REGIONAL WATER SUPPLY STUDY

SAN MARCOS AREA

FINAL REPORT

PREPARED FOR

GUADALUPE-BLANCO RIVER AUTHORITY
AND
TEXAS WATER DEVELOPMENT BOARD

STUDY PARTICIPANTS

CITY OF SAN MARCOS
CITY OF KYLE
CITY OF LOCKHART
CRYSTAL CLEAR WSC
ELIM WS
MARTINDALE WSC
MAXWELL WSC
COUNTY LINE WSC
GOFORTH WSC
PLUM CREEK WSC
CREEDMOOR-MAHA WSC

DECEMBER, 1995

STATE OF TEXAS
KELLY J. KAATZ
75421
REGISTERED
PROFESSIONAL ENGINEER
12-26-95

STATE OF TEXAS
KENNETH L. CHOFFEL
45686
REGISTERED
PROFESSIONAL ENGINEER
12-26-95

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REGIONAL WATER SUPPLY STUDY
SAN MARCOS AREA

TABLE OF CONTENTS

Page

TABLE OF CONTENTS
(CONTINUED)

Page

REGIONAL WATER SUPPLY STUDY
SAN MARCOS AREA

LIST OF TABLES

LIST OF TABLES
(CONTINUED)

REGIONAL WATER SUPPLY STUDY
SAN MARCOS AREA

LIST OF FIGURES

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EXECUTIVE SUMMARY

This report presents the results of a regional water supply study for the Guadalupe-Blanco River Authority (GBRA). The study was sponsored by GBRA and the Texas Water Development Board and was conducted in cooperation with eleven participating entities in the San Marcos area including the City of San Marcos, City of Kyle, City of Lockhart, Crystal Clear Water Supply Corporation (WSC), Elim WS, Maxwell WSC, County Line WSC, Plum Creek WSC, Goforth WSC, Creedmoor-Maha WSC, and Martindale WSC.

The purpose of the study was to evaluate two alternatives for development of a regional water supply system to meet the present and future needs (year 2020) of each of the study participants. Alternative 1 evaluates the feasibility of enlarging the City of San Marcos' proposed water treatment plant to serve both the City of San Marcos and the ten water supply entities outside of the City's service area. Alternative 2 assumes that the City of San Marcos develops its own individual water supply system and the other ten study participants develop a separate regional system to serve their needs. For both alternatives, two raw water supply scenarios were analyzed. The first scenario (A) assumes that all of the water supply needs are met from the San Marcos River, and the second scenario (B) assumes that the water supply needs are met equally from the San Marcos River (50%) and Canyon Lake (50%).

Groundwater availability for the study area is expected to be limited due to impending legislative and court actions regarding the Edwards Aquifer. Projections of future water demands and estimates of groundwater availability were made for each of the study participants. Based on these analyses, the region is expected to have a year 2020 surface water supply need of 13,379 acft/yr during normal conditions and 16,433 acft/yr during drought conditions.

The study showed that development of a regional water supply facility serving all of the study participants (Alternative 1) would result in the least cost to the existing customers and would provide the more economical long-term water supply for the region. Significant cost savings for the City of San Marcos and the ten water supply entities can be realized by developing one regional water supply system rather than two individual systems. A summary of the total cost of water for each of the study participants for each of the two raw water supply scenarios is presented in Table ES-1 for the City of San Marcos and Tables ES-2 and ES-3 for the other study participants. Alternative 1 would cost 10% to 29% less than Alternative 2 for participants outside San Marcos, and it would reduce the City of San Marcos' costs by 8% to 9% over an individual system. A summary of the 20-year cost savings for each entity is shown in Table ES-4 which shows cost savings ranging from $390,000 for County Line WSC to $7,670,000 for the City of San Marcos, depending on the raw water supply.

Table ES-1
Cost Comparison for City of San Marcos

	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System including the ten Participants	
	Alternative 1 (Regional System)		Alternative 2 (San Marcos only)			
Raw Water Supply Source	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
A) San Marcos River Only	$1.12	$1.64	$1.22	$1.78	8%	8%
B) San Marcos River/Canyon Lake	$1.27	$1.86	$1.39	$2.03	9%	8%

Table ES-2
Cost Comparison
for Study Participants Outside of the City of San Marcos Service Area
A) Raw Water Supply from the San Marcos River Only

	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System with City of San Marcos Participating	
	Alternative 1 (with City of San Marcos)		Alternative 2 (without City of San Marcos)			
Participant	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
Crystal Clear WSC	$1.46	$2.14	$1.82	$2.66	20%	20%
Martindale WSC	$2.43	$2.43	$2.95	$2.95	18%	18%
City of Lockhart	$4.60	$4.60	$5.12	$5.12	10%	10%
Elim WS	$2.02	$2.65	$2.42	$3.17	17%	17%
Maxwell WSC	$1.49	$2.38	$1.81	$2.90	18%	18%
City of Kyle	$2.02	$3.55	$2.32	$4.08	13%	13%
County Line WSC	$2.35	$3.39	$2.72	$3.91	14%	13%
Plum Creek WSC	$3.13	$3.13	$3.65	$3.65	14%	14%
Goforth WSC	$3.17	$3.17	$3.70	$3.70	14%	14%
Creedmoor-Maha WSC	$4.50	$4.50	$5.02	$5.02	10%	10%

Table ES-3
Cost Comparison
for Study Participants Outside of the City of San Marcos Service Area
B) Raw Water Supply from San Marcos River (50%) and Canyon Lake (50%)

	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System with City of San Marcos Participating	
	Alternative 1 (with City of San Marcos)		Alternative 2 (without City of San Marcos)			
Participant	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
Crystal Clear WSC	$1.61	$2.35	$2.27	$3.32	29%	29%
Martindale WSC	$2.64	$2.64	$3.61	$3.61	27%	27%
City of Lockhart	$4.81	$4.81	$5.78	$5.78	17%	17%
Elim WS	$2.19	$2.86	$2.93	43.83	25%	25%
Maxwell WSC	$1.62	$2.59	$2.22	$3.56	27%	27%
City of Kyle	$2.14	$3.76	$2.70	$4.74	21%	21%
County Line WSC	$2.50	$3.60	$3.18	$4.57	21%	21%
Plum Creek WSC	$3.34	$3.34	$4.31	$4.31	23%	23%
Goforth WSC	$3.39	$3.39	$4.36	$4.36	22%	22%
Creedmoor-Maha WSC	$4.71	$4.71	$5.68	$5.68	17%	17%

Table ES-4
Summary of 20-Year Cost Savings by
Implementation of Regional Water Supply System

Participant	Raw Water Supply from San Marcos River Only	Raw Water Supply from San Marcos River and Canyon Lake
City of San Marcos	$6,320,000	$7,670,000
Crystal Clear WSC	$1,050,000	$1,950,000
Martindale WSC	$1,100,000	$2,060,000
City of Lockhart	$2,270,000	$4,240,000
Elim WS	$1,580,000	$2,950,000
Maxwell WSC	$1,250,000	$2,320,000
City of Kyle	$930,000	$1,710,000
County Line WSC	$390,000	$730,000
Plum Creek WSC	$1,580,000	$2,960,000
Goforth WSC	$1,930,000	$3,540,000
Creedmoor-Maha WSC	$880,000	$1,650,000
Total	$19,280,000	$31,780,000

Notes:
1) Based on average water use during the 20-year period of 2000-2020 and projected normal usage for each participant
2) Cost savings assume that the difference in costs for Alternative 1 and Alternative 2 remain consistent for the 20-year period.
3) Costs based on 1995 dollars and do not account for inflation.

The first stage of the regional system would include an 18 mgd regional water treatment plant southeast of the City of San Marcos. A regional water transmission system would transmit treated water from the treatment plant to each of the participating entities. Raw water supply is expected to be obtained from the San Marcos River (near Cummings Reservoir) or from a combination of the San Marcos River and Canyon Lake (diverted from Lake Dunlap). An off-channel reservoir is planned adjacent to the water treatment plant site to store San Marcos River water for use during drought conditions and to provide presedimentation of the raw water prior to treatment.

The cost of water from the system is dependent upon the number and location of entities that ultimately participate in the system. Therefore, a two step process has been included in the implementation plan. The first step is for interested entities to sign a "letter of intent." This "letter of intent" would outline major elements of the project along with the responsibility of each entity participating in implementation of the plan. Upon finalization of the "letter of intent", the plan presented in this study would be amended to include facilities for only those entities signing the letter. The amended plan will present revised facility sizing information and revised cost estimates for the project and for each remaining entity. The final plan would include more detailed evaluations of ways to reduce the project costs, including reducing the peak day demands from the surface water supply system, using interconnections to transfer water rather than build new pipelines, and analyzing financing options for the project.

Once all remaining entities have reviewed and approved the amended plan (which may require more than one iteration, if some entities drop out after reviewing the amended plan), the second step would be for participating entities to execute a water purchase agreement with GBRA. Once those agreements are executed, the implementation of the project could begin.

If the "letter of intent" can be executed by all parties by the end of 1995, amending the plan and developing water purchase agreements could be complete by the summer of 1996. Assuming contracts are executed shortly thereafter, construction of the project could begin in late 1997 and be completed by the end of 1998.

1.0 INTRODUCTION

1.1 Study Background

Due to increasing growth in population and water demands, impending groundwater pumpage limits, and water quality concerns, the Guadalupe-Blanco River Authority (GBRA) initiated a regional water supply study to evaluate the potential of meeting current and future water supply needs for cities and rural water supply corporations located primarily in Hays, Caldwell, Travis, and Guadalupe Counties. The study was conducted in cooperation with 11 water supply entities including the City of San Marcos, City of Kyle, City of Lockhart, Crystal Clear Water Supply Corporation (WSC), Elim WSC, Maxwell WSC, County Line WSC, Plum Creek WSC, Goforth WSC, Creedmoor-Maha WSC, and Martindale WSC. The eleven study participants currently serve a total population of about 84,000 people and have predominantly met their water supply needs from wells in the Edwards Aquifer (San Antonio portion), Barton Springs-Edwards Aquifer, Carizzo-Wilcox Aquifer, and alluvium sources.

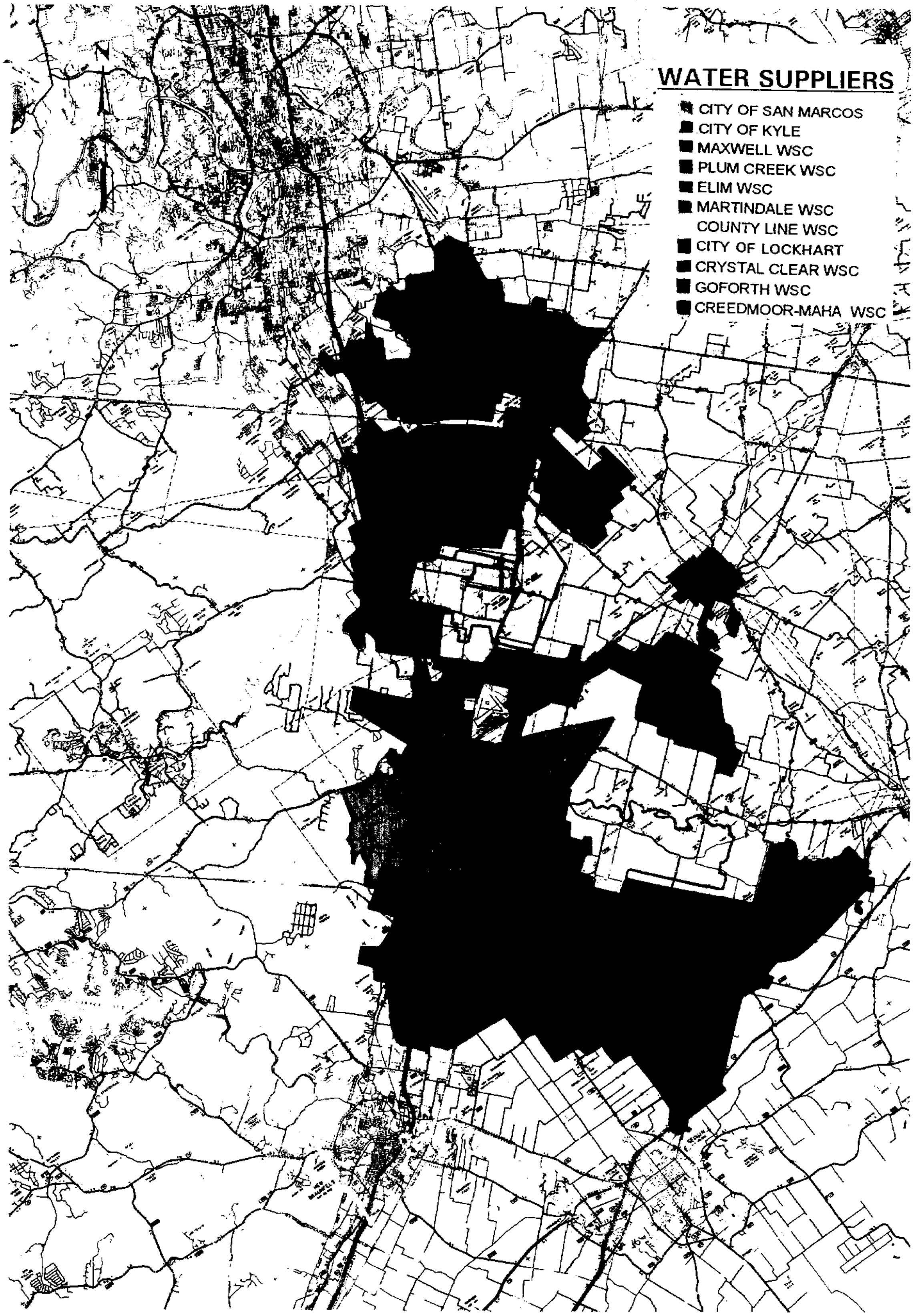
Past water supply studies have evaluated the potential for development of regional surface water supply projects to supply water to at least some of the participants in this study. In 1987, the Guadalupe-Blanco River Authority (GBRA, 1987) performed a water supply study for eight entities in the same general area as this study. The participants in that study included the City of San Marcos, City of Kyle, City of Lockhart, Creedmoor-Maha WSC, Goforth WSC, Maxwell WSC, Crystal Clear WSC, and Springs Hill WSC. In 1989, a regional water supply study was performed for the Hays County Water Development Board (HDR, 1989), an interlocal agency created for the purpose of developing a countywide plan to provide dependable future water resources for Hays County. The Hays County Water Development Board (HCWDB) members consisted of representatives from the Hays County Commissioners Court, the cities of San Marcos, Kyle, Buda, Dripping Springs, Hays City, Mountain City, Neiderwald, and Wood Creek; and Goforth WSC and Wimberley WSC, who in turn represented the rural water supply corporations in Hays County.

Since the completion of these two major studies, the City of San Marcos has initiated a surface water supply project to meet the city's existing and future water supply needs. The proposed surface water supply plan (HDR, 1994) was developed due to impending legislative and court ordered reductions in pumpage from the Edwards Aquifer, the city's present sole source of water supply. The plan includes a surface water treatment plant near San Marcos, raw water intake and diversion facilities on the San Marcos River, an off-channel storage reservoir, and a system to deliver treated water to the city's water distribution system. The 1987 study by GBRA and the 1989 study for the HCWDB showed that regional surface water supply facilities provide mutual benefits to most of the existing water supply entities. The City of San Marcos is in the process of implementing a surface water supply system. One of the main objectives of this study, is to determine the cost of enlarging the proposed City of San Marcos facilities into a regional facility that would economically provide surface water to San Marcos and the participants outside the City of San Marcos. A second objective is to determine the cost of a regional water supply alternative that assumes the City of San Marcos develops its own individual surface water supply system and the remaining ten study participants develop a separate regional surface water supply system. By comparing the two alternatives, the benefits or costs of regionalization can be determined for each of the participants.

The Guadalupe-Blanco River Authority applied for grant funds from the Texas Water Development Board (TWDB) Research and Planning Fund to develop alternative regional water supply plans for the study area (San Marcos area). GBRA entered into a contract with the TWDB in January of 1995 for matching funds. HDR Engineering, Inc. (HDR) was retained on March 20, 1995 by GBRA to serve as the consultant for development of the regional water supply plan.

1.2 Study Area

The study area includes the service areas of the eleven study participants; City of San Marcos, City of Kyle, City of Lockhart, Crystal Clear WSC, Elim WSC, Maxwell WSC, County Line WSC, Plum Creek WSC, Goforth WSC, Creedmoor-Maha WSC, and Martindale WSC. The study area, shown in Figure 1-1, is located in south-central Texas primarily in the Guadalupe-Blanco River Basin, with a portion of the Creedmoor-Maha WSC service area located in the Colorado River Basin. The study area is located within the boundaries of Hays, Caldwell, Guadalupe, Travis, Comal, and Bastrop Counties. The current primary sources of surface water supply to the region are the Guadalupe River, including Canyon Lake, and the San Marcos River



HDR

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GUADALUPE -BLANCO RIVER AUTHORITY
REGIONAL WATER SUPPLY STUDY

REGIONAL STUDY AREA

Date DEC. 1995

Figure 1-1

below its confluence with the Blanco River. Significant flow occurs at both of these sources during normal conditions and each river serves as important water supply and recreational resources for the region.

