite Shoals water treatment plant. Also, the Roth Team recommends the following key infrastructure for the southern region:

- Construct a new intake structure on Lake Marble Falls upstream of Max Starcke Dam; and,
- Construct a new Marble Falls water treatment plant near the Max Starcke Dam and the new intake site.

The southern regional options are shown in Figures 6.10 through 6.14 in Section 6.4.2. Reference Appendix F for an overview map of all the southern regional alternatives.

Southeast Burnet County Regional System

South Options 1 and 2 are both based on the City of Marble Falls' plan to construct a new raw water intake and pump station and new water treatment plant upstream of the Max Starcke Dam, southeast of the City. Both options include water transmission facilities to deliver water to the Highway 71 area south of Marble Falls and east of Highway 281. These facilities would include a water transmission main, intermediate elevated storage tank and booster pump station.

South Option 1 would serve Blanco San Miguel, whereas South Option 2 provides service to participant entities located southeast along Highway 71 and along the upper parts of Lake Travis. Service to the City of Cottonwood Shores and to Smithwick Mills, via other parts of the Marble Falls distribution system, is also included in South Option 2. Like the City of Burnet in the north, the City of Marble Falls would benefit from the economies of scale that could be achieved under either South Option 1 or 2.

South Option 2 could provide Quail Creek with reasonably priced water ($1.91 per 1000 gallons), but the cost for the entities along Lake Travis (Spicewood Beach, Ridge Harbor, and Windermere Oaks) would be in the range of $2.49 to $3.63 per 1000 gallons. However, this is likely the most favorable option of obtaining a reliable water source that could provide water during drought conditions. Thus, these entities will need to consider if they are willing to pay the additional cost for the increased reliability of water.

Similar to Whitewater Springs in the north, Smithwick Mills is located at such a distance from other entities that participation in a regional system does not appear economical at $12.19 per 1000 gallons. Since Smithwick Mill's surface water and existing wells may not be reliable during times of drought, Smithwick Mills may want to explore a groundwater stand-alone option until additional development occurs along FM 1431 east of Marble Falls; thereby, allowing for more participation from other developments for the extension of a transmission main from the City of Marble Falls.

Under both South Options 1 and 2, Blanco San Miguel's cost to receive treated water would be less than $2.30 per 1000 gallons. As expected, the more entities located east along Highway 71 and Lake Travis that participate in a regional system, the lower the cost would be for the Blanco San Miguel development. Although a stand-alone cost was not included in the scope of this project, it is doubtful that Blanco San Miguel could obtain reliable water on its own for less than the cost of South Option 1 or 2.

Cities of Marble Falls and Meadowlakes Interconnect

South Option 3 proposes an interconnection between the Cities of Meadowlakes and Marble Falls, which would allow the City of Marble Falls to purchase treated water from the City of Meadowlakes. The City of Marble Falls might want to pursue an agreement with the City of Meadowlakes to purchase treated water on a wholesale basis. This would allow the region to make use of unused treatment capacity at Meadowlakes and would provide Marble Falls additional time to develop additional treatment capacity at its existing and/or future plant.

Cities of Granite Shoals and Highland Haven Interconnect

In South Option 4, a similar arrangement would allow the City of Granite Shoals system to supply treated water to the City of Highland Haven. The City of Highland Haven might want to pursue a plan to obtain an emergency interconnection with the nearby City of Granite Shoals; however, the Roth Team also recommends that Highland Haven consider the interconnection as a long-term treated water source. Since Granite Shoals' system is much larger and anticipates future expansions, Highland Haven may gain a cost savings from the economies of scale by eventually purchasing treated water from Granite Shoals.

APPENDIX A

*Reference large scale map for this appendix.

APPENDIX B

*Reference large scale map for this appendix.

APPENDIX C

*Reference large scale map for this appendix.

APPENDIX D

Burnet-Llano County Regional Water Facility Study
Population Projections for Entities (TWDB Approved)

Entity	Annual Growth Projected by Entity	POPULATION 2010	2015	2020	2025	2030	2035	2040
Burnet County								
TWDB Projections (2011 Region K Water Plan)	2.4%	47160	54176	61191	69662	78133	86425	94716
Comprehensive Trans Plan Projections	3.5%	47300	55500	64700	74500	84500	94400	104000
Llano County								
TWDB Projections (2011 Region K Water Plan)	0.4%	21284	22146	23007	23239	23471	23702	23932
City of Bertram								
TWDB Projection (within existing city limits)	2.2%	1430	1645	1859	2093	2327	2554	2781
City's Projections for existing city limits	4.0%	1400	1703	2072	2521	3068	3732	4541
Proposed Developments within ETJ & outside city limits								
-- Campo Colinas		15	58	88	118	150	150	150
-- Headwaters of San Gabriel Subdivision								
Sum for City of Bertram Area	4.1%	1415	1761	2160	2639	3218	3882	4691
City of Burnet								
TWDB Projection (within existing city limits)	2.2%	6358	7311	8263	9302	10341	11351	12360
City's Projections for existing city limits	3.3%	5987	7042	8283	9743	11461	13481	15857
Proposed Developments within ETJ & outside city limits		683	995	1308	1620	2245	2460	2460
-- Eagle's Nest								
-- Delaware Springs								
-- Ranch at Delaware Creek								
-- East Side Commercial Park								
-- Rancho Viejo (Section 1)								
Sum for City of Burnet Area	3.4%	6670	8037	9591	11363	13706	15941	18317
City of Cottonwood Shores								
TWDB Projection (within existing city limits)	5.3%	1229	1907	2585	3345	4105	4968	5830
City's Projections for existing city limits	2.0%	1340	1479	1633	1803	1991	2198	2427
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Cottonwood Shores Area	2.0%	1340	1479	1633	1803	1991	2198	2427
City of Granite Shoals								
TWDB Projection (within existing city limits)	2.2%	2738	3149	3559	4007	4454	4889	5324
City's Projections for existing city limits	2.0%	5080	5609	6192	6837	7549	8334	9202
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Granite Shoals Area	2.0%	5080	5609	6192	6837	7549	8334	9202