1.3 Study Objectives

The overall objective of this study is to provide a plan to conserve existing water supplies and to develop alternative regional water supply plans for the region to meet existing and future water supply needs of the study participants. To accomplish this objective, the following tasks were undertaken as components of this regional water supply study.

Task 1.0 Data Collection

Existing water resources data was collected and analyzed using records from the Texas Water Development Board, Texas Natural Resource Conservation Commission, Edwards Underground Water District, Guadalupe-Blanco River Authority, and study participants. The data forms the basis for making projections of future water needs for each of the participants.

Task 2.0 Meeting with GBRA to discuss individual goals and special problems of the study participants and to establish requirements and time tables for data to be furnished by the study participants needed to complete the study.

Meetings were held between HDR and GBRA to discuss data required from each of the study participants (Task 1.0) to complete the study. A timetable was set for acquiring the data to meet the scheduled completion date of the study.

Task 3.0 Develop a reproducible base map for the report with pertinent study features.

Using County roadway maps, a 30" by 42" reproducible base map was developed for the report. Pertinent study features were located on the map including the service area of the study participants, and dams and reservoirs. Well sites, treatment facilities, storage tanks, and pump stations were located on the map as provided by the study participants. The location of the raw water supply source, treatment facility, potential pipeline routes and sizes, and points of delivery to each participant were also shown on the base map.

Task 4.0 **Update existing population data for each participant and make projections of future needs through a 20 year planning period.**

Using population, connection, and water use data for the last 10 to 20 years as provided by each participant, projections of population and total water demand were made for the 20 year planning horizon from the year 2000 to 2020. The projections were extended to the year 2050 based on consideration of the TWDB projections in the area and based on information provided by GBRA and the study participants. Future groundwater availability was projected for each participant based on existing pumping levels and expected legislative and court actions limiting groundwater pumpage. From the projections of total water demand and future groundwater availability, future water supply needs were developed for each study participant.

Task 5.0 **Review existing studies to eliminate unlikely alternatives and prepare two regional water supply alternatives.**

After reviewing existing studies and reports, a regional water supply alternative was developed to provide surface water to meet the needs of all participants (Alternative 1). The alternative included delivery of water to each participant at a specified delivery point in their system. A second regional water supply alternative was developed to provide surface water to meet the needs of all participants except the City of San Marcos (Alternative 2), assuming the City of San Marcos develops its own surface water supply. The water treatment plant site selected for Alternatives 1 and 2 was assumed to be located at approximately the same location. All facilities including intakes, pipelines, and treatment plants were sized to deliver treated surface water to the selected delivery locations to meet year 2020 demands. Hydraulic analyses were performed to size the regional water distribution system.

Task 6.0 **Using information partially furnished by GBRA and other sources, develop preliminary estimates of probable construction cost of each identified project.**

A preliminary estimate of probable construction cost for each of the two regional water supply alternatives was developed. Cost estimates were itemized and estimates of annual operation and maintenance costs for the proposed facilities were included. The capital cost for individual components, by location, of each implementation phase were presented as well as the capacity/volume of each component. Using the estimated capital costs, financing terms, and estimates of annual operation and maintenance costs, user rate impact estimates were developed for each participant. An implementation plan for Alternative 1 was developed. The outline included the steps required for permits from state and federal agencies, environmental impact assessments and/or statements, legal, engineering, right-of-way acquisition and/or easements, bid documents, bidding, and construction. A schedule for implementation of Alternative 1 was developed.

Task 7.0 Legal assistance regarding groundwater, surface water, easements, rates, certificates of convenience and necessity, permits, water rights, etc.

A cursory review of the legal requirements regarding groundwater and surface water rights found these issues to be too complex for this feasibility study. Decisions regarding pumpage of groundwater and surface water sources were made for purposes of this study to develop a range of potential options. Further studies are needed to properly address these issues.

Task 8.0 Meetings and preparation of draft and final reports.

A draft final report describing the methodologies and results of the work was prepared and submitted to all of the study participants. The draft report contains an executive summary detailing the regional water supply alternatives. The executive summary presents a comparison of the costs of the two alternatives. The draft report was submitted to the TWDB, GBRA, and each of the study participants for review and comment. After receipt of comments, a final report will be completed and provided to the TWDB, GBRA, and each of the study participants. A "kick-off" meeting was held at the beginning of the study on March 16, 1995. A second coordination meeting was held on October 11, 1995 to present the findings and recommendations of the study.

Task 9.0 Supervise and coordinate the study, conduct public meetings and give notices. Participate in planning, develop operating cost and user rates. Make monthly progress reports and monthly billings.

Status reports were provided on an intermittent basis to describe progress and any problems that have developed. GBRA coordinated the overall study, served as a liaison between HDR and the study participants, and provided notice of coordination meetings with study participants.

Task 10.0 Develop water conservation plans.

A water conservation plan was developed by GBRA for all study participants to be used as a guide for developing individual plans. The plan incorporated basic TWDB requirements. Each participant is encouraged to modify the plan to meet specific needs prior to formal adoption.

Task 11.0 Prepare environmental and archeological studies

Due to similar pipeline routes used under the Trans-Texas Water Program, the environmental work performed under that program was taken into consideration for this study. Based on the Trans-Texas Water Program findings, no endangered or threatened species were reported along the proposed pipeline route. Additional studies are needed to properly address the pipeline route and sites for other proposed facilities.

Task 12.0 Develop preliminary time schedule

A preliminary time schedule for implementation of the selected alternative was developed. The schedule identifies key decision points and the major tasks that are required to implement the selected alternative.

2.0 POPULATION AND WATER USE PROJECTIONS

2.1 Population Projections

Population projections for each of the study participants were prepared for the 1995 through 2050 planning period in order to estimate future water demands of each entity. The Texas Water Development Board Consensus population projections (TWDB, 1995) for Hays, Comal, Travis, Guadalupe, and Caldwell Counties were used as the basis of the projections, with adjustments by HDR and the study participants. The TWDB data included county-wide projections as well as projections for incorporated cities in each county. However, the TWDB does not make projections for individual rural water supply corporations (WSC) which were required for this study. In order to prepare projections for the individual WSC's, HDR compiled historic and projected annual growth rates for selected areas, using TWDB and other data, and made adjustments as indicated by recent demographic data. It should be noted that a large portion of the study area lies along the Interstate Highway 35 corridor which has the potential for very rapid growth. For purposes of this study, the annual growth rates used by TWDB and adjusted rates made by HDR were utilized for planning, as presented in Table 2-1.

For the City of San Marcos resident population, the growth rate of the 1970's of 2.19 percent per year was applied for the period 1990 through 2010. This rate was chosen to reflect the recent trends which appear to be higher than the rates of the 1980's. For the period 2010 through 2030, the historic growth rate that occurred in the 1980's of 2.07 percent per year was used. This rate is slightly lower than that used for the 1990-2010 period, but was generated during the 1980's when San Marcos was growing during stressful economic times. For the remainder of the projection period, the TWDB projected growth rate of 0.97 percent per year was used (TWDB, 1992). This lower rate for the distant projection years, was based upon demographic factors of Hays County, in which San Marcos is a significant component, and was selected to reflect a leveling of growth rates as the central area population reaches higher levels. Projections for the Southwest Texas State University (SWTSU) component of the San Marcos water service area were based upon the planned rate of growth of this population, which is 1.0 percent per year (THECB, 1992). SWTSU has adopted admission standards to accomplish the

Table 2-1
GBRA Regional Water Supply Study
Population Projections / Compound Annual Growth Rates in Percent

Area		Historic		Projected					
		1970 to 1980	1980 to 1990	1990 to 2000	2000 to 2010	2010 to 2020	2020 to 2030	2030 to 2040	2040 to 2050
San Marcos	TWDB	2.19	2.07	1.61	1.78	1.63	1.82	1.84	1.84
	HDR**	2.19	2.07	2.19	2.19	2.07	2.07	0.97	0.97
Lockhart	TWDB	2.05	1.47	1.89	1.75	1.43	0.90	0.06	0.06
	HDR[1]	2.05	1.47	2.77	1.61	1.33	0.84	0.06	0.06
Kyle	TWDB	2.54	0.61	0.87	0.59	0.85	1.23	1.57	1.57
	HDR	2.54	0.61	2.10	2.00	1.90	1.80	1.75	1.70
Elim WSC North		*	*	0.00	0.60	1.10	0.50	0.50	0.45
Elim WSC South		*	*	***	***	***	***	***	***
Creedmoor-Maha WSC		*	*	1.00	1.60	1.60	1.30	1.00	1.00
Goforth WSC		*	*	2.66	2.10	1.55	1.34	1.18	1.05
Plum Creek WSC		*	*	1.82	1.82	1.82	1.82	1.82	1.53
County Line WSC		*	*	1.80	1.80	1.80	1.80	1.80	1.53
Maxwell WSC		*	*	1.80	1.80	1.80	1.80	1.80	1.80
Martindale WSC		*	*	2.50	2.50	2.25	2.00	1.80	1.70
Crystal Clear WSC		*	*	4.55	2.50	1.50	1.00	0.90	0.80

* Data not available.
** San Marcos Service Area (permanent residents plus SWTSU students and Gary Job Corps).
***Commercial service only.
1 Takes into account the addition of 1,000 inmates at a new prison in 1995.

enrollment goals. For purposes of this study, it was assumed that the number of Gary Job Corps Center students, staff, and staff family residents would remain constant at 3,000 throughout the projection period. The San Marcos permanent resident projections are higher than those made by TWDB during the first 40 years of the projection period due to the difference in growth rates; however, the TWDB and HDR permanent resident projections are nearly equal at year 2050. It should be noted that the HDR total projections include the city, SWTSU students who reside in the city on a temporary basis, and the Gary Job Corps Center residents, giving a San Marcos service area projection which is larger than the TWDB projection. Based upon this estimate and the projections described above, the population for the San Marcos service area is projected to increase from 36,743 in 1990 to 67,715 in 2020, and to 97,681 in 2050 (See Table 2-2 and Figure 2-1).

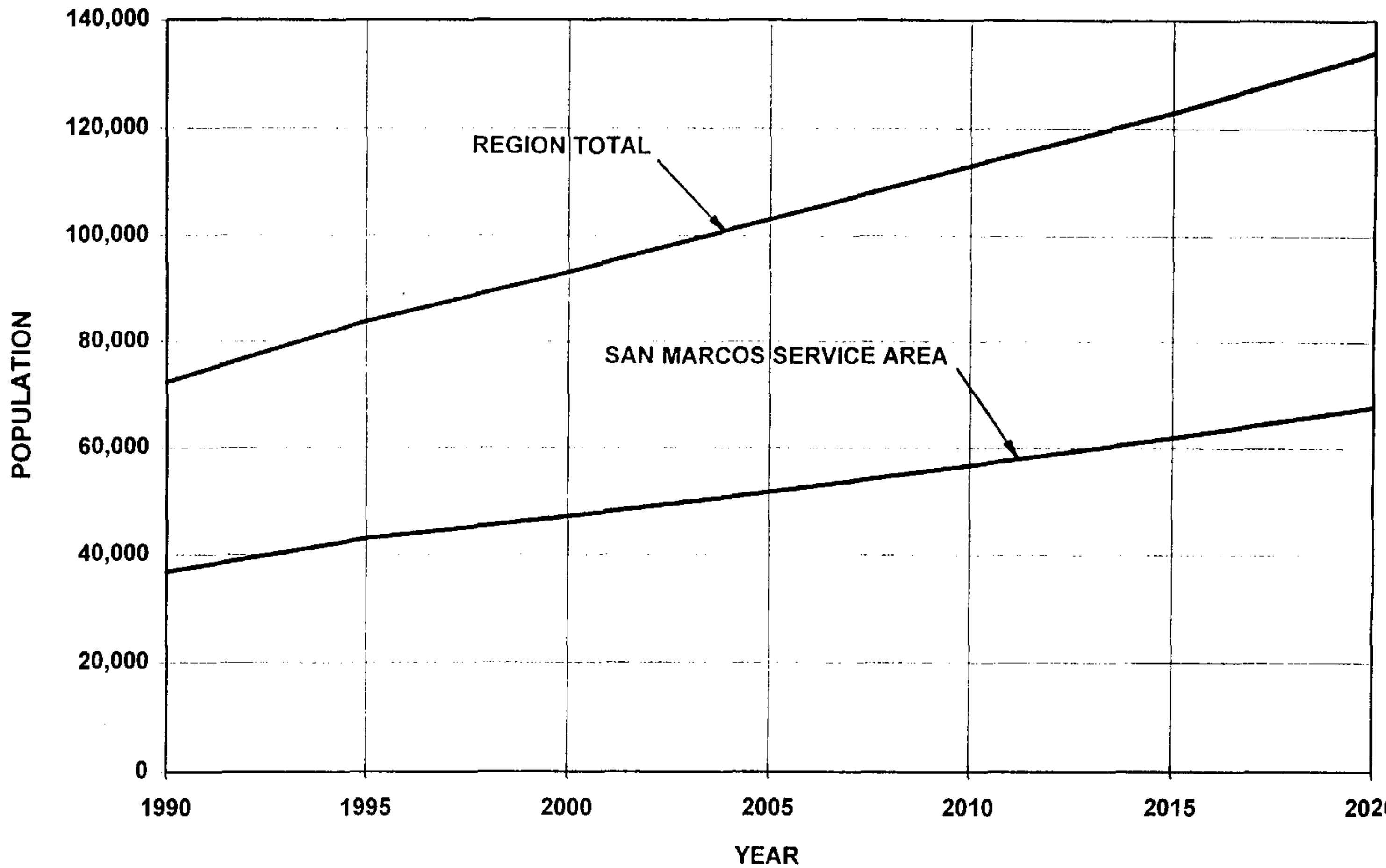
Table 2-2 GBRA Regional Water Supply Study City of San Marcos Service Area Projections				
Year	**San Marcos Residents[3]**	**SWTSU Students[4]**	**Gary Job Corps[5]**	**Total Population**
1990	28,743	5,000	3,000	36,743
1995	32,031	8,063	3,000	43,067
2000	35,696	8,446	3,000	47,142
2005	39,779	8,877	3,000	51,656
2010	44,330	9,329	3,000	56,659
2015	49,112	9,805	3,000	61,917
2020	54,410	10,305	3,000	67,715
2030	66,782	11,383	3,000	81,165
2040	73,551	12,574	3,000	89,125
2050	80,825	13,856	3,000	97,681

[1] Texas Water Development Board, most likely projections, with below normal precipitation and above average water conservation, January, 1995; Permanent residents of San Marcos.
[2] HDR Engineering, Inc., projections based on historic data, with projections of growth and water conservation.
[3] Permanent residents; projections based on City of San Marcos data.
[4] Southwest Texas State University (SWTSU) students who are temporary residents. SWTSU records show town resident student numbers of 5,000 in 1990 and 7,800 in 1992/93. The projections were based upon the 1992/93 residents (7,800), and a 1.0 percent per year growth rate; "Enrollment Forecasts 1995 - 2000: Texas Institutions of Higher Education Study Paper 27, Texas Higher Education Coordinating Board", revised October 1992; Texas Higher Education Coordinating Board, Austin, Texas, 1992.
[5] Students and staff held constant at 1990 level.

For Lockhart, the HDR projections take into account the location of a 1,000 inmate prison which is served by the Lockhart water system. The TWDB projections were adjusted upward to include the additional 1,000 inmates in 1995 and at each projection date thereafter (Table 2-2).

In the case of Kyle, the HDR projection rates are higher than those underlying TWDB's projections. The reason for this is the resurgence of growth in the early 1990's, as shown by the growth in meter connections for the 1990-1994 period, and the general expectation that Kyle will grow at rates somewhat like the rates experienced during the 1970's due to its location in relation to the Austin-San Antonio corridor.

For the water supply corporations (i.e., Elim, Creedmoor-Maha, Goforth, Plum Creek, County Line, Maxwell, Martindale, and Crystal Clear), population was calculated from the number of connections of each WSC (from data available for the past five year period) multiplied by the estimated number of persons per connection. The number of persons per connection



HDR

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POPULATION PROJECTIONS

Date DEC. 1995

Figure 2-1

ranged from 3.0 to 3.5. The population growth rates for the individual water supply corporation service areas were based on the TWDB projections for unincorporated (rural and suburban) areas of the counties in which the individual WSC's are located. However, for those WSC's in Travis and northeastern Hays Counties, the rates were adjusted upward to take into account the increased growth that is expected to occur as a result of the location of Austin's new airport at the former Bergstrom Air Force Base site and other planned development in the area.

For the 1990 to 2020 time period, the population of the study area is projected to increase from 72,298 to 134,067, an increase of 88 percent (Table 2-3). Of the projected year 2020 total, 88,571, or 66 percent, are projected to be in the cities of San Marcos, Lockhart, and Kyle, with the remainder (34 percent) located in the nine water supply corporation service areas (Table 2-3). The combined growth rate of the cities of San Marcos, Lockhart, and Kyle for the 1990 to 2020 planning period is 84 percent and for the nine WSC's, the combined growth rate is 89 percent.

Table 2-3
GBRA Regional Water Supply Study
Population Projections

Area	1990 Actual	1995	2000	2005	2010	2015	2020	2050
San Marcos[1]	36,743	43,067	47,142	51,656	56,659	61,917	67,715	97,681
Lockhart [2]	9,205	10,766	12,108	13,163	14,218	15,223	16,229	17,854
Kyle[2][3]	2,225	2,414	2,678	3,472	3,833	4,211	4,627	7,785
Elim WSC North [4]	800	800	800	825	850	900	950	1,100
Elim WSC South[4]	0	0	0	0	100	200	300	300
Creedmoor-Maha WSC [4]	4,125	4,250	4,467	4,836	5,235	5,668	6,136	8,519
Goforth WSC [4]	3,746	4,309	4,873	5,354	5,835	6,411	6,987	11,660
Plum Creek WSC [4]	3,224	3,542	3,861	4,242	4,624	5,080	5,537	9,250
County Line WSC [4]	834	915	997	1,094	1,192	1,308	1,425	2,369
Maxwell WSC [4]	2,955	3,243	3,532	3,877	4,222	4,634	5,046	8,618
Martindale WSC [4]	1,802	2,054	2,324	2,650	2,975	3,049	3,716	6,408
Crystal Clear WSC [4]	6,639	8,502	10,365	11,816	13,268	14,333	15,399	20,148
Region Total	72,298	83,862	93,147	102,985	113,011	122,934	134,067	191,692

1 From Table 2-2.
2 Texas Water Development Board, most likely projections, January, 1995, with adjustments for growth rates provided in Table 2-1.
3 Includes adjustments for planned housing developments.
4 HDR Engineering, Inc., projections based on historic data, with growth rates applied from Table 2-1.

2.2 Water Use Projections

2.2.1 Water Use Projection Methods

Projections of annual water demand for each entity in the study area for the 1995 to 2050 planning period were made by multiplying the projected population by estimated per capita water use at the desired point in time. This figure represents the total average daily demand for each year in terms of gallons per day. In order to express the average demand in acre-feet per year (acft/yr), which are common units used in water supply planning, the average daily demand is multiplied by 365 days/year and then divided by 325,851 gallons/acft.

2.2.2 Per Capita Water Use

Per capita water use was computed for 1990 for dry weather type conditions using TWDB water use surveys for cities in the study area and from information supplied by the water supply corporations. These data are summarized in Table 2-4. Projections of per capita water use for the cities was based upon the condition that the installation of low flow plumbing fixtures and conservation efforts will result in lowering per capita water use in future years. For the WSC's, per capita water use rates were calculated for the early 1990's using data supplied by each WSC, and since the rates are in the range of 100 to 140 gallons per person per day, they were held constant for the projection period. This is thought to be appropriate since future growth in the WSC service areas is likely to be toward larger homes than are located there now, and more water using commercial establishments will be located in the respective WSC service areas as population density increases. These two factors will work toward increasing per capita water use, which to some extent, will offset the reductions in per capita water use from the installation of low flow plumbing fixtures.

Table 2-4
GBRA Regional Water Supply Study
Water Use Projections / Per Capita Water Use in Gallons Per Day*

Area		Reported		Year 2000 to 2050					
		1980	1990	2000	2010	2020	2030	2040	2050
San Marcos	TWDB	**	196	229	219	210	207	205	204
	HDR**	**	210	200	178	178	178	178	178
Lockhart	TWDB	**	176	167	157	149	146	143	143
	HDR	**	176	167	157	149	146	143	143
Kyle	TWDB	**	130	135	127	120	116	113	112
	HDR	**	130	135	127	120	116	113	112
Elim WSC North		**	90	90	90	90	90	90	90
Elim WSC South		**	***	***	135	135	135	135	135
Creedmoor-Maha WSC		**	100	100	100	100	100	100	100
Goforth WSC		**	140	140	140	140	140	140	140
Plum Creek WSC		**	140	140	140	140	140	140	140
County Line WSC		**	140	140	140	140	140	140	140
Maxwell WSC		**	140	140	140	140	140	140	140
Martindale WSC		**	140	140	140	140	140	140	140
Crystal Clear WSC		**	140	140	140	140	140	140	140

* Below normal precipitation, with conservation.
** Data not available.
*** Commercial service only.

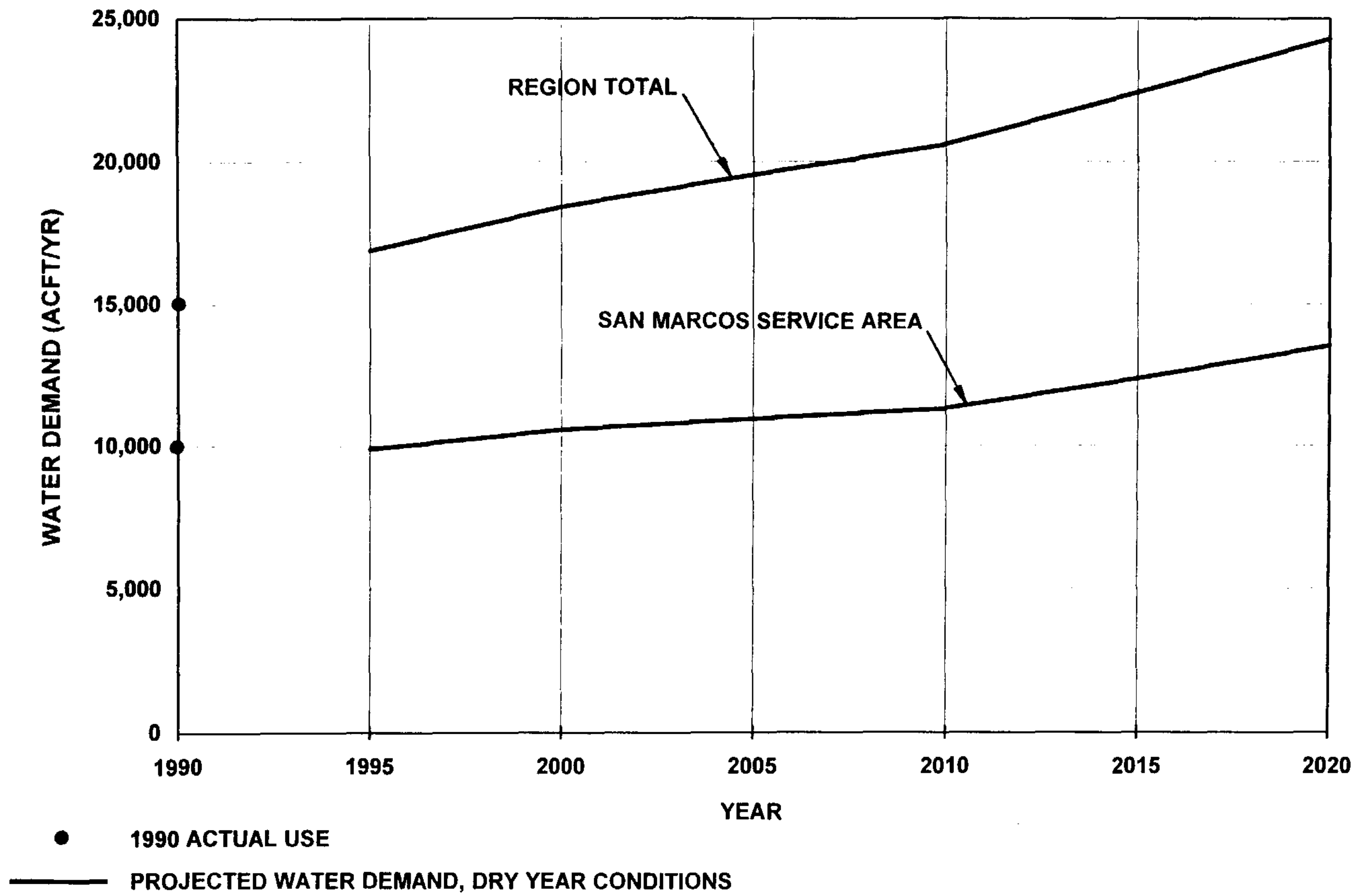
2.2.3 Water Use Projections

Reported and projected water demand for each of the study participants for the 1990 to 2050 time period is provided in Table 2-5. Figure 2-2 shows a plot of projected water demands for the San Marcos service area and the study area as a whole. As shown in Table 2-5, for the 1990 to 2020 time period, the water demand of the study area is projected to increase from 12,735 acft/yr to 24,287 acft/yr, an increase of 91 percent. Of the projected year 2020 total demand, 16,830 acft/yr, or 69 percent, is projected to be in the cities of San Marcos, Lockhart, and Kyle, with the remaining demand (31 percent) located in the nine water supply corporation service areas (Table 2-3). The combined growth rate in water demand of the cities of San Marcos, Lockhart, and Kyle for the 1990 to 2020 planning period is 88 percent and for the nine WSC's, the combined water demand growth rate is 97 percent.

Table 2-5
GBRA Regional Water Supply Study
Reported Water Use and Projected Water Demands
(acft/yr)

Area	1990 Actual	1995	2000	2005	2010	2015	2020	2050
San Marcos [1]	6,810	9,888	10,560	10,935	11,296	12,344	13,500	19,474
Lockhart [2]	1,816	2,152	2,264	2,387	2,504	2,609	2,708	2,858
Kyle [2][3]	326	359	405	509	545	585	622	977
Elim WSC North [4]	81	81	81	83	86	91	95	111
Elim WSC South [4][5]	230	393	524	524	539	685	700	700
Creedmoor-Maha WSC [4]	462	476	500	542	586	635	687	954
Goforth WSC [4]	587	675	764	839	915	1,005	1,096	1,828
Plum Creek WSC [4]	505	555	605	665	725	796	868	1,450
County Line WSC [4]	131	143	156	171	187	205	223	371
Maxwell WSC [4]	463	508	554	608	662	726	791	1,351
Martindale WSC [4]	282	322	364	415	466	478	583	1,005
Crystal Clear WSC [4]	1,042	1,333	1,625	1,852	2,080	2,247	2,414	3,159
Region Total	12,735	16,885	18,402	19,530	20,591	22,406	24,287	34,238

[1] From Table 2-2.
[2] Using base data from Texas Water Development Board, most likely projections, with below normal precipitation and above average water conservation, January, 1995, with adjustments for growth rates provided in Table 2-1.
[3] Includes adjustments for planned housing developments.
[4] HDR Engineering, Inc., projections based on historic data, with growth rates applied from Table 2-1.
[5] Reported use in 1990, with estimates for 1995 based on reported water use in 1991, 1992, and 1993; projections based on 1995 use plus addition of commercial space development of 206 Living Unit Equivalents (LUE) by year 2000 and an additional 206 LUEs by 2015, where one LUE requires 0.6385 acft/yr (3.0 persons at 190 gallons per person per day). Correspondence between TC&B Engineers and City of San Marcos, September, 1992.



HDR Engineering, Inc.

GUADALUPE -BLANCO RIVER AUTHORITY
REGIONAL WATER SUPPLY STUDY

WATER DEMAND PROJECTIONS

Date DEC. 1995

Figure 2-2

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3.0 EXISTING WATER SUPPLIES AND PROJECTED NEEDS

3.1 Existing Water Supplies

Groundwater is currently the sole source of water for nine of the eleven study participants. Crystal Clear WSC and Creedmoor-Maha WSC are the only study participants that currently use groundwater and surface water supplies conjunctively. Crystal Clear WSC uses surface water from Canyon Lake supplied by New Braunfels Utilities and Canyon Regional Water Authority in addition to groundwater from the Edwards Aquifer. Creedmoor-Maha WSC receives a portion of its water supply from surface water from the Colorado River through the City of Austin in addition to its primary groundwater supply from the Barton Springs - Edwards Aquifer. Table 3-1 provides a summary of the current sources of groundwater supply for each of the study participants.

Table 3-1
Summary of Existing Groundwater Supply Sources

Study Participants	Existing Groundwater Supply Sources
City of San Marcos	Edwards Aquifer
City of Kyle	Edwards Aquifer
City of Lockhart	Carizzo-Wilcox Aquifer
Crystal Clear WSC	Edwards Aquifer
Elim WSC	Edwards Aquifer
Maxwell WSC	Edwards Aquifer
County Line WSC	Edwards Aquifer
Plum Creek WSC	Barton Springs - Edwards Aquifer
Goforth WSC	Barton Springs - Edwards Aquifer
Creedmoor-Maha WSC	Barton Springs - Edwards Aquifer
Martindale WSC	Alluvium

The primary surface water resources in the study area are the Guadalupe River and the San Marcos River. Each of these rivers sustain more than enough flow to meet the combined water supply needs of all of the study participants during normal times. However, severe droughts will cause significant reductions in flow in these rivers which will limit the availability of water.

The San Marcos River has its beginnings where Sink Creek and Purgatory Creek join Spring Lake. The U.S. Geological Survey (USGS) has operated a gaging station on the San

Marcos River to measure springflows since 1956. During this time, the minimum spring flow recorded has been 30 mgd (46 cfs) and the maximum has been 276 mgd (427 cfs). The average flow has been 107 mgd, which is more than adequate to meet the region's growing needs. However, not all of the water in the San Marcos River is available due to downstream water rights and possible environmental requirements. Senior water rights on the San Marcos River and Guadalupe River downstream of San Marcos involve significant diversion quantities, and during drought conditions all water is fully appropriated. Previous hydrologic analyses performed in development of the City of San Marcos surface water supply plan show that significant storage volume and purchase or subordination of downstream water rights would be required in order to develop a firm yield from the San Marcos capable of meeting the regions' needs.

The Guadalupe River sustains significant flows during normal conditions. The USGS has operated a streamflow gaging station on the Guadalupe River at New Braunfels (upstream of the Comal River) since 1927. Canyon Lake was constructed about 22 miles upstream of New Braunfels and began operation in 1960. Since 1962, the minimum streamflow recorded was 1.7 mgd in September, 1984. The average streamflow has been 349 mgd (540 cfs), which is more than adequate to meet the region's water supply needs. Similar to the San Marcos River, not all of the flow in the Guadalupe River is available due to downstream water rights and possible environmental requirements. Senior water rights and environmental requirements on the Guadalupe River will limit the amount of water that can be withdrawn from the river especially during times of drought. However, on the Guadalupe River, stored water, available in Canyon Lake for contract from GBRA, may be used to provide a constant or firm supply of water even during times of drought.

3.2 Water Quality

The quality of a raw water source may affect the feasibility of its use, since water quality dictates the type and cost of treatment required to meet state and federally mandated drinking water standards. Raw water quality is usually evaluated by comparing contaminant concentrations to applicable drinking water standards to determine which contaminants must be removed. Surface water of unusually low quality may be uneconomical to treat, whereas high quality ground water, such as water from the Edwards Aquifer and Barton Springs - Edwards Aquifer, may require very little treatment prior to distribution.

All of the water sources evaluated in this study appear to be suitable for treatment for domestic consumption based on current state and federal rules. It must be stressed, however, that drinking water standards continue to evolve, and the evaluation of any raw water supply can not predict with certainty that additional or modified treatment processes will not be required in the future.

Groundwater from the Edwards Aquifer or the Barton Springs - Edwards Aquifer supplies nine of the study participants. Treatment is not required prior to distribution other than the addition of fluoride and chlorine. Fluoride is sometimes added as a prophylactic against tooth decay, and chlorine acts as a disinfectant to control waterborne pathogens. In general, water from the Edwards Aquifer and Barton Springs - Edwards Aquifer is high in alkalinity and hardness (due to the limestone formations of the aquifer), but overall is of high quality. The high hardness and alkalinity may be objectionable to some customers due to its propensity to form scale in domestic plumbing systems, the relatively large amount of soap and detergent required with hard water, and spotting of dishes and fixtures. Efforts to soften the water, however, may also be met with resistance from customers since changes in water quality may be perceived by some as undesirable.

The Carizzo-Wilcox Aquifer is the current source for the City of Lockhart. In general, the Carizzo-Wilcox aquifer yields water that meets the National Primary Drinking Water Regulation standards for public health, however, secondary standards for iron may be exceeded in certain areas and hydrogen sulfide or methane gas may be found in localized areas (HDR, 1994). Treatment methods are currently in use for water from the Carizzo-Wilcox Aquifer which will produce water meeting primary and secondary standards for public water supply.