		POPULATION						
Entity	Annual Growth Projected by Entity	2010	2015	2020	2025	2030	2035	2040
City of Highland Haven								
City's Projections for existing city limits	1.5%	720	776	836	900	920	920	920
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Highland Haven Area		720	776	836	900	920	920	920
City of Marble Falls								
TWDB Projection (within existing city limits)	2.2%	7796	8964	10132	11406	12679	13917	15155
City's Projections for existing city limits	3.2%	6077	7114	8327	9747	11410	13356	15634
Proposed Developments within ETJ								
-- Flatrock Springs		0	125	375	875	1375	2125	2875
Sum for City of Marble Falls	3.8%	6077	7239	8702	10622	12785	15481	18509
City of Meadowlakes								
TWDB Projection (within existing city limits)	2.2%	2331	2681	3030	3411	3791	4162	4532
City's Projections for existing city limits	0.3%	1777	1865	1953	1953	1953	1953	1953
Proposed Developments in city limits		0	0	0	0	0	0	0
Sum for City of Meadowlakes Area		1777	1865	1953	1953	1953	1953	1953
Chisholm Trail Special Utility District								
TWDB Projections (Burnet County)	2.6%	178	214	249	285	321	356	390
Projections for Service Area (Burnet County)	2.0%	56	62	68	75	83	92	101
Proposed Developments		0	0	0	0	0	0	0
Sum for CTSUD Area in Burnet County		56	62	68	75	83	92	101
Capstone Water System								
Projections for existing area (Phase I)	3.7%	23	45	68	68	68	68	68
Proposed Developments								
-- Capstone Ranch, Phase 2A		0	15	30	30	30	30	30
-- Capstone Ranch, Phase 2B		0	18	33	33	33	33	33
-- Capstone Ranch, Phase 3		0	0	13	25	40	40	40
-- Capstone Ranch, Phase 4		0	0	10	20	35	35	35
-- Capstone Ranch, Phase 5		0	0	0	13	25	38	38
-- Capstone Ranch, Phase 6		0	0	0	20	40	60	98
Sum for Capstone Water System	9.5%	23	78	153	208	270	303	340
Burnet County MUD No. 2								
Proposed Buildout Schedule	6.3%	0	100	200	300	400	500	630
-- Lake View Tier 1-3 & Non-Lake View								
Sum For Development	6.3%	0	100	200	300	400	500	630
Buena Vista Water System								
Projections for existing area	2.4%	372	436	500	564	628	692	756
Other developments within area								

Entity	Annual Growth Projected by Entity	POPULATION 2010	2015	2020	2025	2030	2035	2040
-- Laguna Vista Subdivision	0.5%	30	31	32	32	33	34	35
-- Clear Creek Subdivision	0.5%	38	38	39	40	41	42	44
-- Willows Subdivision	2.0%	100	110	122	135	149	164	181
-- Inks Lake Village Subdivision (Llano County)	0.5%	75	77	79	81	83	85	87
-- Camp Longhorn (Llano County)								
Sum for Buena Vista Area	2.0%	615	693	772	852	934	1017	1103
Cassie Subdivision								
Projections for Cassie Water System	0%	112	112	112	112	112	112	112
Projections for POA Member on Private Wells	1.0%	356	376	396	416	436	456	476
Sum for Cassie Subdivision		468	488	508	528	548	568	588
Kempner Water Supply Corporation								
TWDB Projections	2.1%	884	1012	1140	1271	1402	1527	1652
Projections for area w/in Burnet County	0.1%	151	152	152	153	154	155	155
Proposed Developments		0	0	0	0	0	0	0
Sum For Kempner WSC (Burnet County)		151	152	152	153	154	155	155
Kingsland Water Supply Corporation								
TWDB Projections	0.5%	4958	5174	5390	5471	5551	5630	5708
Projections for existing service area	0.5%	8120	8325	8535	8751	8972	9198	9431
Proposed Developments		0	0	0	0	0	0	0
Sum for Kingsland WSC Area		8120	8325	8535	8751	8972	9198	9431
Windermere Oaks Water Supply Corporation								
Projections for existing service area	0.5%	578	592	607	622	638	654	671
Proposed Developments		0	0	0	0	0	0	0
Sum for Windermere Oaks WSC		578	592	607	622	638	654	671
Council Creek Village Water System								
Projections for existing service area	0.5%	438	449	460	472	484	496	509
Proposed Developments		0	0	0	0	0	0	0
Sum for Council Creek Village Area		438	449	460	472	484	496	509
South Silver Creek (I, II & III) Water System								
Projections for existing service area	0.5%	252	258	265	272	278	285	293
Proposed Developments		0	0	0	0	0	0	0
Sum for South Silver Creek Area		252	258	265	272	278	285	293
Blanco San Miguel (Ranches & Rivers Realty)								
Projections for planned development	12.6%	0	300	1300	3050	5550	8050	10550
Sum for Blanco San Miguel Area		0	300	1300	3050	5550	8050	10550
Lower Colorado River Authority (Burnet County)								