The water quality of the San Marcos River and Guadalupe River are very similar to the water currently obtained by some of the participants from the Edwards Aquifer and Barton Springs - Edwards Aquifer. The rivers are high in hardness and alkalinity and low in chemical contaminants. Although contaminants are present in the rivers at slightly greater concentrations (as would generally be expected of a surface water source), they are still generally at concentrations well below the standards set for drinking water without any treatment. Raw water quality for surface water sources can be expected to be highly variable. Upstream rainfall (or drought) probably has the greatest impact on instream water quality, but human activities including land development and agricultural practices, can cause water quality fluctuations. Based on a review of available water quality data from the USGS, water quality fluctuations would not be expected to pose treatment problems, particularly if storage is constructed at the water treatment plant site. An off-channel reservoir near the plant would allow for cessation of raw water diversions from the supply streams during events of poor water quality and would provide presedimentation of the raw water. Water quality would be expected to be much more consistent as a result, allowing for more predictable and efficient treatment.

3.3 Need for Additional Supply

Almost all of the water currently used by the study participants is from existing groundwater resources in the region. Six of the study participants obtain their present water supply from the Edwards Aquifer and account for 75% of the current total water usage of the eleven study participants. The Edwards Aquifer serves as an important source of water to a large area of South-Central Texas and is the sole source of water supply to an estimated 1,500,000 people including San Marcos, San Antonio, Hondo, Uvalde, and other entities. The Edwards Aquifer also serves as a source of water for extensive agricultural operations in the area overlaying the aquifer and provides habitat to several endangered species that are protected by federal legislation.

In 1990, pumpage from the Edwards Aquifer totaled 520,000 acre-feet. Unrestricted pumpage and use of water from the Edwards Aquifer have become major issues due to concerns that the pumping rates are steadily increasing, now exceed drought recharge rates, and are threatening springflows at Comal Springs and San Marcos Springs. In response to a Federal Court Judgment (Sierra Club, et al, 1993) establishing minimum springflows to protect endangered species, legislation that would result in a management plan that would limit pumpage from the Edwards Aquifer was enacted by the Texas Legislature in 1993 and 1995. Legal issues regarding management of the Edwards Aquifer are still pending, however, both state and federal actions are underway which will likely result in regulation and reduction of Edwards Aquifer pumpage in the immediate future. Given the condition that pumpage from the Edwards Aquifer must be reduced, water conservation and increased use of surface water will be necessary in order to meet present needs and to provide an adequate water supply for future growth.

Three of the study participants currently obtain their water supply from the Barton Springs - Edwards Aquifer and make up 10% of the current total usage of the eleven study participants. Increased water usage from the Barton Springs - Edwards Aquifer due to significant growth, in combination with drought conditions, could threaten flows from Barton Springs.

The Carizzo-Wilcox Aquifer is the present source of water supply for the City of Lockhart, accounting for 13% of the current total usage of the eleven study participants. Although the Carizzo-Wilcox Aquifer could sustain additional demands, water quality factors may limit its future development for municipal water supply.

Martindale WSC utilizes alluvium groundwater sources as its present supply, accounting for 2% of the total current usage of the eleven study participants. Alluvium groundwater sources may be threatened during periods of extreme drought and, without proper treatment, sometimes pose water quality problems due to the direct influence of surface water.

3.4 Projected Surface Water Supply Needs

The quantity of groundwater available to each of the study participants during the planning period depends on the potential yields of the respective aquifers from which they now obtain their water and the degree or extent of future regulation. The estimates of groundwater available to the study participants over the planning period are based on the following assumptions:

1) Pumpage from the Edwards Aquifer will be regulated to protect springflows in a manner similar to that specified in Senate Bill 1477, Texas Legislature, Regular Session, 1993. Under the conditions of SB 1477, the estimated quantity of water available to those who depend upon the Edwards Aquifer during average weather conditions would be only 75% (400,000 acft/yr) of the quantity that was used in 1990 beginning in the year 2008. Further pumping restrictions to insure springflows in a repeat of the 1950's drought could result in a drought management plan that would limit pumpage during drought conditions to about 38% (200,000 acft/yr) of the quantity used in 1990. These estimates are based upon the 1990 Edwards Aquifer total pumpage of 520,000 acft, as reported to the Texas Water Development Board in surveys of water users, and the assumption that pumpage

would be scaled back proportionately for all users in order to achieve the levels allowed under SB 1477.

2) Pumpage from the Barton Springs - Edwards Aquifer can continue through the planning period at the same rate that occurred in 1990.
3) Pumpage from the Carizzo-Wilcox Aquifer and alluvium sources can continue through the planning period at the same rate that occurred in 1990.

Based on the assumptions and conditions for the Edwards Aquifer, the quantity of water that would be available to the study participants presently utilizing this source would be reduced to 6,746 acft/yr during normal conditions and 3,419 acft/yr during a severe drought. Table 3-2 presents a summary of estimated supply from the Edwards Aquifer.

Table 3-2
Edwards Aquifer - Groundwater Availability

Participant	1990 Usage (acft/yr)	Normal Supply (acft/yr)	Drought Supply (acft/yr)
City of San Marcos	6,810	5,107	2,588
City of Kyle	326	245	124
Crystal Clear WSC	1,042	782	396
Elim WS	311	233	118
Maxwell WSC	407	305	155
County Line WSC	99	74	38
Aquifer Total	520,000	400,000	200,000
Portion of 1990 Usage	100%	≈75%	≈38%

The quantity of water available from the Barton Springs - Edwards Aquifer, Carizzo-Wilcox Aquifer, and alluvium sources was assumed to be approximately equal to the 1990 level of pumpage by each participant from these respective sources. Based on these assumptions and conditions, the quantity of water that would be available from the Barton Springs - Edwards Aquifer would be limited to 792 acft/yr. The Carizzo-Wilcox Aquifer and alluvium sources were assumed to supply 1,816 acft/yr and 148 acft/yr, respectively. Table 3-3 presents a summary of the estimated supply from the Barton Springs - Edwards Aquifer, Carizzo-Wilcox Aquifer, and alluvium sources.

Table 3-3
Groundwater Availability for
Barton Springs - Edwards Aquifer, Carizzo-Wilcox Aquifer, and Alluvium Sources

Participant	Source	1990 Usage (acft/yr)	Normal Supply (acft/yr)	Drought Supply (acft/yr)
Plum Creek WSC	Barton Springs - Edwards Aquifer	269	269	269
Goforth WSC	Barton Springs - Edwards Aquifer	370	370	370
Creedmoor-Maha WSC	Barton Springs - Edwards Aquifer	153	153	153
City o Lockhart	Carizzo-Wilcox Aquifer	1,816	1,816	1,816
Martindale WSC	Alluvium	148	148	148

Projections of present and future surface water supply needs for the planning period were made using the projections of water demand and the estimates of groundwater availability. Table 3-4 presents a summary of projected surface water supply needs for each of the study participants for the year 2020. As shown in the table, the projected need for surface water in the year 2020 is 13,379 acft/yr for normal conditions and 16,433 acft/yr for drought conditions. These projections of need account for the use of some surface water by Crystal Clear WSC and Creedmoor-Maha WSC. Crystal Clear WSC presently uses surface water provided by other entities including New Braunfels Utilities and Canyon Regional Water Authority. For purposes of this study, Crystal Clear WSC was assumed to obtain 25% of its surface water needs from the proposed regional water supply system and 75% of its surface water needs from other sources. Creedmoor-Maha WSC also currently uses some surface water from the Colorado River provided by the City of Austin which was accounted for in the future projections of additional need. Table 3-5 presents projections of surface water supply need for the year 2000, the initial year of the planning period. Based on the projected year 2000 water demand, the estimated surface water supply need in the year 2000 is 8,087 acft/yr for normal conditions and 11,125 acft/yr for drought conditions.

Table 3-4
Projected Surface Water Supply Needs - Year 2020

Participant	Demand: Water Demand (acft/yr)	Groundwater Supply: Estimated Normal Supply (acft/yr)	Groundwater Supply: Estimated Drought Supply (acft/yr)	Other Supply: Normal Supply (acft/yr)	Other Supply: Drought Supply (acft/yr)	Projected Need: Normal Usage (acft/yr)	Projected Need: Drought Usage (acft/yr)
City of San Marcos	13,500	5,108	2,588	0	0	8,392	10,912
City of Kyle	622	245	124	0	0	377	498
Crystal Clear WSC	2,414	781	396	1,225	1,500	408	518
Elim WS - North	95	61	31	0	0	34	64
Elim WS - South	700	173	87	0	0	527	613
Maxwell WSC	791	305	155	0	0	486	636
County Line WSC	223	74	38	0	0	149	185
Plum Creek WSC	868	269	269	0	0	599	599
Goforth WSC	1,096	370	370	0	0	726	726
Creedmoor-Maha WSC	687	153	153	180	180	354	354
Martindale WSC	583	148	148	0	0	435	435
City of Lockhart	2,708	1,816	1,816	0	0	892	892
Total	24,287	9,503	6,174	1,405	1,680	13,379	16,433

Notes:

1) Estimated normal supply from the Edwards Aquifer is based upon the assumption that the aquifer would be managed and normal pumpage will be restricted to about 75% of the 1990 pumpage levels or about 400,000 acft/yr total.

2) Estimated drought supply from the Edwards Aquifer is based upon the assumption that, in a severe drought, the aquifer would be managed to protect springflows and pumpage would be limited to about 38% of the 1990 pumpage levels or about 200,000 acft/yr total.

3) Estimated normal and drought supply from the Barton Springs - Edwards Aquifer, Carizzo-Wilcox Aquifer, and alluvium sources is based upon the assumption that the aquifers are capable of continuing to supply water at the 1990 level of production.

4) Crystal Clear WSC is assume to obtain 25% of its surface water need from the regional system and 75% of its surface water need from other sources (i.e. New Braunfels Utilities, Canyon Regional Water Authority).

5) Creedmoor-Maha WSC is assumed to obtain 180 acft/yr of surface water from existing service connections with the City of Austin, based on 1994-95 usage.

Table 3-5
Projected Surface Water Supply Needs - Year 2000

	Demand	Groundwater Supply		Other Supply		Projected Need	
Participant	Water Demand (acft/yr)	Estimated Normal Supply (acft/yr)	Estimated Drought Supply (acft/yr)	Normal Supply (acft/yr)	Drought Supply (acft/yr)	Normal Usage (acft/yr)	Drought Usage (acft/yr)
City of San Marcos	10,560	5,108	2,588	0	0	5,453	7,972
City of Kyle	405	245	124	0	0	160	281
Crystal Clear WSC	1,625	781	396	634	922	210	307
Elim WS - North	81	61	31	0	0	20	50
Elim WS - South	524	173	87	0	0	352	437
Maxwell WSC	554	305	155	0	0	249	399
County Line WSC	156	74	38	0	0	82	118
Plum Creek WSC	605	269	269	0	0	336	336
Goforth WSC	764	370	370	0	0	394	394
Creedmoor-Maha WSC	500	153	153	180	180	167	167
Martindale WSC	364	148	148	0	0	216	216
City of Lockhart	2,264	1,816	1,816	0	0	448	448
Total	18,402	9,503	6,174	814	1,102	8,087	11,125

Notes:
1) Estimated normal supply from the Edwards Aquifer is based upon the assumption that the aquifer would be managed and normal pumpage will be restricted to about 75% of the 1990 pumpage levels or about 400,000 acft/yr total.
2) Estimated drought supply from the Edwards Aquifer is based upon the assumption that, in a severe drought, the aquifer would be managed to protect springflows and pumpage would be limited to about 38% of the 1990 pumpage levels or about 200,000 acft/yr total.
3) Estimated normal and drought supply from the Barton Springs - Edwards Aquifer, Carizzo-Wilcox Aquifer, and alluvium sources is based upon the assumption that the aquifers are capable of continuing to supply water at the 1990 level of production.
4) Crystal Clear WSC is assume to obtain 25% of its surface water need from the regional system and 75% of its surface water need from other sources (i.e. New Braunfels Utilities, Canyon Regional Water Authority).
5) Creedmoor-Maha WSC is assumed to obtain 180 acft/yr of surface water from existing service connections with the City of Austin, based on 1994-95 usage.

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4.0 WATER SUPPLY ALTERNATIVES

4.1 Background

Two surface water supply alternatives capable of meeting the present and future water supply needs of the study participants were investigated. The criteria used for sizing and cost estimating were the same, providing a consistent basis for comparison. Estimates of total project cost and annual power and operation and maintenance costs were made for each alternative. Total capital cost and annual costs were calculated to provide a common economic basis for comparison.

The water supply alternatives were evaluated with consistent sizing of system components and were sized to meet the projected municipal water demands in the year 2020. Intakes, pump stations, and pipelines were sized to meet the year 2020 peak day demands (approximately 1.75 times the average day demand). Water treatment plants were sized to meet peak day demands in the year 2020, however, phasing of the water treatment plant was considered to reduce the initial capital costs.

The estimated construction costs for each alternative were based on 1995 construction cost information derived from similar type projects. More detailed analyses will be required to refine the costs prior to design, financing, and implementation of the project. however, the cost estimates are considered appropriate for comparing alternatives. Total project costs include right-of-way costs, 15 percent for construction contingencies, and 15 percent for permitting, engineering, legal, and financial services. The annual debt service factor was calculated assuming financing at an interest rate of 7.0 percent for 20 years. Power costs were calculated using a unit cost of $0.075 per kilowatt-hour. Annual operation and maintenance (O&M) costs were estimated as one percent of the total construction cost, except for water treatment plants. For water treatment plants, annual O&M costs were developed based on the treatment capacity and treatment process. Alternatives were compared on a similar economic basis by calculating the total annual costs. Total annual costs were computed by adding the separate annual costs for debt service, power, O&M, and water purchases.

Annual costs were distributed based on each participant's prorata share of the projected normal usage in the year 2000 for the raw water supply system, off-channel reservoir storage, and water treatment plant. For the regional water distribution system, costs were distributed to each participant based on the prorata share of the cost of the pump stations and pipelines that are required to deliver water to each participant.

4.2 General Description of Alternatives

Two surface water supply alternatives were evaluated as part of this study. Alternative 1 evaluates enlarging the facilities proposed by the City of San Marcos to include water supply entities outside of the City of San Marcos service area. Alternative 2 evaluates developing a separate regional surface water supply system to serve all of the study participants, except the City of San Marcos. Alternative 2 assumes that the City of San Marcos develops its own individual surface water supply system, and the remaining ten study participants develop a separate regional system to serve their needs.

Alternative 1 and Alternative 2 are further subdivided into two scenarios for raw water supply. The first scenario (A) assumes that all of the water supply needs are met from the San Marcos River, and the second scenario (B) assumes that the water supply needs are met equally from the San Marcos River (50%) and Canyon Lake (50 %).

4.3 Alternative 1

Alternative 1 evaluates increasing the capacity of the facilities proposed by the City of San Marcos so both San Marcos and the ten other study participants' surface water needs can be met by this facility. The facilities required for this alternative include:

- raw water supply system;
- regional water treatment plant; and
- regional water distribution system.

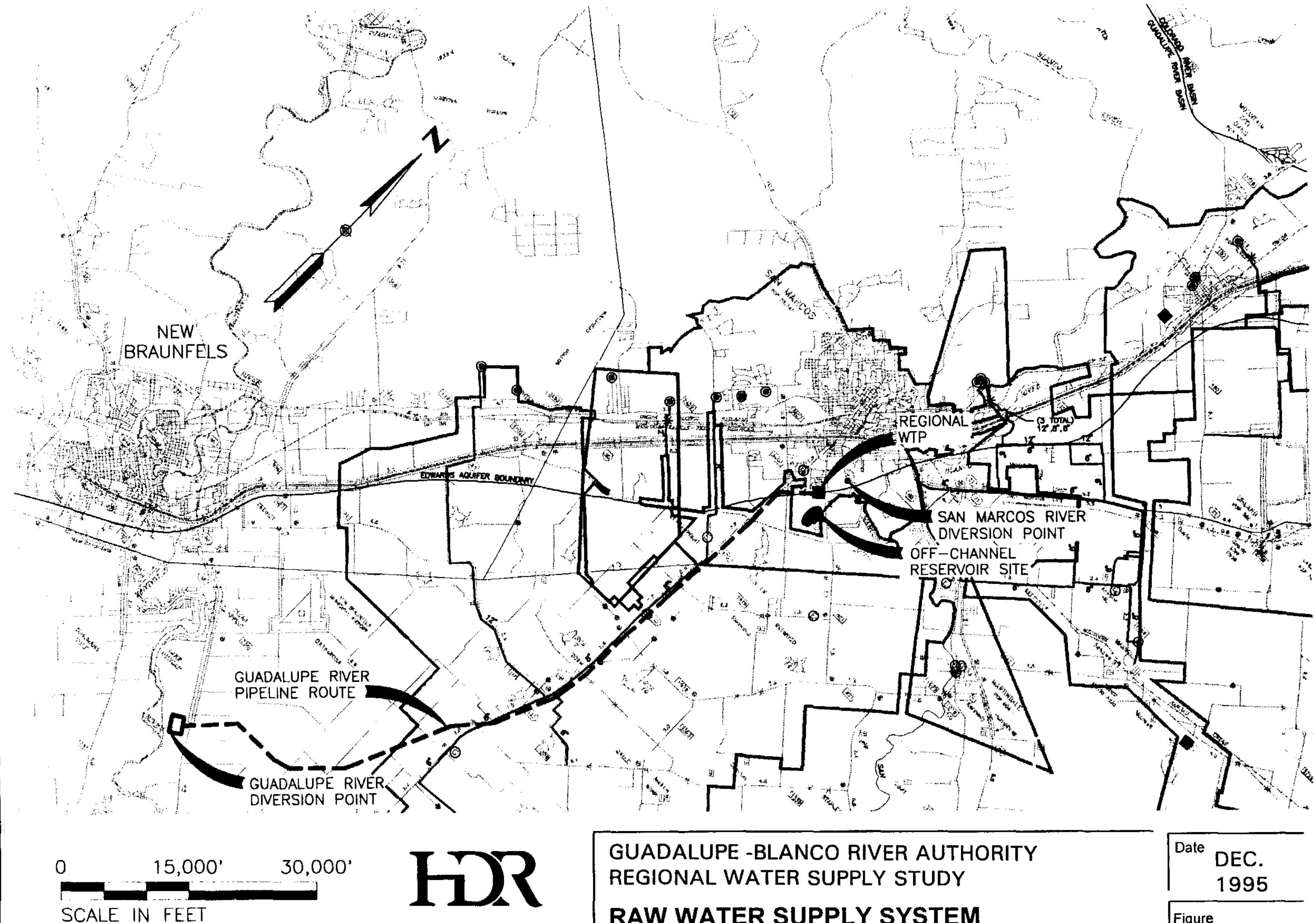
4.3.1 Raw Water Supply System

Two scenarios for raw water supply were evaluated for Alternative 1. The first scenario (Alternative 1A) considers that all of the water supply needs are met from the San Marcos River. The second scenario (Alternative 1B) considers that water supply needs are met equally from the San Marcos River and Canyon Lake.

Alternative 1A requires an off-channel storage reservoir, river intake and pump station, and a raw water pipeline. The concept of the off-channel storage reservoir is to pump raw water from the San Marcos River when flow in the river is adequate to meet downstream needs and store it for future use during dry periods. Storage in the off-channel reservoir also allows flexibility in system operations, provides presedimentation prior to treatment, provides reliability in the event the raw water conveyance facilities are disrupted by power failure or mechanical problems, and permits the raw water intake and pumping facilities to be taken out of operation for maintenance or if the water quality in the river is undesirable. Typically, the watershed area above an off-channel reservoir is small and, therefore, natural inflows to the reservoir do not contribute significantly to the yield of the project. A major advantage of the relatively small watershed area and low natural inflow is that spillway requirements for the dam are minimal and the potential for sediment accumulation in the reservoir is reduced. Additionally, the watershed area can be better controlled to prevent undesirable land use.

Major factors that influence the location of an off-channel storage reservoir include availability of land, ability to control the drainage area of the reservoir if it is constructed in a drainage channel, and ability of natural soils to provide a relatively impermeable liner for the reservoir. Such factors were included in evaluating sites for the off-channel reservoir as part of the City of San Marcos Surface Water Supply Study (HDR, 1994). The site selected is located southeast of the City of San Marcos, as shown in Figure 4-1, and could accommodate a reservoir with a capacity of approximately 8,800 acre-feet (surface area of approximately 223 acres).

Preliminary hydrologic analyses show that a reservoir capacity of 6,300 acre-feet is needed to meet the year 2020 regional water supply need of 16,433 acre-feet per year for Alternative 1A. This capacity assumes that downstream water rights on the Guadalupe River, which are impacted by diversions from the San Marcos River, could be made whole with releases



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RAW WATER SUPPLY SYSTEM

Date DEC. 1995

Figure 4-1

of stored water from Canyon Lake. Preliminary hydrologic analyses conducted as part of the City of San Marcos study show that a quantity of firm yield from Canyon Lake in the amount of about 25 percent of the annual diversion from the river would be required to mitigate downstream water rights during a drought.

The diversion point for raw water from the San Marcos River was selected along the perimeter of Cummings Reservoir downstream of the confluence of the San Marcos River and Blanco River. This diversion point offers multiple advantages in that the existing reservoir pool created by Cummings Dam on the San Marcos River provides a minimum head at the intake from which to pump from, is located downstream of the Blanco River confluence which increases water availability, and is downstream from the primary habitat area for endangered species near San Marcos Springs. Facilities required to divert water from the San Marcos River at this location include a river intake and pump station on the south bank of the river and a 9,000 foot long pipeline from the intake/pump station structure to the off-channel reservoir site. The intake structure, pump station, and raw water pipeline were sized to meet the peak day needs of the region in the year 2020. The raw water pipeline was sized as a 42-inch diameter pipeline and would have an ultimate capacity of 30 mgd (46 cfs).

Alternative 1B includes raw water supply facilities from both the San Marcos River and Canyon Lake. The raw water supply facilities from the San Marcos River source for Alternative 1B are essentially the same as required in Alternative 1A except that the sizing is based on 50 percent of the year 2020 need. Therefore, the off-channel reservoir was downsized to 3,020 ac-ft and the intake, pump station, and raw water pipeline from the San Marcos River were sized to deliver 15 mgd or 23 cfs (50% of year 2020 peak day need). For this alternative, the raw water pipeline from the San Marcos River was downsized to a 30-inch diameter pipeline.

For Alternative 1B, raw water supply from Canyon Lake can be withdrawn from a number of points. Four possible withdrawal points for Canyon Lake water were investigated as part of the City of San Marcos Surface Water Supply Study (HDR, 1994). These withdrawal points included directly from Canyon Lake, Guadalupe River just downstream of Canyon Lake, Guadalupe River at Lake Dunlap, and the GBRA Hydro-Canal located east of Lake Dunlap. Based on analyses of conveyance facility costs, the GBRA Hydro-Canal withdrawal point was found to be the most economical location for diversion of water supplied by Canyon Lake (see

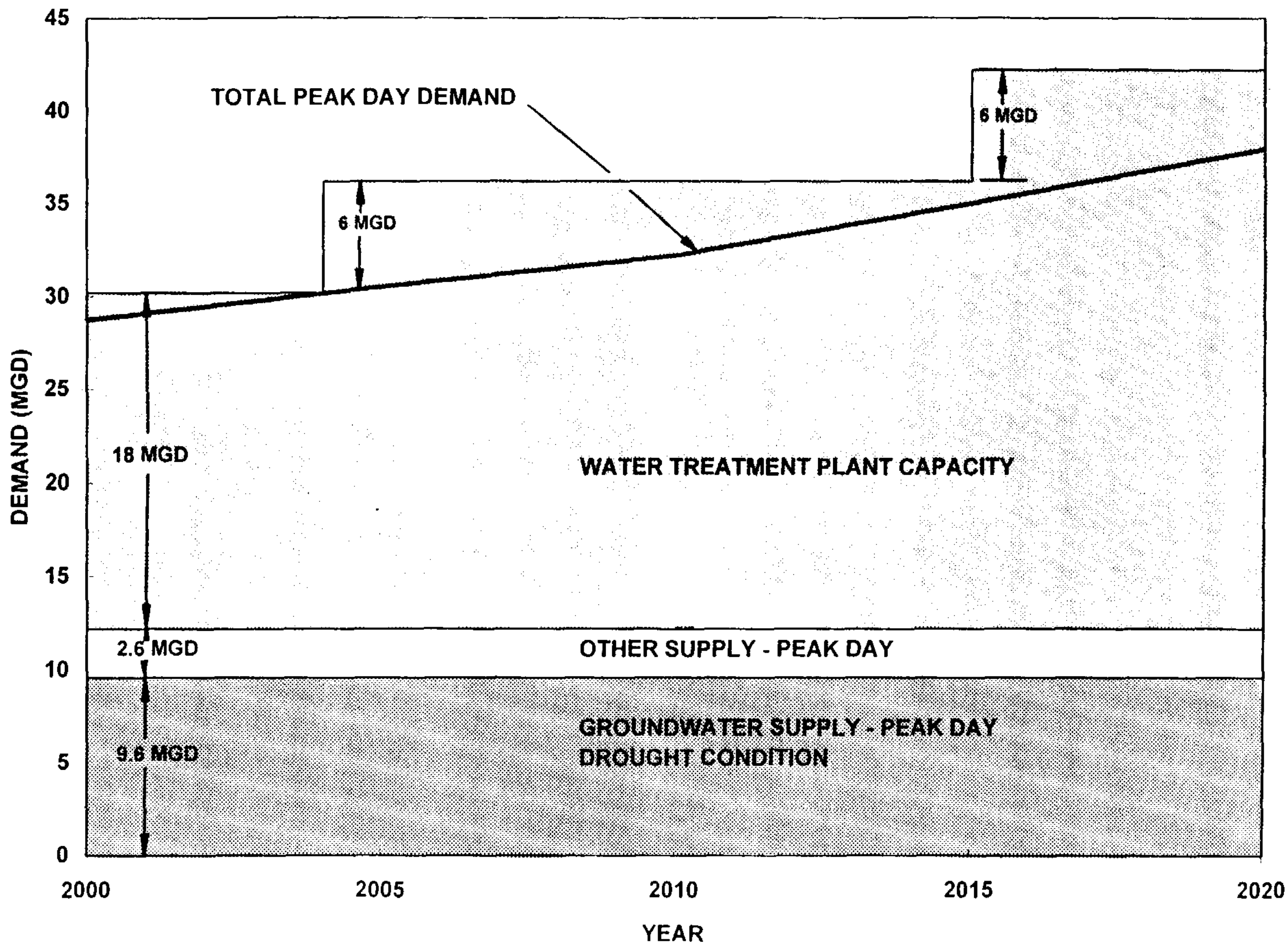
Figure 4-1). The primary advantages of this location were lower construction costs for the intake and conveyance facilities and less environmental impact. Facilities required to divert water released from Canyon Lake to the GBRA Hydro-Canal location include an intake and pump station and a 17.6 mile pipeline from the diversion point to the off-channel reservoir site. The intake structure, pump station, and raw water pipeline were sized to meet 1.5 times the average day drought needs of the region in the year 2020 (14.6 mgd or 34 cfs). Due to the large distance of the raw water pipeline, the pipeline was sized based on an economic analyses of capital cost and annual power cost which resulted in the selection of a pipe diameter of 30-inches.

4.3.2 Regional Surface Water Treatment Plant

Development of a regional surface water treatment plant will require the construction of significant facilities. Water treatment plants which obtain their water supply from surface water sources are required to include pretreatment disinfection, taste and odor control, continuous coagulation, sedimentation, filtration, covered clearwell storage, and final disinfection with chlorine, suitable chlorine compounds, or other disinfection procedures as part of the process stream. The TNRCC Rules and Regulations cover the design and operation of all of these processes.

Sizing of the water treatment plant was based on peak day needs of all the study participants. The initial peak day need in the year 2000 is approximately 17.4 mgd and in the year 2020 the peak day need is projected to be 25.6 mgd. An initial plant capacity of 18 mgd was selected to provide sufficient capacity until about the year 2004. A plant expansion to 24 mgd would be anticipated about this time followed by a third expansion in about the year 2015 to 30 mgd. Figure 4-2 shows a projected phasing scheme for the regional water treatment plant. Facility planning should allow for the ultimate development of a plant capacity of at least 30 mgd, but phased construction will ensure that the improvements are provided at times necessary to meet the region's water needs, based on actual growth in water demands, without requiring excessive capital expenditures well in advance of those needs.

Based on treatability analyses performed as part of the City of San Marcos Surface Water Supply Study (HDR, 1994), the coagulation/filtration process is recommended for the regional



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ALTERNATIVE NO. 1
WATER TREATMENT PLANT CAPACITY

Date DEC. 1995

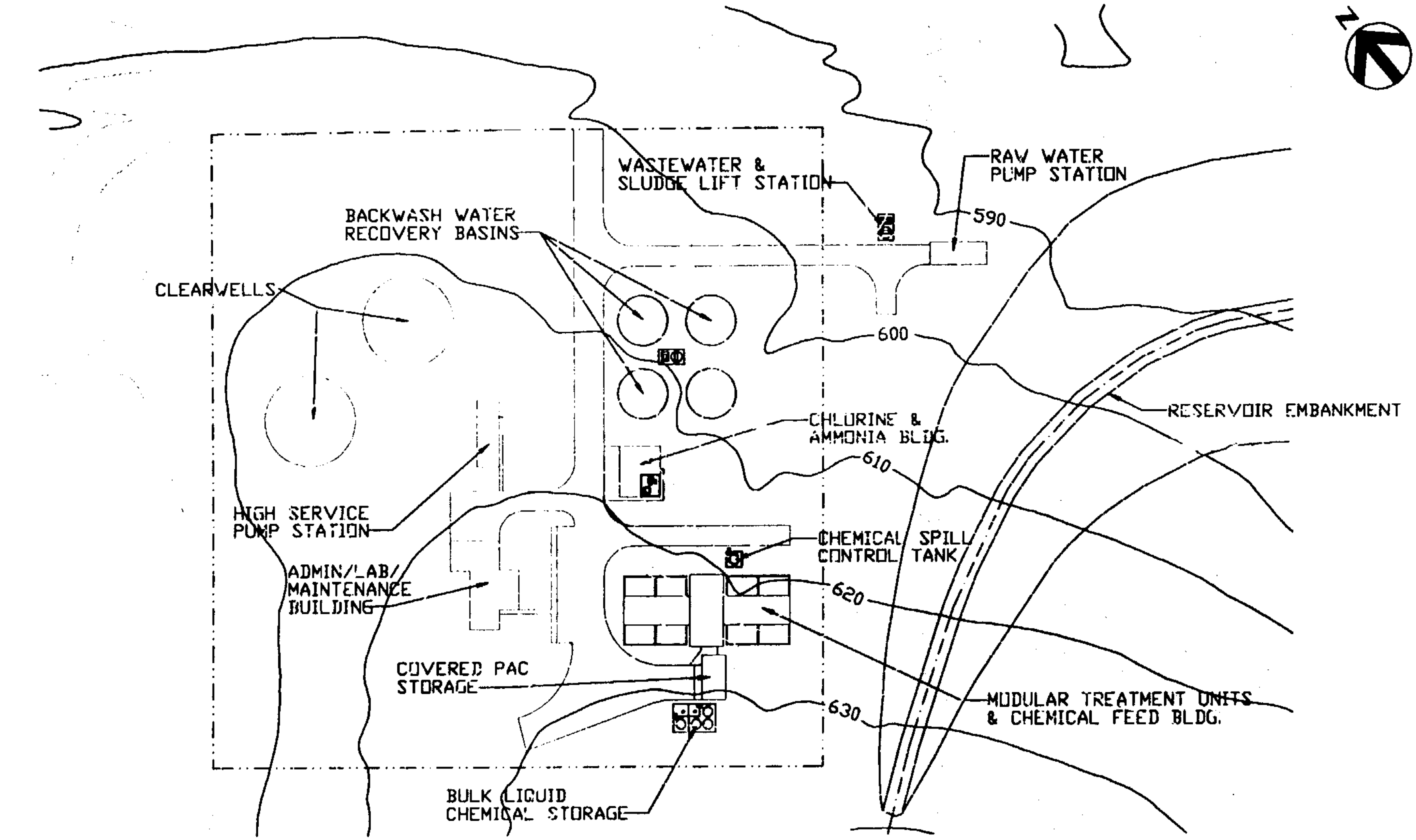
Figure 4-2

treatment plant. This process is employed at water treatment plants treating water from the same sources of raw water including plants at Seguin, New Braunfels, and Luling. There are three basic variations of the coagulation/filtration process which are suitable for consideration. These three options, which differ in their flocculation, clarification, and filtration processes, include the use of the conventional coagulation/filtration process, upflow clarifiers with gravity filtration, and modular treatment units with adsorption clarification and filtration. The treated water quality from all three options is comparable in regards to removal of suspended solids, however, the modular treatment units with adsorption clarification and filtration are recommended, as adsorption clarifiers offer several advantages. The modular treatment units are considerably smaller than either conventional flocculation and sedimentation basins or upflow clarifiers, so less land is needed to provide the same treatment capacity. Their use also eliminates much of the expensive concrete construction associated with conventional and upflow clarifier-type plants, requiring a lower capital investment. Finally, their operation can possibly be automated to a higher degree than either conventional or upflow clarifier plants. The modular treatment units with adsorption clarifiers were recommended on the basis of capital cost, anticipated operation and maintenance cost, and favorable treatment results achieved elsewhere. Figure 4-3 illustrates an example layout of the regional water treatment plant with a capacity of 24 mgd (Phase 2). The principal elements are the modular treatment units, chemical feed systems, clearwell, backwash recovery and solids handling facilities, and laboratory, administration, and maintenance facilities.