		POPULATION						
Entity	Annual Growth Projected by Entity	2010	2015	2020	2025	2030	2035	2040
(1) Bonanza Beach Water System								
Projections for existing service area	0.9%	149	156	163	170	178	186	195
Proposed Developments		0	0	0	0	0	0	0
Sum for Bonanza Beach Area		149	156	163	170	178	186	195
(2) Hamilton Creek Water System								
Projections for existing service area	1.0%	135	142	149	157	165	173	182
Proposed Developments		0	0	0	0	0	0	0
Sum for Hamilton Creek Area		135	142	149	157	165	173	182
(3) Quail Creek Water System								
Projections for existing service area	0%	105	105	105	105	105	105	105
Proposed Developments		0	0	0	0	0	0	0
Sum for Quail Creek Area		105	105	105	105	105	105	105
(4) Ridge Harbor Water System								
Projections for existing service area	2.3%	423	474	531	595	667	747	837
Proposed Developments		0	0	0	0	0	0	0
Sum for Ridge Harbor Area		423	474	531	595	667	747	837
(5) Smithwick Mills Water System								
Projections for existing service area	0.75%	176	183	190	197	204	212	220
Proposed Developments		0	0	0	0	0	0	0
Sum for Smithwick Mills Area		176	183	190	197	204	212	220
(6) Spicewood Beach Water System								
Projections for existing service area	0.5%	1241	1272	1304	1337	1371	1406	1441
Proposed Developments		0	0	0	0	0	0	0
Sum for Spicewood Beach Area		1241	1272	1304	1337	1371	1406	1441
(7) South Road Water System								
Projections for existing service area	0.9%	162	169	177	185	194	203	212
Proposed Developments		0	0	0	0	0	0	0
Sum for South Road Area		162	169	177	185	194	203	212
(8) Whitewater Springs Water System								
Projections for existing service area	3.0%	155	180	208	241	280	325	376
Proposed Developments		0	0	0	0	0	0	0
Sum for Whitewater Springs Area		155	180	208	241	280	325	376
Lower Colorado River Authority (Llano County)								
(9) Tow Village Water System								
Projections for existing service area	1.0%	98	103	108	114	120	126	132
Proposed Developments		0	0	0	0	0	0	0
Sum for Tow Village Area		98	103	108	114	120	126	132

		POPULATION						
Entity	Annual Growth Projected by Entity	2010	2015	2020	2025	2030	2035	2040
(10) Paradise Point Water System								
Projections for existing service area	0.4%	381	389	397	405	413	421	429
Proposed Developments		0	0	0	0	0	0	0
Sum for Paradise Point Area		381	389	397	405	413	421	429
(11) Lake Buchanan Water System								
Projections for existing service area	2.5%	1425	1612	1824	2064	2335	2642	2989
-- Willows Subdivision (Burnet County)								
-- Grand Subana Subdivision (Llano County)								
Sum for Lake Buchanan Water System		1425	1612	1824	2064	2335	2642	2989
(12) Sandy Harbor Water System								
Projections for existing service area	1.0%	248	261	274	288	303	318	334
Proposed Developments		0	0	0	0	0	0	0
Sum for Sandy Harbor Area		248	261	274	288	303	318	334
(13) City of Sunrise Beach Water System								
TWDB Projection (within existing city limits)	0.4%	829	863	896	905	914	923	932
City's Projections for existing city limits	1.0%	2453	2578	2710	2848	2993	3146	3306
Proposed Developments		0	0	0	0	0	0	0
Sum for Sunrise Beach Area		2453	2578	2710	2848	2993	3146	3306
TOTALS FOR PARTICIPANTS								
TWDB Projections-Burnet County Participants	2.5%	22944	26881	30817	35119	39420	43722	48024
TWDB Projections-Llano County Participants	0.5%	5787	6037	6286	6376	6465	6553	6640
Total of Entities' Projections and Proposed Developments								
-- Burnet County	3.3%	28204	32617	38380	45638	54624	64187	74527
-- Llano County	0.9%	12725	13268	13848	14469	15135	15851	16622

Burnet-Llano County Regional Water Facility Study
Water Connection Projections for Entities (For Infrastructure Sizing)

Note: 2010 Connections represent existing connections for entity

		WATER CONNECTIONS						
Entity	**Annual Growth Projected by Entity**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
City of Bertram								
City's Projections based on water connections	4.0%	732	891	1084	1318	1604	1951	2374
Proposed Developments within ETJ & outside city limits								
-- Campo Colinas		6	23	35	47	60	60	60
-- Headwaters of San Gabriel Subdivision								
Sum for City of Bertram Area	4.1%	738	914	1119	1365	1664	2011	2434
City of Burnet								
City's Projections based on water connections	3.3%	2262	2661	3130	3681	4330	5093	5991
Proposed Developments within ETJ & outside city limits		273	398	523	648	898	984	984
-- Eagle's Nest								
-- Delaware Springs								
-- Ranch at Delaware Creek								
-- East Side Commercial Park								
-- Rancho Viejo (Section 1)								
Sum for City of Burnet Area	3.4%	2535	3059	3653	4329	5228	6077	6975
City of Cottonwood Shores								
City's Projections based on water connections	2.0%	536	592	653	721	796	879	971
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Cottonwood Shores Area	2.0%	536	592	653	721	796	879	971
City of Granite Shoals								
City's Projections based on water connections	2.0%	2032	2243	2477	2735	3019	3334	3681
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Granite Shoals Area	2.0%	2032	2243	2477	2735	3019	3334	3681
City of Highland Haven								
City's Projections based on water connections	1.5%	360	388	418	440	440	440	440
Proposed Developments within ETJ		0	0	0	0	0	0	0
Sum for City of Highland Haven Area		360	388	418	440	440	440	440
City of Marble Falls								
City's Projections based on water connections	3.2%	3202	3748	4388	5136	6012	7037	8238
Proposed Developments within ETJ & outside city limits								
-- Flatrock Springs		0	50	150	350	550	850	1150
-- Falling Waters								
Sum for City of Marble Falls	3.7%	3202	3798	4538	5486	6562	7887	9388