4.3.3 Regional Distribution System

A regional system for distribution of water to the study participants will cover a large area and will require an extensive pumping and transmission system. Where possible, pipeline routes follow existing road, railroad, power, or pipeline right-of-way. These locations minimize the inconvenience to property owners, reduces the number of property owners affected, and provide for ease of construction access and future maintenance access.

Based on a review of past water supply studies for the region, two distinctly different delivery options were initially considered. The first option includes a split delivery system which extends from the treatment plant east toward Lockhart and west to Interstate Highway 35



SITE PLAN

NOTE:
SITE PLAN SHOWN IS FOR
24 MGD TREATMENT CAPACITY.

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REGIONAL WATER SUPPLY STUDY

WATER TREATMENT PLANT
SITE LAYOUT

Date DEC. 1995

Figure 4-3

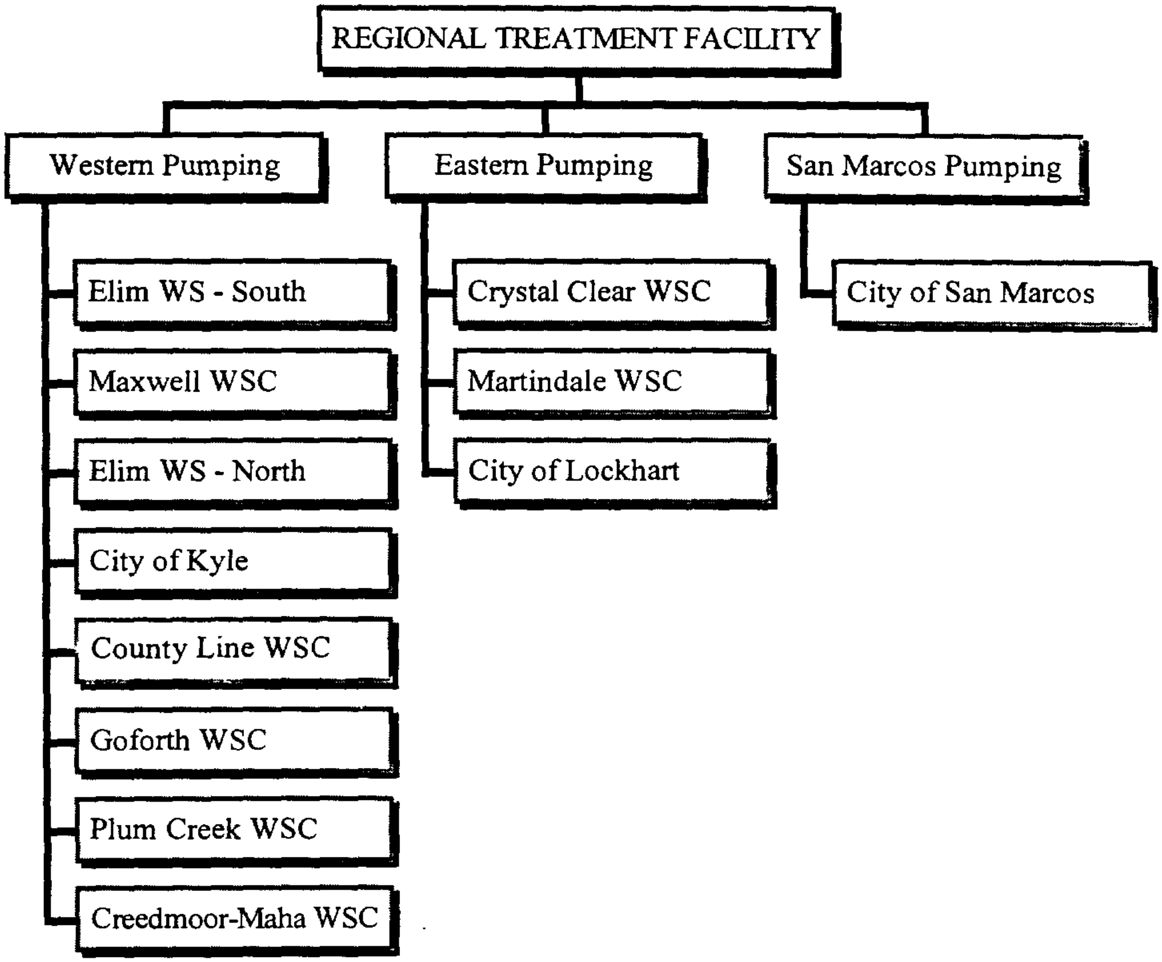
(IH-35) and would deliver treated water to facilities located near the participants' current supply sources. The western portion of this system would deliver treated water to participants with well fields in the Edwards Aquifer (San Antonio portion and Barton Springs portion). The eastern portion of this system would deliver treated water to participants primarily relying on the Carizzo-Wilcox and alluvium aquifer. The second delivery system option considered involved a single transmission pipeline extending north from the treatment facility with spurs to the east and west to deliver treated water to the participants' distribution systems.

A review of the two delivery options revealed that the first option would minimize modifications to the participants' distribution systems and require the least amount of pipe. The second option required lengthy spur lines to deliver water to the location of participant demands. This is the same finding reported in the Hays County Regional Water Supply Study (HDR, 1989). Therefore, since the split transmission approach described in the first option minimizes the initial cost of the regional system to the participants, it was incorporated into Alternative 1.

For Alternative 1, the regional supply system would be configured as illustrated conceptually in Figure 4-4. Separate pumping facilities, located at the treatment facility, would pump to the western participants, eastern participants, and the City of San Marcos. These separate pumping systems will provide efficient operations and simplified control. Both the western and eastern pumping systems will likely require variable frequency drives because of the broad range of demands. The San Marcos treated water pumping facility would likely use fixed speed pumps since it will experience less variation in demand.

In general, the regional delivery system alternative was developed to provide treated surface water to ground storage tanks rather than delivering water under pressure into each individual system, although pressure in the regional distribution system will be maintained at a minimum of 20 psi to meet regulatory requirements, and each participant will then pump water from the ground storage tanks into their system. This allows the size of the regional delivery system pump stations and pipelines to be reduced.

The western transmission route, which serves Elim WS (South), Maxwell WSC, Elim WS (North), City of Kyle, County Line WSC, Plum Creek WSC, Goforth WSC, and Creedmoor-Maha WSC, would cross IH-35 south of the San Marcos River and then would generally follow



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DELIVERY SYSTEM SCHEMATIC
ALTERNATIVE 1

Date DEC. 1995

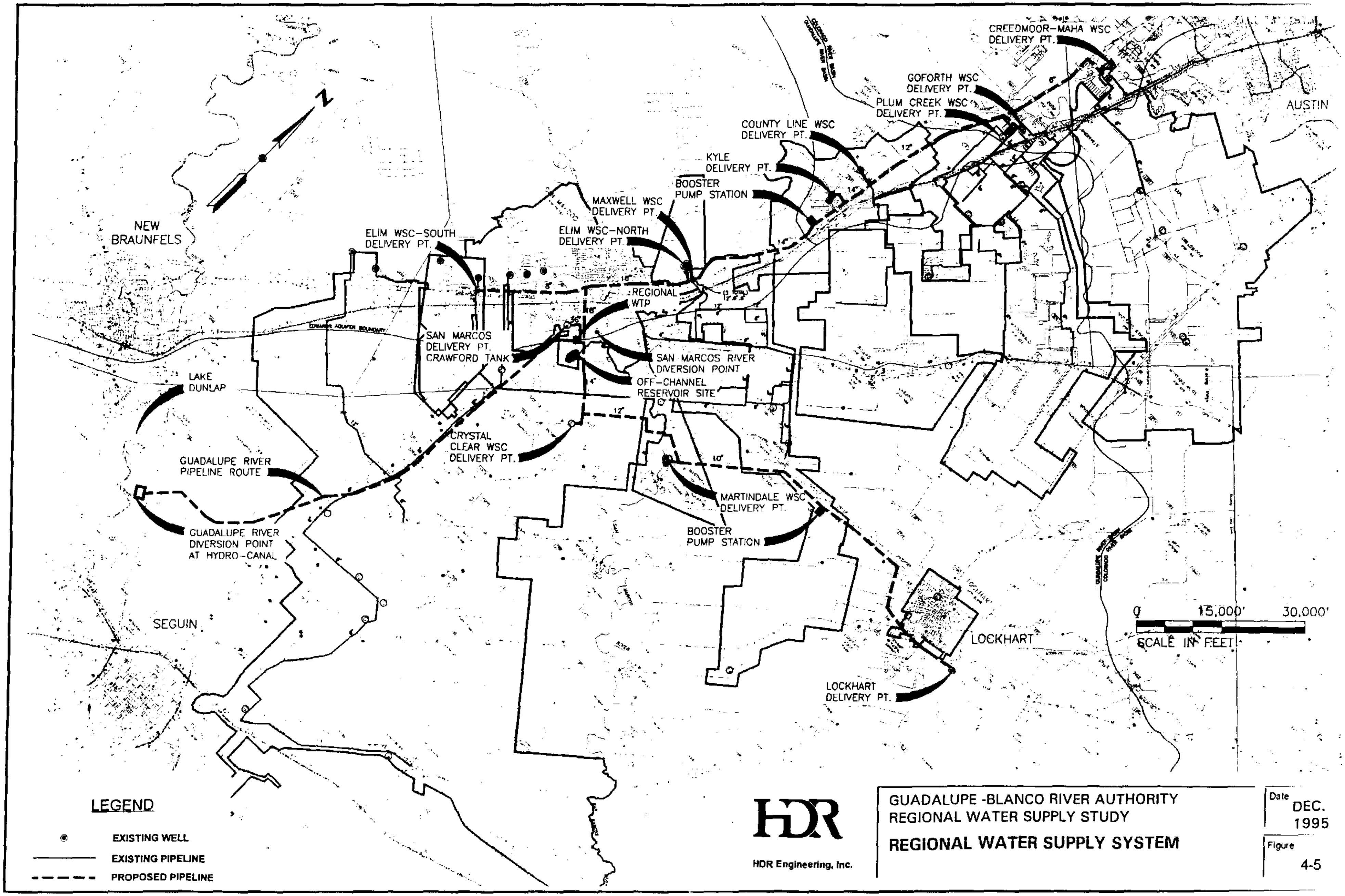
Figure 4-4

the railroad right-of-way as shown on Figure 4-5. Short spurs from the transmission line will deliver water to existing ground storage facilities near current well fields. At each delivery location, termination facilities would include a connection to an existing tank, a control valve, flow meter, and telemetry to the treated water pumping facility.

The Elim WS (south) system does not have a ground storage tank to accept delivery of treated surface water. Therefore a new 10,000 gallon ground storage tank, located near the intersection of the railroad and the Elim WS's 12-inch primary transmission main, has been included in this study. Other delivery options to the Elim WS (south) system could include pumping and piping modifications so an existing ground storage tank at the well field could be used or an interconnection to the City of San Marcos' system so water could be passed through its distribution system to the Elim WS (South) system. An investigation of these two alternatives for delivery of water to Elim WS (South) was beyond the scope of this study.

Maxwell WSC suggested water be delivered to a transmission pipeline in their system, however, the cost of additional ground storage and pumping facilities at this location was found to be more expensive than delivery to Maxwell WSC's well field because the western delivery system route is very close to Maxwell WSC's wells. However, during final design of the regional system, a detailed evaluation of their system hydraulics may alter the location of the delivery point.

Transmission lines were sized to provide sufficient capacity to meet projected peak day demands in year 2020 under drought conditions. Under these conditions, a booster pump station, located just south of Kyle (see Figure 4-5), would be required to deliver water to the more distant participants. Pipeline sizes gradually decrease as water is delivered at various points. The pipeline diameter at the pump station at the water treatment plant would be 18-inches in diameter. It would reduce to 16-inches in diameter after the Elim WS (South) spur, and then reduce to 14-inches in diameter from the spur to Maxwell WSC to the County Line WSC spur. After the County Line WSC spur, the pipeline diameter would reduce to 12-inches to deliver water to the Plum Creek WSC and Goforth WSC spurs, and then the line would further reduce to 6-inches in diameter to deliver water to Creedmoor-Maha WSC. The pipeline routes and sizes are graphically illustrated in Figure 4-6. As indicated by the hydraulic grade lines in this figure, pipe pressure classes would also decrease with distance from pumping stations.


N
NEW BRAUNFELS
LAKE DUNLAP
GUADALUPE RIVER PIPELINE ROUTE
GUADALUPE RIVER DIVERSION POINT AT HYDRO-CANAL
SEGUIN
ELIM WSC-SOUTH DELIVERY PT.
SAN MARCOS DELIVERY PT. CRAWFORD TANK
CRYSTAL CLEAR WSC DELIVERY PT.
ELIM WSC-NORTH DELIVERY PT.
MAXWELL WSC DELIVERY PT.
REGIONAL WTP
SAN MARCOS RIVER DIVERSION POINT
OFF-CHANNEL RESERVOIR SITE
BOOSTER PUMP STATION
KYLE DELIVERY PT.
COUNTY LINE WSC DELIVERY PT.
PLUM CREEK WSC DELIVERY PT.
GOFORTH WSC DELIVERY PT.
CREEDMOOR-MAHA WSC DELIVERY PT.
AUSTIN
MARTINDALE WSC DELIVERY PT.
BOOSTER PUMP STATION
LOCKHART
LOCKHART DELIVERY PT.
0 15,000' 30,000'
SCALE IN FEET
LEGEND
EXISTING WELL
EXISTING PIPELINE
PROPOSED PIPELINE
HDR
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REGIONAL WATER SUPPLY SYSTEM
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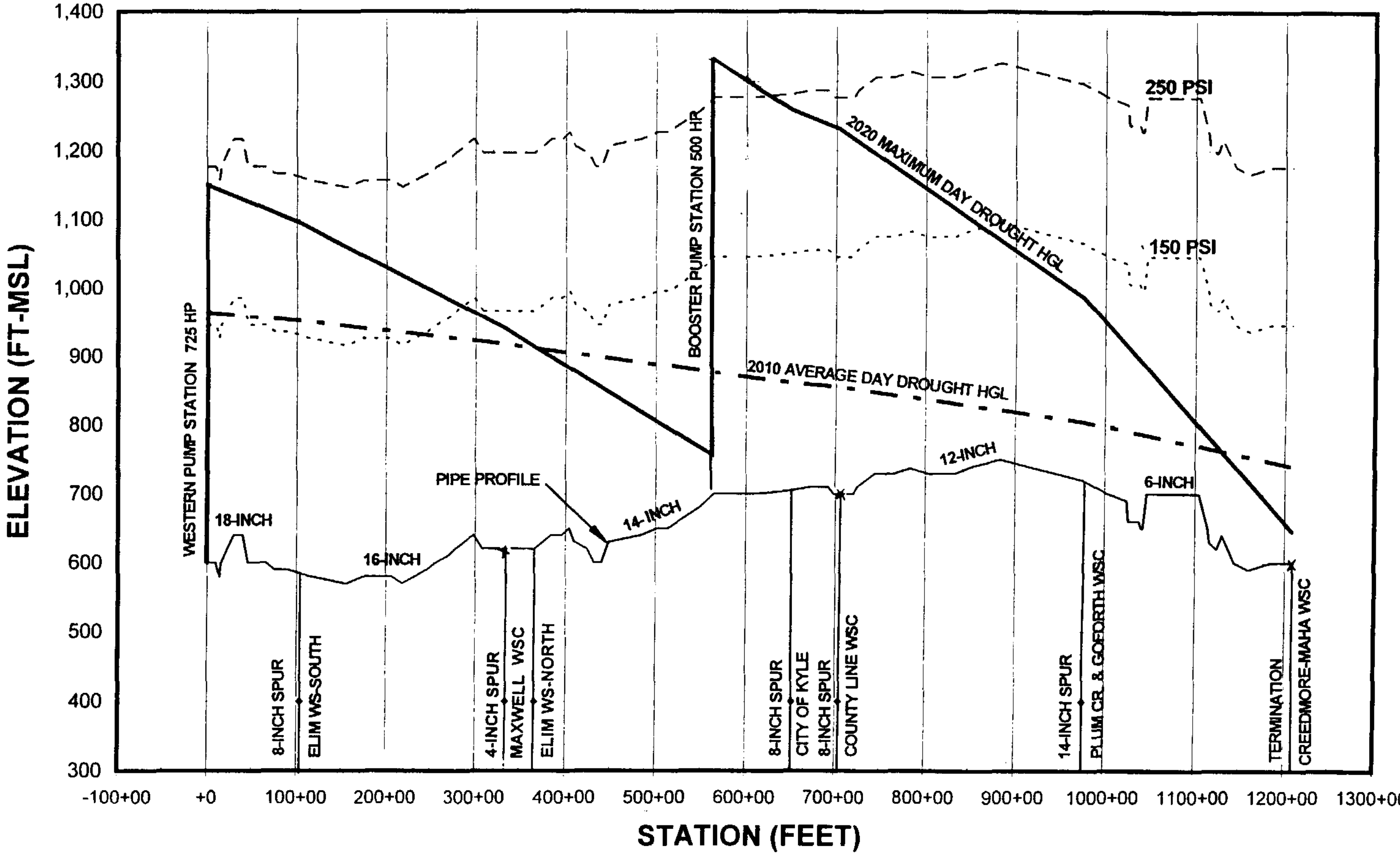
Figure 4-5