		WATER CONNECTIONS						
Entity	**Annual Growth Projected by Entity**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
City of Meadowlakes								
City's Projections based on water connections	0.3%	880	920	960	960	960	960	960
Proposed Developments in city limits		0	0	0	0	0	0	0
Sum for City of Meadowlakes Area		880	920	960	960	960	960	960
Chisholm Trail Special Utility District								
Projections for Service Area (Burnet County)	2.0%	20	22	24	27	30	33	36
Proposed Developments		0	0	0	0	0	0	0
Sum for CTSUD Area in Burnet County		20	22	24	27	30	33	36
Capstone Water System								
Projections for existing area (Phase I)	3.7%	9	18	27	27	27	27	27
Proposed Developments								
-- Capstone Ranch, Phase 2A		0	6	12	12	12	12	12
-- Capstone Ranch, Phase 2B		0	7	13	13	13	13	13
-- Capstone Ranch, Phase 3		0	0	5	10	16	16	16
-- Capstone Ranch, Phase 4		0	0	4	8	14	14	14
-- Capstone Ranch, Phase 5		0	0	0	5	10	15	15
-- Capstone Ranch, Phase 6		0	0	0	8	16	24	39
Sum for Capstone Water System	9.5%	9	31	61	83	108	121	136
Burnet County MUD No. 2								
Proposed Buildout Schedule	6.3%	0	40	80	120	160	200	252
-- Lake View Tier 1-3 & Non-Lake View								
Sum For Development	6.3%	0	40	80	120	160	200	252
Buena Vista Water System								
Projections for existing area	1.8%	125	146	167	188	209	230	251
Other developments within area								
-- Laguna Vista Subdivision	0.5%	12	12	13	13	13	14	14
-- Clear Creek Subdivision	0.5%	15	15	16	16	17	17	17
-- Willows Subdivision	2.0%	40	44	49	54	59	66	72
-- Inks Lake Village Subdivision (Llano County)	0.5%	30	31	32	32	33	34	35
-- Camp Longhorn (Llano County)								
Sum for Buena Vista Area	1.9%	222	248	275	303	331	360	389
Cassie Subdivision								
Projections for Cassie Water System	0%	56	56	56	56	56	56	56
Projections for POA Member on Private Wells	1.0%	178	188	198	208	218	228	238
Sum for Cassie Subdivision	0.8%	234	244	254	264	274	284	294
Kempner Water Supply Corporation								

		WATER CONNECTIONS						
Entity	**Annual Growth Projected by Entity**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Projections for area w/in Burnet County	0.1%	67	67	68	68	68	69	69
Proposed Developments		0	0	0	0	0	0	0
Sum For Kempner WSC (Burnet County)	0.1%	67	67	68	68	68	69	69
Kingsland Water Supply Corporation								
Projections for existing service area	0.5%	3813	3909	4008	4109	4213	4319	4428
Proposed Developments		0	0	0	0	0	0	0
Sum for Kingsland WSC Area	0.5%	3813	3909	4008	4109	4213	4319	4428
NE Lake Buchanan Developments								
Projections for planned development	5.3%	0	250	500	750	1000	1188	1188
Sum for Developments		0	250	500	750	1000	1188	1188
Windermere Oaks Water Supply Corporation								
Projections for existing service area	0.5%	231	237	243	249	255	262	268
Proposed Developments		0	0	0	0	0	0	0
Sum for Windermere Oaks WSC		231	237	243	249	255	262	268
Council Creek Village Water System								
Projections for existing service area	0.5%	146	150	153	157	161	165	170
Proposed Developments		0	0	0	0	0	0	0
Sum for Council Creek Village Area		146	150	153	157	161	165	170
South Silver Creek (I, II & III) Water System								
Projections for existing service area	0.5%	84	86	88	91	93	95	98
Proposed Developments		0	0	0	0	0	0	0
Sum for South Silver Creek Area		84	86	88	91	93	95	98
Blanco San Miguel (Ranches & Rivers Realty)								
Projections for planned development	12.6%	0	120	520	1220	2220	3220	4220
Sum for Blanco San Miguel Area		0	120	520	1220	2220	3220	4220
Lower Colorado River Authority (Burnet County)								
(1) Bonanza Beach Water System								
Projections for existing service area	0.9%	54	56	59	62	65	68	71
Proposed Developments		0	0	0	0	0	0	0
Sum for Bonanza Beach Area		54	56	59	62	65	68	71
(2) Hamilton Creek Water System								
Projections for existing service area	1.0%	40	42	44	46	49	51	54
Proposed Developments		0	0	0	0	0	0	0
Sum for Hamilton Creek Area		40	42	44	46	49	51	54

		WATER CONNECTIONS						
Entity	Annual Growth Projected by Entity	2010	2015	2020	2025	2030	2035	2040
(3) Quail Creek Water System								
Projections for existing service area	0%	40	40	40	40	40	44	44
Proposed Developments		0	0	0	0	0	0	0
Sum for Quail Creek Area		40	40	40	40	40	44	44
(4) Ridge Harbor Water System								
Projections for existing service area	2.3%	159	178	200	224	251	281	315
Proposed Developments		0	0	0	0	0	0	0
Sum for Ridge Harbor Area		159	178	200	224	251	281	315
(5) Smithwick Mills Water System								
Projections for existing service area	0.75%	64	66	69	72	74	77	80
Proposed Developments		0	0	0	0	0	0	0
Sum for Smithwick Mills Area		64	66	69	72	74	77	80
(6) Spicewood Beach Water System								
Projections for existing service area	0.5%	437	448	459	471	483	495	508
Proposed Developments		0	0	0	0	0	0	0
Sum for Spicewood Beach Area		437	448	459	471	483	495	508
(7) South Road Water System								
Projections for existing service area	0.9%	58	61	63	66	69	73	76
Proposed Developments		0	0	0	0	0	0	0
Sum for South Road Area		58	61	63	66	69	73	76
(8) Whitewater Springs Water System								
Projections for existing service area	3.0%	62	72	83	97	112	130	150
Proposed Developments		0	0	0	0	0	0	0
Sum for Whitewater Springs Area		62	72	83	97	112	130	150
Lower Colorado River Authority (Llano County)								
(9) Tow Village Water System								
Projections for existing service area	1.0%	33	35	36	38	40	42	44
Proposed Developments		0	0	0	0	0	0	0
Sum for Tow Village Area		33	35	36	38	40	42	44
(10) Paradise Point Water System								
Projections for existing service area	0.4%	140	143	146	149	152	155	158
Proposed Developments		0	0	0	0	0	0	0
Sum for Paradise Point Area		140	143	146	149	152	155	158

		WATER CONNECTIONS						
Entity	Annual Growth Projected by Entity	2010	2015	2020	2025	2030	2035	2040
(11) Lake Buchanan Water System								
Projections for existing service area	2.5%	576	652	737	834	944	1068	1208
-- Willows Subdivision (Burnet County--wholesale)								
-- Grand Subana Subdivision (Llano County--wholesale)								
Sum for Lake Buchanan Water System		576	652	737	834	944	1068	1208
(12) Sandy Harbor Water System								
Projections for existing service area	1.0%	97	102	107	113	118	124	131
Proposed Developments		0	0	0	0	0	0	0
Sum for Sandy Harbor Area		97	102	107	113	118	124	131
(13) City of Sunrise Beach Water System								
City's Projections for existing city limits	1.0%	926	973	1023	1075	1130	1188	1248
Proposed Developments		0	0	0	0	0	0	0
Sum for Sunrise Beach Area		926	973	1023	1075	1130	1188	1248
TOTALS FOR PARTICIPANTS								
Total of Entities' Projections and Proposed Developments								
-- Burnet County	3.4%	12210	14123	16602	19696	23513	27616	33266
-- Llano County	0.9%	5585	6064	6558	7068	7597	8084	7218

APPENDIX E

*Reference large scale map for this appendix.

APPENDIX F

*Reference large scale map for this appendix.

APPENDIX G

WATER CONSERVATION PLAN GUIDANCE CHECKLIST

This guidance checklist applies to all Texas Water Development Board (TWDB) Financial Assistance Programs specified in its rules under Texas Administrative Code 31, Chapters 355, 363, 371, 375, 382, and 384. **The TWDB will accept Water Conservation Plans determined by the Texas Commission on Environmental Quality (TCEQ) to satisfy the requirements of 30 TAC Chapter 288.**

Basically, *the water conservation plan* is a strategy or combination of strategies for reducing the consumption of water, reducing the loss or waste of water, improving or maintaining the efficiency in the use of water, or increasing recycling and reuse of water. It contains best management practices measures to try to meet the targets and goals identified in the plan. *The Drought Contingency (Emergency Demand Management) Plan* is a strategy or combination of strategies for responding to temporary and potentially recurring water supply shortages and other supply emergencies.

THE WATER CONSERVATION PLAN REQUIREMENTS:

A. _____ An evaluation of the Applicant's water and wastewater system and customer use characteristics to identify water conservation opportunities and potential targets and goals. Completion of the ***Water Conservation Utility Profile,*** **WRD-264,** as part of the evaluation is required. Attach it to the Plan.

B.______ Inclusion of 5-year and 10 –year targets & goals. Target and goals should be specific and quantified for <u>municipal use</u> **expressed in gallons per capita per day (<u>gpcd</u>) as well as <u>goals for water loss programs</u>).** Consider state and regional targets and goals, local climate, demographics, and the utility profile. Consider the anticipated savings that can be achieved by utilizing the appropriate Best Management Practices and other conservation techniques.

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

D. _____ A method for tracking the implementation and effectiveness of the plan. The method should track annual water use and provide information sufficient to evaluate the implementation conservation measures. The plan should measure progress annually, and, at a minimum, evaluate the progress towards meeting the targets and goals every five years.

E. _____ A master meter to measure and account for the amount of water diverted from the source of supply.

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

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

H. _____ A continuous program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control water loss.

I. ______ A program of continuing education and information regarding water conservation. This should include providing water conservation information directly to each residential, industrial and commercial customer annually, and providing water conservation literature to new customers when they apply for service.

J. _____ A water rate structure which is not “promotional,” i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. Include copy of the rate structure.

K. ____ A means of implementation and enforcement which shall be evidenced by adoption of the plan:

1. a copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the applicant and
2. a description of the authority by which the applicant will implement and enforce the conservation plan.