NOTE: HGL - HYDRAULIC GRADE LINE

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WESTERN TRANSMISSION PROFILE

Date DEC. 1995

Figure 4-6

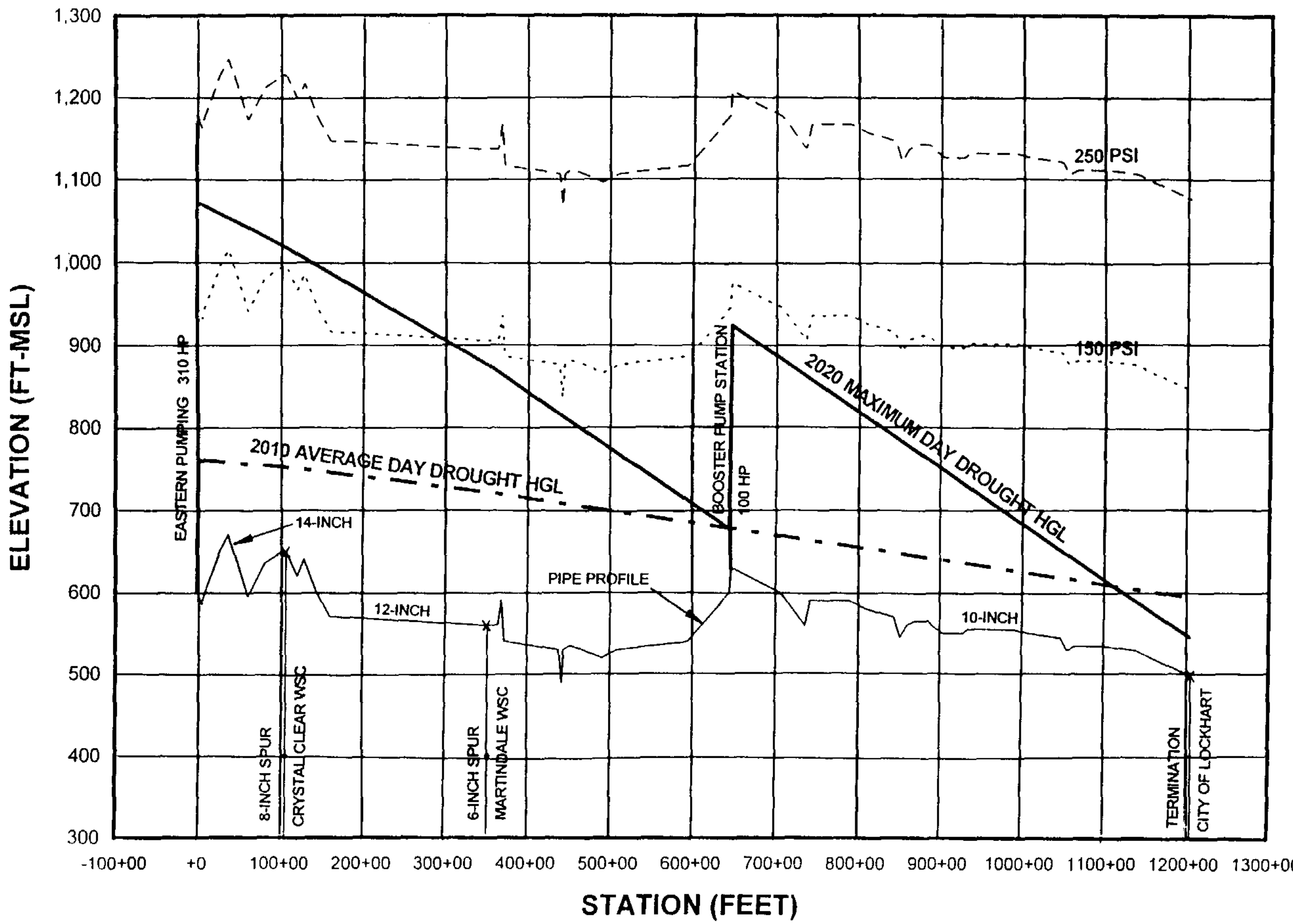
The eastern transmission line would serve Crystal Clear WSC, Martindale WSC, and the City of Lockhart. The transmission line route follows State Highway 621 east to an unnamed road and then crosses the San Marcos River near Sculls Crossing. From this point, the route generally follows State Highway 142 to near Lockhart. As the route approaches Lockhart, it leaves State Highway 142 and follows a power line easement to near the City of Lockhart's water treatment plant (See Figure 4-5). Short spurs from the transmission line deliver water to the existing ground storage facilities of Crystal Clear WSC and Martindale WSC.

Delivery of water to the eastern side of the Maxwell WSC is also possible from this system since the route passes near a Maxwell WSC storage tank. However, because the distribution system network in this area is small and would not be able to utilize the surface water supply as well as the delivery point on the western transmission route, the eastern location was not considered as a delivery site for this study.

The Lockhart delivery point at the existing water treatment plant was selected by the City of Lockhart. However, it may be less expensive to deliver the water on the western side of the City's system. This would shorten the transmission line and provide a dual supply for the City, making their system more reliable and may improve the City's key insurance rate.

At each delivery location on the eastern transmission system, termination facilities would include a connection to an existing tank, a control valve, flow meter, and telemetry to the treated water pumping facility. Transmission lines for this alternative were sized to provide sufficient capacity to meet projected peak day demand in year 2020 under drought conditions. Under these conditions, a booster pump station would be required to deliver water to the City of Lockhart. The station location would be along State Highway 142 just east of Martindale (See Figure 4-5). Pipeline sizes would gradually decrease as water is delivered at various points. Initially, the pipeline would be 14-inches in diameter and it would reduce to 12-inches after the Crystal Clear WSC spur. It would then reduce to 10-inches from Martindale WSC to the City of Lockhart. These pipeline sizes are graphically illustrated in Figure 4-7. Pipe pressure classes also decrease with distance from pumping stations.

The City of San Marcos would be served by an independent transmission line. The transmission route and line size were previously determined in the City of San Marcos Surface Water Supply Study (HDR, 1994). The transmission route generally follows State Highway 621



NOTE: HGL - HYDRAULIC GRADE LINE

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EASTERN TRANSMISSION PROFILE

Date DEC. 1995

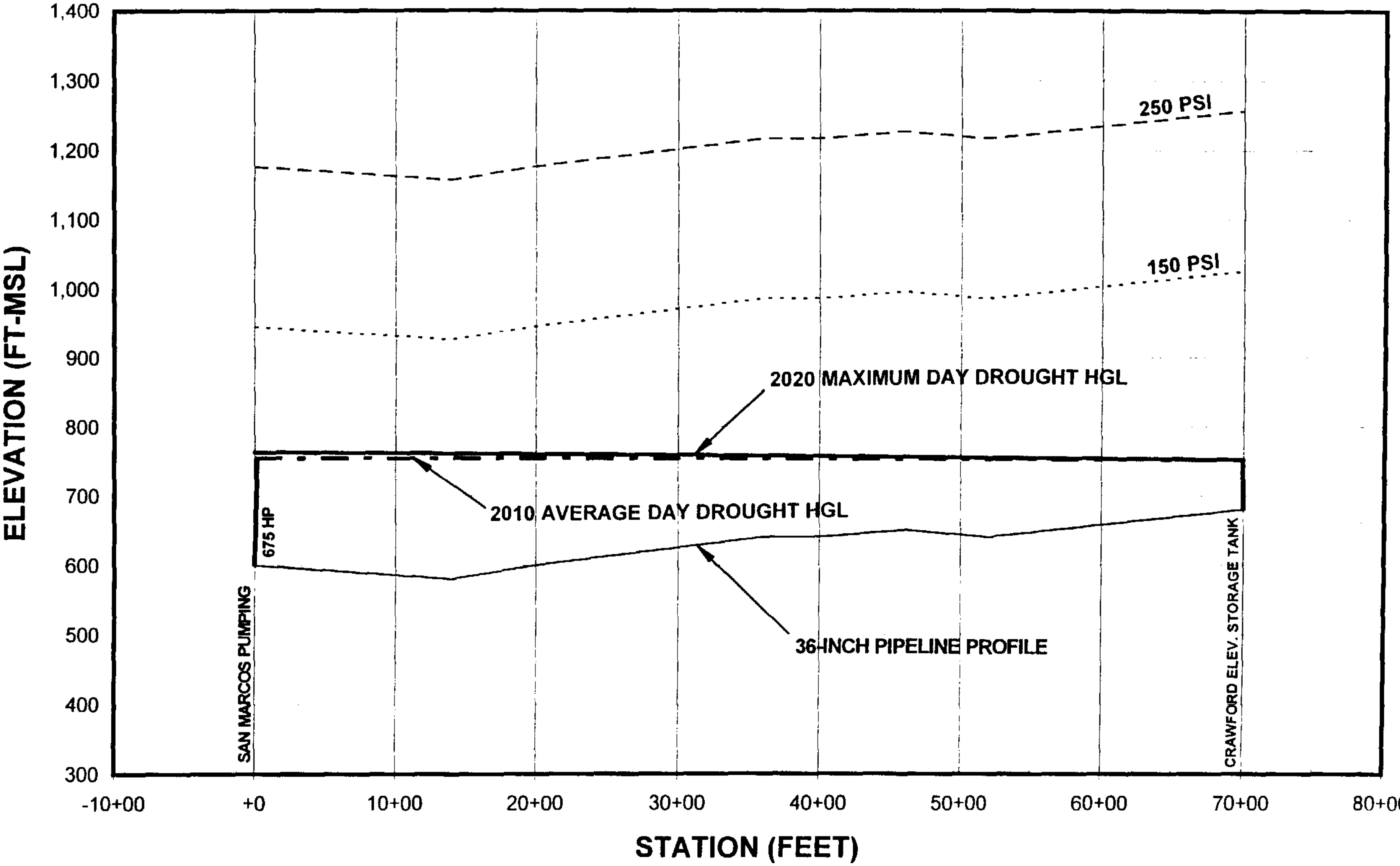
Figure 4-7

east to De Zavala Drive and then south to the Crawford Tank. A 36-inch diameter transmission line was selected to provide sufficient capacity to meet projected demand in year 2020 under drought conditions. As shown in Figure 4-8, the pressure class of this line would be 150 psi and operating characteristics would be stable over a large flow range.

4.3.4 Project Cost Estimate

Cost estimates for Alternative 1A and Alternative 1B were computed in terms of capital cost, annual debt service, and operation and maintenance costs including power. The cost estimates are for facilities sized to meet year 2020 average and peak day demands, except for the regional water treatment plant. The regional water treatment plant is expected to be constructed in three phases to meet the year 2020 demands.

The total estimated project cost for Alternative 1A, shown in Table 4-1, is $44,227,000 which results in a total annual cost, including operation and maintenance, of $5,694,000. The total estimated project cost for Alternative 1B, shown in Table 4-2, is $45,748,000 which results in a total annual cost, including operation and maintenance, of $6,256,000. Alternative 1B is approximately 10 percent more than Alternative 1A due to the additional costs for the pipeline to the Guadalupe River and the purchase of additional raw water. The annual operation and maintenance costs included in these estimates were for the projected year 2000 demands.



NOTE: HGL - HYDRAULIC GRADE LINE

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REGIONAL WATER SUPPLY STUDY

SAN MARCOS TRANSMISSION PROFILE

Date DEC. 1995

Figure 4-8

Table 4-1
Project Cost Estimate - Alternative 1A

Facility	Capital Cost[1]	Annual Debt Service[2]	Annual O&M Cost[3]	Total Annual Cost[4]
Raw Water Supply System				
San Marcos River Source				
Intake/Pump Station	$1,918,000	$181,000	$162,000	$343,000
Raw Water Pipeline	$1,125,000	$106,000	$11,000	$117,000
Raw Water Purchase[5]	$0	$0	$218,000	$218,000
Off-Channel Reservoir				
Dam/Spillway[6]	$9,197,000	$868,000	$92,000	$960,000
Reservoir Land (300 acres)[7]	$750,000	$71,000	$0	$71,000
Guadalupe River Source				
Intake/Pump Station	$0	$0	$0	$0
Raw Water Pipeline	$0	$0	$0	$0
Raw Water Purchase	$0	$0	$0	$0
Subtotal	$12,990,000	$1,226,000	$483,000	$1,709,000
Regional Water Treatment Plant				
Water Treatment Plant (18 mgd)[8]	$15,574,000	$1,470,000	$706,000	$2,176,000
Subtotal	$15,574,000	$1,470,000	$706,000	$2,176,000
Regional Water Distribution System				
Western Distribution System	$8,453,000	$798,000	$142,000	$940,000
Eastern Distribution System	$5,436,000	$513,000	$56,000	$569,000
San Marcos Distribution System	$1,774,000	$167,000	$133,000	$300,000
Subtotal	$15,663,000	$1,478,000	$331,000	$1,809,000
TOTAL	$44,227,000	$4,174,000	$1,520,000	$5,694,000

Notes:
1) Capital cost includes 15% for construction contingencies, 15% for permitting, engineering, legal, and financial services.
2) Annual debt service based on an interest rate of 7 percent and a financing period of 20 years.
3) Annual O&M costs includes general operation and maintenance expenses and cost of power at $0.075 per kilowatt-hour.
4) Total annual cost is the sum of annual debt service and annual O&M cost.
5) Raw water purchase for San Marcos River water includes purchase of Canyon Lake yield at an amount equal to 25 percent of the annual amount used from the San Marcos River for mitigation of downstream water rights.
6) Off-channel reservoir dam/spillway cost are based on an off-channel reservoir storage capacity of 6,300 acre-feet.
7) Off-channel reservoir land cost based on purchase of the watershed area (300 acres) in order to control land use in the contributing area.
8) Water treatment plant size of 18 mgd based on initial capacity (Phase 1). Water treatment plant proposed to be constructed in phases based on actual growth rates.

Table 4-2
Project Cost Estimate - Alternative 1B

Facility	Capital Cost[1]	Annual Debt Service[2]	Annual O&M Cost[3]	Total Annual Cost[4]
Raw Water Supply System				
San Marcos River Source				
Intake/Pump Station	$1,045,000	$99,000	$101,000	$200,000
Raw Water Pipeline	$689,000	$65,000	$7,000	$72,000
Raw Water Purchase[5]	$0	$0	$109,000	$109,000
Off-Channel Reservoir				
Dam/Spillway[6]	$4,342,000	$410,000	$43,000	$453,000
Reservoir Land (300 acres)[7]	$750,000	$71,000	$0	$71,000
Guadalupe River Source				
Intake/Pump Station	$909,000	$86,000	$157,000	$243,000
Raw Water Pipeline	$6,776,000	$640,000	$47,000	$687,000
Raw Water Purchase[8]	$0	$0	$436,000	$436,000
Subtotal	$14,511,000	$1,371,000	$900,000	$2,271,000
Regional Water Treatment Plant				
Water Treatment Plant (18 mgd)[9]	$15,574,000	$1,470,000	$706,000	$2,176,000
Subtotal	$15,574,000	$1,470,000	$706,000	$2,176,000
Regional Water Distribution System				
Western Distribution System	$8,453,000	$798,000	$142,000	$940,000
Eastern Distribution System	$5,436,000	$513,000	$56,000	$569,000
San Marcos Distribution System	$1,774,000	$167,000	$133,000	$300,000
Subtotal	$15,663,000	$1,478,000	$331,000	$1,809,000
TOTAL	$45,748,000	$4,319,000	$1,937,000	$6,256,000

Notes:
1) Capital cost includes 15% for construction contingencies, 15% for permitting, engineering, legal, and financial services.
2) Annual debt service based on an interest rate of 7 percent and a financing period of 20 years.
3) Annual O&M costs includes general operation and maintenance expenses and cost of power at $0.075 per kilowatt-hour.
4) Total annual cost is the sum of annual debt service and annual O&M cost.
5) Raw water purchase for San Marcos River water includes purchase of Canyon Lake yield at an amount equal to 25 percent of the annual amount used from the San Marcos River at a rate of $53 per ac-ft for mitigation of downstream water rights.
6) Off-channel reservoir dam/spillway cost are based on an off-channel reservoir storage capacity of 3,020 acre-feet.
7) Off-channel reservoir land cost based on purchase of the watershed area (300 acres) in order to control land use in the contributing area.
8) Raw water purchase for Guadalupe River water includes purchase of Canyon Lake yield at an amount equal to 8,217 acre-feet per year (50% of the regional need in the year 2020) at a rate of $53 per ac-ft.
9) Water treatment plant size of 18 mgd based on initial capacity (Phase 1). Water treatment plant proposed to be constructed in phases based on actual growth rates.