L. ______ If the Applicant will utilize the project financed by the TWDB to furnish water or wastewater services to another supplying entity that in turn will furnish the water or wastewater services to the ultimate consumer, the requirements for the water conservation plan also pertain to these supplier entities.
To comply with this requirement the applicant shall:

1. submit its own water conservation plan;
2. submit the other entity’s (or entities) water conservation plan;
3. require, by contract, that the other entity (or entities), adopt a water conservation plan that conforms to the board’s requirement and submit it to the board. If the requirement is to be included in an existing water or wastewater service contract, it may be included, at the earliest of the renewal or substantial amendment of that contract, or by other appropriate measures.

M. _____ Documentation that the regional water planning group for the service area of the applicant has been notified of the applicant’s water conservation plan.

Note: The water conservation plan may also include other conservation method or technique that the applicant deems appropriate.

N. The Drought Contingency Plan shall include:

1. _____ **Trigger conditions**. Describe information to be monitored. For example, reservoir levels, daily water demand, water production or distribution system limitations. Supply source contamination and system outage or equipment failure should be considered too. Determine specific quantified targets of water use reduction.

2. _____ **Demand management measures**. Refers to actions that will be implemented by the utility during each stage of the plan when predetermined triggering criteria are met. **Drought plans must include quantified and specific targets for water use reductions to be achieved during periods of water shortage and drought.** Supply management measures typically can be taken by the utility to better manage available water supply, as well as the use of backup or alternative water sources. The demand management measures should curtail nonessential water uses, for example, outdoor water use.

3. _____ **Initiation and termination procedures**. The drought plan must include specific procedures to be followed for the initiation or termination of each drought response stage, including procedures for notification of the public.

4. ______ **Variances and enforcement.** The plans should specify procedures for considering (approving and denying) variances to the plan. Equally as important is the inclusion of provisions for enforcement of any mandatory water use restrictions, including specification of penalties for violations of such restrictions.

5. ______ **Measures to inform and educate the public**. Involving the public in the preparation of the drought contingency plan provides an important means for educating the public about the need for the plan and its content.

0. ______ **Adopt the plan.** No plan is complete without formal adoption by the governing body of the entity. For a municipal water system, adoption would be by the city council as an ordinance, or a resolution by an entity's board of directors.

P. ____ Reporting Requirement: Identify who will be responsible for preparing the annual report on the utility profile form WRD-264. Loan/Grant Recipients must maintain an approved water conservation program in effect until all financial obligations to the state have been discharged and shall **report annually** to the executive administrator of the TWDB on the progress in implementing each of the minimum requirements in its water conservation plan and the status of any of its customers' water conservation plan required by contract, within one year after closing on the financial assistance and annually thereafter. The content and format for the annual reporting is included in the form: ***Water Conservation Program Annual Report,*** **WRD-265**.

Assistance: For information and assistance contact:

Adolph L. Stickelbault (adolph.stickelbault@twdb.state.tx.us)
Texas Water Development Board
PO Box 13231
Austin, Texas 78711-3231
512-936-2391

Municipal Plan Assistance and Forms:
http://www.twdb.state.tx.us/assistance/conservation/Municipal/Plans/CPlans.asp

Best Management Practices Information:
http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

Quantification Techniques:
http://www.twdb.state.tx.us/assistance/conservation/gdsstudy.asp

APPENDIX H

Drought Contingency Plan
for a Retail Public Water Supplier

Texas Commission on Environmental Quality

Instructions: The following form is a model of a drought contingency plan for a retail public water supplier. Not all items may apply to your system's situation. This form is supplied for your convenience, but you are not required to use this form to submit your plan to the TCEQ. Submit completed plans to: Water Supply Division MC 160, TCEQ, P.O. Box 13087, Austin TX 78711-3087.

____

(Name of Utility)

____

(Address, City, Zip Code)

____

(CCN#)

____

(PWS #s)

____

(Date)

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the ___________________ (name of your water supplier) hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance/or resolution (see Appendix C for an example).

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the ______________ (name of your water supplier) by means of ________________ (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; for example, scheduling and providing public notice of a public meeting to accept input on the Plan).

Section III: Public Education

The ______________ (name of your water supplier) will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of __________________ (describe methods to be used to provide information to the public about the Plan; for example, public events, press releases or utility bill inserts).

Section IV: Coordination with Regional Water Planning Groups

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

Section V: Authorization

The ___________________ (designated official; for example, the mayor, city manager, utility director, general manager, etc.), or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _______________, (designated official) or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

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

Section VII: Definitions

For the purposes of this Plan**,** the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by _________________ (name of your water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or jacuzzi-type pools;

(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The ________________ (designated official) or his/her designee shall monitor water supply and/or demand conditions on a __________ (example: daily, weekly, monthly) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering criteria described below are based on ______________________________________
____
(*provide a brief description of the rationale for the triggering criteria; for example, triggering criteria / trigger levels based on a statistical analysis of the vulnerability of the water source under drought of record conditions, or based on known system capacity limits*).

Stage 1 Triggers – MILD Water Shortage Conditions

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII–Definitions, when

____
(*describe triggering criteria / trigger levels; see examples below*).

Following are examples of the types of triggering criteria that might be used in one or more successive stages of a drought contingency plan. One or a combination of such criteria must be defined for each drought response stage, but usually not all will apply. Select those appropriate to your system:

Example 1: *Annually, beginning on May 1 through September 30.*

Example 2: *When the water supply available to the _______ (name of your water supplier) is equal to or less than _______ (acre-feet, percentage of storage, etc.).*

Example 3: *When, pursuant to requirements specified in the _____________(name of* ***your*** *water supplier) wholesale water purchase contract with ____________ (name* *of your wholesale water supplier), notification is received requesting initiation of Stage 1 of the Drought Contingency Plan.*

Example 4: *When flows in the _______ (name of stream or river) are equal to or less than ____cubic feet per second.*

Example 5: *When the static water level in the ____________ (name of your water supplier) well(s) is equal to or less than _____feet above/below mean sea level.*

Example 6: *When the specific capacity of the __________________ (name of your water supplier) well(s) is equal to or less than _____ percent of the well's original specific capacity.*

Example 7: *When total daily water demand equals or exceeds ______ million gallons for ___consecutive days of ____ million gallons on a single day (example: based on the "safe" operating capacity of water supply facilities).*

Example 8: *Continually falling treated water reservoir levels which do not refill above __ percent overnight (example: based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria which are tailored to its system.

<u>Requirements for termination</u>
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g. 3) consecutive days.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

<u>Requirements for initiation</u>
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when ____________ (*describe triggering criteria; see examples in Stage 1*).

<u>Requirements for termination</u>
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Triggers – SEVERE Water Shortage Conditions

<u>Requirements for initiation</u>
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when ____________ (*describe triggering criteria; see examples in*

Stage 1).

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when ____________ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 4, Stage 3 becomes operative.

Stage 5 Triggers -- EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when ____________ (designated official), or his/her designee, determines that a water supply emergency exists based on:

1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; **or**

2. Natural or man-made contamination of the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

Stage 6 Triggers -- WATER ALLOCATION

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 5 of this Plan when ____________ (describe triggering criteria, see examples in Stage 1).

Requirements for termination - Water allocation may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

> *Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (example: supply source contamination and system capacity limitations).*

Section IX: Drought Response Stages

The _______________ (designated official), or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency or water shortage condition exists and shall implement the following notification procedures:

Notification

Notification of the Public:
The _________ (designated official) or his/ her designee shall notify the public by means of:

Examples:
publication in a newspaper of general circulation,
direct mail to each customer,
public service announcements,
signs posted in public places
take-home fliers at schools.

Additional Notification:
The _________ (designated official) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

Examples:
Mayor / Chairman and members of the City Council / Utility Board
Fire Chief(s)
City and/or County Emergency Management Coordinator(s)
County Judge & Commissioner(s)
State Disaster District / Department of Public Safety
TCEQ *(required when* mandatory *restrictions are imposed)*
Major water users

Critical water users, i.e. hospitals
Parks / street superintendents & public facilities managers

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Stage 1 Response -- MILD Water Shortage Conditions

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

Best Management Practices for Supply Management:

D*escribe additional measures, if any, to be implemented directly by (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes.*

Voluntary Water Use Restrictions for Reducing Demand :

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of midnight and 10:00 a.m. and 8:00 p.m to midnight on designated watering days.

(b) All operations of the ______________ (name of your water supplier) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response -- MODERATE Water Shortage Conditions

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

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

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

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rises. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to fire fighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the ___________________ (name of your water supplier).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight. However, if the golf course utilizes a water source other than that provided by the _______________ (name of your water supplier), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. use of water for dust control;
4. flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response -- SEVERE Water Shortage Conditions

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

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
All requirements of Stage 2 shall remain in effect during Stage 3 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the ____________________ (name of your water supplier).

(c) The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

Stage 4 Response -- CRITICAL Water Shortage Conditions

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

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ____________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:. All requirements of Stage 2 and 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10 p.m.

(c) The filling, refilling, or adding of water to swimming pools, wading pools, and jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response -- EMERGENCY Water Shortage Conditions

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

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by ___________ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand. All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

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

Stage 6 Response -- WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare, the ___________ (designated official) is hereby authorized to allocate water according to the following water allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

“Household” means the residential premises served by the customer’s meter. “Persons per household” includes only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer’s household is comprised of two (2) persons unless the customer notifies the ____________ (name of your water supplier) of a greater number of persons per household on a form prescribed by the ____________ designated official). The _________ (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a

form, it shall be the customer’s responsibility to go to the ____________ (name of your water supplier) offices to complete and sign the form claiming more than two (2) persons per household. New customers may claim more persons per household at the time of applying for water service on the form prescribed by the __________ (designated official). When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the _________ (name of water supplier) on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the _________(name of your water supplier) in writing within two (2) days. In prescribing the method for claiming more than two (2) persons per household, the _________ (designated official) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the ____________ (name of your water supplier) of a reduction in the number of person in a household shall be fined not less than $________.

Residential water customers shall pay the following surcharges:

$____ for the first 1,000 gallons over allocation.
$____ for the second 1,000 gallons over allocation.
$____ for the third 1,000 gallons over allocation.
$____ for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (example: apartments, mobile homes) shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer’s meter serves two dwelling units unless the customer notifies the ____________ (name of your water supplier) of a greater number on a form prescribed by the __________ (designated official). The _________ (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer. If, however, a customer does not receive such a form, it shall be the customer's responsibility to go to the ___________ (name of your water supplier) offices to complete and sign the form claiming more than two (2) dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not. New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the __________ (designated official). If the number of dwelling units served by a master meter is reduced, the customer shall notify the _________(name of your water supplier) in writing within two (2) days. In prescribing the method for claiming more than two (2) dwelling units, the _________ (designated official) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the ___________ (name of your water supplier) of a reduction in the number of person in a household shall be fined not less than $________. Customers billed from a master meter under this provision shall pay the following monthly surcharges:

$____ for 1,000 gallons over allocation up through 1,000 gallons for each dwelling unit.
$____, thereafter, for each additional 1,000 gallons over allocation up through a second 1,000 gallons for each dwelling unit.
$____, thereafter, for each additional 1,000 gallons over allocation up through a third 1,000 gallons for each dwelling unit.
$ ____, thereafter for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the __________ (designated official), or his/her designee, for each nonresidential commercial customer other than an industrial customer who uses water for processing purposes. The non-residential customer's allocation shall be approximately __ (e.g. 75%) percent of the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. Provided, however, a customer, __ percent of whose monthly usage is less than ____ gallons, shall be allocated ____ gallons. The _________ (designated official) shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the ____________ (name of your water supplier) to determine the allocation. Upon request of the customer or at the initiative of the ___________ (designated official), the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage, (2) one nonresidential customer agrees to transfer part of its allocation to another nonresidential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the __________ (designated official or alternatively, a special water allocation review committee). Nonresidential commercial customers shall pay the following surcharges:

Customers whose allocation is _____ gallons through ______ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation.
$____ per thousand gallons for the second 1,000 gallons over allocation.
$____ per thousand gallons for the third 1,000 gallons over allocation.
$____ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is ______ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
___ times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Industrial Customers

A monthly water allocation shall be established by the __________ (designated official), or his/her designee, for each industrial customer, which uses water for processing purposes. The industrial customer's allocation shall be approximately __ (example: 90%) percent of the customer's water usage baseline. Ninety (90) days after the initial imposition of the allocation for industrial customers, the industrial customer's allocation shall be further reduced to __ (example: 85%) percent of the customer's water usage baseline. The industrial customer's water use baseline will be computed on the average water use for the ______ month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than ___ months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The _________ (designated official) shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the ____________ (name of your water supplier) to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of receipt of written notice. Upon request of the customer or at the initiative of the __________ (designated official), the allocation may be reduced or increased, (1) if the designated period does not accurately reflect the customer's normal water use because the customer had shutdown a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shutdown or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the ___________ (designated official or alternatively, a special water allocation review committee). Industrial customers shall pay the following surcharges:

Customers whose allocation is _____ gallons through _______ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation.
$____ per thousand gallons for the second 1,000 gallons over allocation.
$____ per thousand gallons for the third 1,000 gallons over allocation.
$____ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is ______ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
___ times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the _________________ (name of your water supplier) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by _____________(designated official), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction shall be punished by a fine of not less than _______ dollars ($__) and not more than ______ dollars ($__). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the _____________ (designated official) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $______, and any other costs incurred by the ___________________ (name of your water supplier) in discontinuing service. In addition, suitable assurance must be given to the ________________ (designated official) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the ______________ (name of your water supplier), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that a violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any employee of the _______________ (name of your water supplier), police officer, or other _____ employee designated by the ___________ (designated official), may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the _____________ (example: municipal court) on the date shown on the citation for which the date shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in _________ (example: municipal court) to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in __________ (example: municipal court), a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and given preferential setting in __________ (example: municipal court) before all other cases.

Section XI: Variances

The ________________ (designated official), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the _________________ (name of your water supplier) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the __________ (designated official), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

APPENDIX I

Scan to Comm Court
Susan Roth

Texas Water Development Board

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

to discuss in Court
10-11-11

October 3, 2011

REC'D OCT 0 5 2011

The Honorable Donna Klaeger
Burnet County Judge
220 South Pierce Street
Burnet, Texas 78611

RE: Regional Water Facility Planning Grant Contract between the Texas Water Development Board (TWDB) and Burnet County (County); TWDB Contract No. 1004831072, Draft Report Comments

Dear Judge Klaeger:

Staff members of the TWDB have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT I provides the comments resulting from this review. As stated in the TWDB contract, the County will consider incorporating draft report comments from the EXECUTIVE ADMINISTRATOR as well as other reviewers into the final report. In addition, the County will include a copy of the EXECUTIVE ADMINISTRATOR'S draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. The County shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions concerning the contract, please contact David Meesey, the TWDB's designated Contract Manager for this project at (512) 936-0852.

Sincerely,

Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Enclosures

c: David Meesey, TWDB

Attachment I

TWDB Comments on Burnet-Llano County Regional Water Supply Facility Plan Report
TWDB Contract #1004831072

1. On page 6, the first paragraph states that "a regional water system would be designed in conformance with the treatment requirements of the State Water Quality Management Plan…" This statement is applicable to wastewater systems but not to water systems. Please consider deleting this statement.

2. On page 112, Potential Funding Sources, paragraphs 4 and 5 make reference to funding programs for construction of wastewater systems. Since the report discusses the feasibility of funding regional water systems, please consider changing the language to "water and wastewater" systems or just "water" systems.

3. On page 112, the first sentence in paragraph 5 states the TWDB has several programs that offer loans…for public "wastewater" systems that facilitate compliance with "wastewater" regulations. Please consider changing the sentence to state that TWDB has several programs that offer loans…for public "**water and** wastewater" systems that facilitate compliance with "**state and federal**" regulations.

4. On page 115, the first paragraph under Revenue Bonds describes wastewater programs and systems. Please consider changing the reference to water systems.

Memorandum

Burnet-Llano County Regional Water Facility Study – Response to TWDB Draft Report Review Comments

TO: *David Meesey (TWDB)*

FROM: *Susan K. Roth, P.E. (Susan Roth Consulting, LLC)*

DATE: *November 17, 2011*

This memorandum summarizes the project team's responses to the draft report review comments provided by the Texas Water Development Board (TWDB) for the Burnet-Llano County Regional Water Facility Study on October 3, 2011 .

General Comments

- Will provide double-sided copies of the final report to both TWDB and the project participants.
- Made the recommended changes to Page 6, Paragraph 1.
- Made the recommended changes to Page 112, Paragraphs 4 and 5 regarding potential funding sources.
- Made the recommended changes to Page 115, Paragraph 1 regarding revenue bonds.