The estimated costs at the regional water supply system were allocated to each of the study participants based on projected usage. The cost of the raw water supply system and water treatment plant were allocated based on the projected normal usage in the year 2000. The costs for the transmission system were allocated on the prorata share of components of the system that they utilized, based on the projected peak day use in the year 2020, which was the basis for sizing the pipelines. As a result, the cost to study participants that are the greatest distance from the water treatment plant (i.e. Creedmoor-Maha WSC and the City of Lockhart) would be significantly higher. However, the cost of the pump stations and pipelines for these two entities would be more economical than constructing their own independent transmission facilities.

Table 4-3 and Table 4-4 summarize the total annual cost and the unit cost of water per thousand gallons for each study participant based on the normal and drought needs in the year 2000. For Alternative 1A, the cost of treated water for each participant at the water treatment plant is $1.41 per thousand gallons based on the year 2000 normal usage. The cost of water delivered to each study participant based on normal usage, however, varies from $1.64 per thousand gallons for the City of San Marcos to $4.60 per thousand gallons for the City of Lockhart. For Alternative 1B, the cost of treated water at the water treatment plant is $1.69 per thousand gallons based on the year 2000 normal usage. The cost of water delivered to each study participant based on normal usage ranged from $1.86 per thousand gallons for the City of San Marcos to $4.81 per thousand gallons for the City of Lockhart. The large variation in cost is attributable to the cost of delivery of treated water from the regional water treatment plant to each study participant. The City of San Marcos incurs lower costs for water primarily because a large volume of water would be delivered a relatively short distance. The City of Lockhart, as well as Creedmoor-Maha WSC, require a much smaller volume of water to be delivered over a much longer distance, resulting in significantly higher overall costs.

Table 4-3
Alternative 1A
Summary of Costs by Study Participant

Participant	Projected Usage from Regional System in Year 2000 Normal (acft/yr)	Projected Usage from Regional System in Year 2000 Drought (acft/yr)	Annual Cost Raw Water Supply[1]	Annual Cost Water Treatment Plant[2]	Annual Cost Regional Distribution System[3]	Annual Cost Total[4]	Cost Per Thousand Gallons in Year 2000 Normal	Cost Per Thousand Gallons in Year 2000 Drought
City of San Marcos	5,453	7,972	$1,152,400	$1,467,300	$300,400	$2,920,100	$1.64	$1.12
Crystal Clear WSC	210	307	$44,400	$56,500	$45,300	$146,200	$2.14	$1.46
Martindale WSC	216	216	$45,600	$58,100	$67,200	$170,900	$2.43	$2.43
City of Lockhart	448	448	$94,700	$120,500	$456,300	$671,500	$4.60	$4.60
Elim WS	372	487	$78,600	$100,100	$142,400	$321,100	$2.65	$2.02
Maxwell WSC	249	399	$52,600	$67,000	$73,600	$193,200	$2.38	$1.49
City of Kyle	160	281	$33,800	$43,100	$108,300	$185,200	$3.55	$2.02
County Line WSC	82	118	$17,300	$22,100	$51,100	$90,500	$3.39	$2.35
Plum Creek WSC	336	336	$71,000	$90,400	$181,300	$342,700	$3.13	$3.13
Goforth WSC	394	394	$83,300	$106,000	$218,400	$407,700	$3.17	$3.17
Creedmoor-Maha WSC	167	167	$35,300	$44,900	$164,700	$244,900	$4.50	$4.50
Total	8,087	11,125	$1,709,000	$2,176,000	$1,809,000	$5,694,000	$2.16	$1.57

Notes:
1) Includes annual costs for debt service, O&M (including power), and raw water purchase. Raw water supply system facilities include intake/pump station on the San Marcos River, raw water pipeline, raw water purchase from Canyon Lake for mitigation of downstream water right impacts, off-channel reservoir storage (6,300 ac-ft), and purchase of off-channel reservoir watershed area (300 acres).
2) Annual cost includes the annual debt service and O&M (including power) for a water treatment plant with an initial capacity of 18 mgd. O&M costs based on normal water demand in the year 2000.
3) Annual cost for regional distribution system includes annual debt service and O&M (including power) for pump stations, pipelines, and appurtenant facilities to deliver water to each participant at existing ground storage tanks. O&M costs based on year 2000 normal water usage. The costs for the regional distribution system were prorated to each participant for only the facilities required to deliver water to their system.
4) Sum of annual costs for raw water supply, water treatment plant, and regional distribution system. Annual debt service based on an interest rate of 7.0% over a 20 year period. Cost for treated water from the regional water treatment plant for each participant is $1.47 per thousand gallons based on normal usage.

Table 4-4
Alternative 1B
Summary of Costs by Study Participant

	Projected Usage from Regional System in Year 2000		Annual Cost				Cost Per Thousand Gallons in Year 2000	
Participant	Normal (acft/yr)	Drought (acft/yr)	Raw Water Supply[1]	Water Treatment Plant[2]	Regional Distribution System[3]	Total[4]	Normal	Drought
City of San Marcos	5,453	7,972	$1,531,300	$1,467,300	$300,400	$3,299,000	$1.86	$1.27
Crystal Clear WSC	210	307	$59,000	$56,500	$45,300	$160,800	$2.35	$1.61
Martindale WSC	216	216	$60,700	$58,100	$67,200	$186,000	$2.64	$2.64
City of Lockhart	448	448	$125,800	$120,500	$456,300	$702,600	$4.81	$4.81
Elim WS	372	487	$104,500	$100,100	$142,400	$347,000	$2.86	$2.19
Maxwell WSC	249	399	$69,900	$67,000	$73,600	$210,500	$2.59	$1.62
City of Kyle	160	281	$44,900	$43,100	$108,300	$196,300	$3.76	$2.14
County Line WSC	82	118	$23,000	$22,100	$51,100	$96,200	$3.60	$2.50
Plum Creek WSC	336	336	$94,400	$90,400	$181,300	$366,100	$3.34	$3.34
Goforth WSC	394	394	$110,600	$106,000	$218,400	$435,000	$3.39	$3.39
Creedmoor-Maha WSC	167	167	$46,900	$44,900	$164,700	$256,500	$4.71	$4.71
Total	8,087	11,125	$2,271,000	$2,176,000	$1,809,000	$6,256,000	$2.37	$1.73

Notes:
1) Includes annual costs for debt service, O&M (including power), and raw water purchase. Raw water supply system includes intake/pump station on the San Marcos River, raw water pipeline, raw water purchase from Canyon Lake for mitigation of downstream water right impacts, off-channel reservoir storage (3,020 ac-ft), and purchase of off-channel reservoir watershed area (300 acres). The raw water supply system also includes an intake/pump station at the GBRA Hydro-Canal location, raw water pipeline, and raw water purchase from Canyon Lake for 50% of the year 2020 annual need.
2) Annual cost includes the annual debt service and O&M (including power) for a water treatment plant with an initial capacity of 18 mgd. O&M costs based on normal water demand in the year 2000.
3) Annual cost for regional distribution system includes annual debt service and O&M (including power) for pump stations, pipelines, and appurtenant facilities to deliver water to each participant at existing ground storage tanks. O&M costs based on year 2000 normal water usage. The costs for the regional distribution system were prorated to each participant for only the facilities required to deliver water to their system.
4) Sum of annual costs for raw water supply, water treatment plant, and regional distribution system. Annual debt service based on an interest rate of 7.0% over a 20 year period. Cost for treated water from the regional water treatment plant for each participant is $1.69 per thousand gallons based on normal usage.

4.4 Alternative 2

Alternative 2 includes an evaluation of a regional surface water supply system serving all of the study participants except for the City of San Marcos. Alternative 2 assumes that the City of San Marcos develops its own surface water supply system and the remaining ten study participants develop a separate regional system. The water treatment plant and off-channel storage facility locations for Alternative 2 were assumed to be at approximately the same location as in Alternative 1. The facilities required to develop this alternative are the same as Alternative 1 and include:

- raw water supply system;
- regional water treatment plant; and
- regional water distribution system.

4.4.1 Raw Water Supply System

Similar to Alternative 1, two scenarios for raw water supply were evaluated for Alternative 2. The first scenario (Alternative 2A) was based on meeting all of the water supply needs from the San Marcos River. The second scenario (Alternative 2B) assumes that water supply needs are met equally from the San Marcos River and Canyon Lake.

Alternative 2A requires an off-channel storage reservoir, river intake and pump station, and a raw water pipeline. These facilities are sized to meet only the needs of the ten participants outside of the City of San Marcos. Based on preliminary hydrologic analyses, a reservoir capacity of 2,060 acre-feet is needed to meet the year 2020 regional water supply need of 5,521 acre-feet per year for the ten study participants. As in Alternative 1, a purchase of firm yield from Canyon Lake in the amount of 25 percent of the annual diversion from the San Marcos River was assumed to be required to mitigate impacts to downstream water rights.

The diversion point for raw water from the San Marcos River for Alternative 2 was the same location as in Alternative 1, along the perimeter of Cummings Reservoir. The intake structure, pump station, and raw water pipeline to deliver raw water to the off-channel reservoir were sized to meet the peak day needs in the year 2020. The peak day capacity of the water treatment plant for Alternative 2 in the year 2020 was estimated to be 10 mgd or about 15 cfs. The raw water pipeline was sized to be a 24-inch diameter pipeline.

Alternative 2B includes raw water supply facilities from both the San Marcos River and Canyon Lake. The raw water supply facilities to divert from the San Marcos River are downsized based on 50 percent of the year 2020 need. The off-channel reservoir was downsized to 1,065 ac-ft and the intake, pump station, and raw water pipeline from the San Marcos River to the off-channel reservoir were sized to deliver 5 mgd or 8 cfs (50 % of the year 2020 peak day need). The raw water pipeline from the San Marcos River would be 18-inches in diameter.

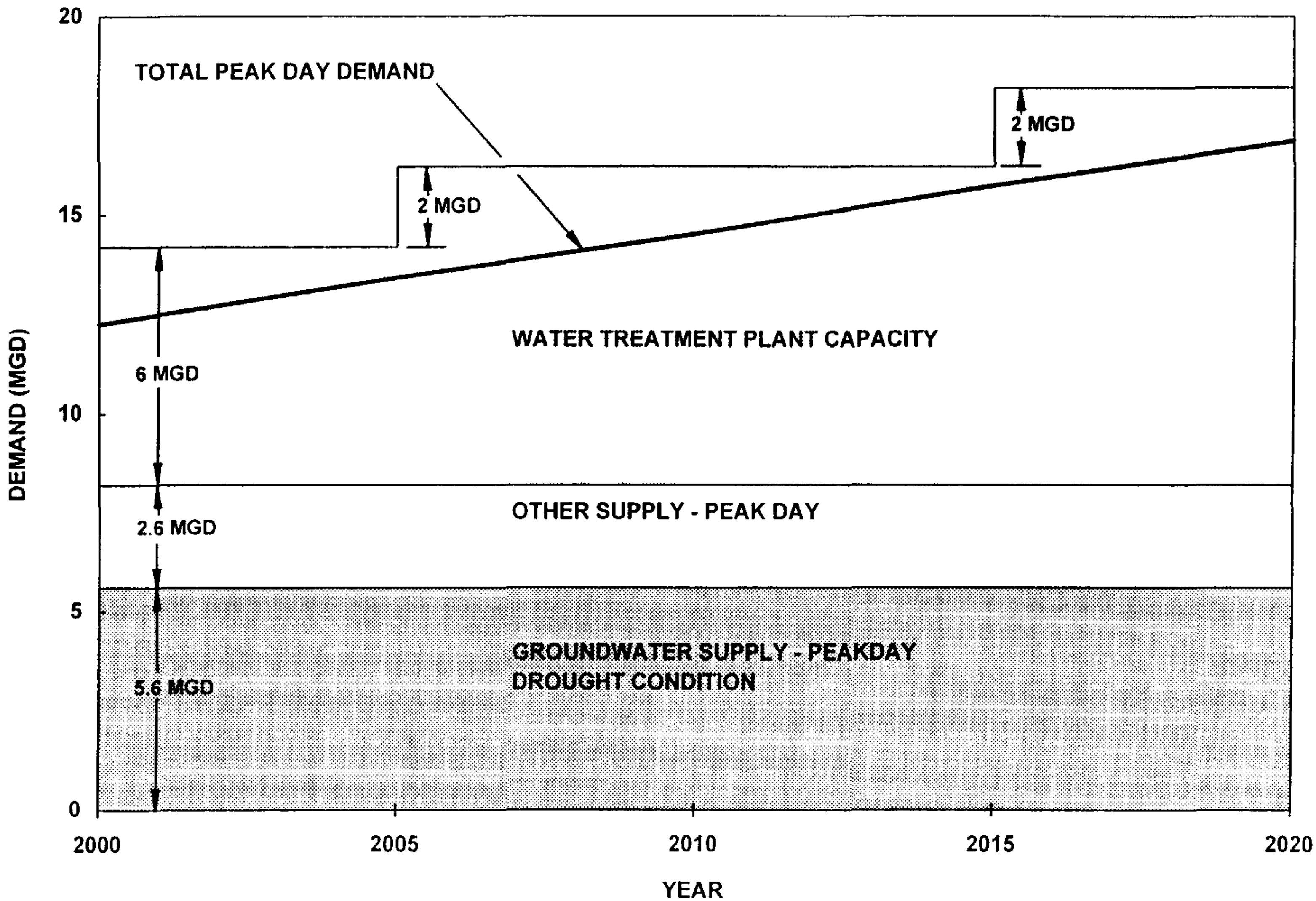
For Alternative 2B, raw water from Canyon Lake would be withdrawn from GBRA's Hydro-Canal diversion point as in Alternative 1B. The intake, pump station, and pipeline were sized to deliver 1.5 times the average day need in the year 2020 (7.4 mgd or 11 cfs). The raw water pipeline size was based on an economic analyses of capital cost and annual power cost, resulting in the selection of a pipe diameter of 16 inches.

4.4.2 Regional Surface Water Treatment Plant

The regional surface water treatment plant for Alternative 2 was sized to meet peak day needs of the ten study participants and utilizes the same treatment process described for Alternative 1. The initial peak day need in the year 2000 would be approximately 4.9 mgd, and in the year 2020 the peak day need is projected to be 8.6 mgd. An initial plant capacity of six mgd would provide sufficient capacity until about the year 2005. A plant expansion to eight mgd would be anticipated about this time, and a third expansion to 10 mgd would be needed about the year 2015. Figure 4-9 shows this water treatment plant phasing scheme for Alternative 2.

4.4.3 Regional Distribution System

The regional water treatment plant for Alternative 2 was assumed to be at approximately the same location as in Alternative 1. As a result, the distribution system for Alternative 2 is essentially identical to Alternative 1 except that the delivery system for the City of San Marcos is eliminated. The regional distribution system would consist only of the western and eastern transmission systems. The capital cost and annual operation and maintenance cost would be the same as presented in Alternative 1.



HDR Engineering, Inc.

GUADALUPE -BLANCO RIVER AUTHORITY
REGIONAL WATER SUPPLY STUDY

ALTERNATIVE NO. 2
WATER TREATMENT PLANT CAPACITY

Date DEC. 1995

Figure 4-9

4.4.4 Project Cost Estimate

Cost estimates for Alternative 2A and Alternative 2B were computed in terms of capital cost, annual debt service, and operation and maintenance costs including power, using the same methodology as presented for Alternative 1. The total estimated project cost for Alternative 2A, shown in Table 4-5, is $26,679,000 which results in a total annual cost of $3,224,000, including an O&M cost of $705,000 per year. For Alternative 2B, the total estimated cost is $30,792,000 and the total O&M cost was estimated to be $883,000, resulting in an annual cost of $3,790,000. As in Alternative 1, the annual O&M costs were based on the projected year 2000 demands. Alternative 2B was found to be about 18 percent higher than Alternative 2A due to the cost to deliver Canyon Lake water.

The costs for Alternative 2 were allocated to each of the study participants based on projected usage using the same methodology as in Alternative 1. Table 4-7 and Table 4-8 summarize the total annual cost and the unit cost of water per thousand gallons for each study participant based on normal and drought needs in the year 2000. For Alternative 2A, the cost of treated water for each of the participants at the water treatment plant is $2.00 per thousand gallons based on the year 2000 normal usage. The cost of treated water delivered to the study participants ranges from $2.66 per thousand gallons for Crystal Clear WSC to $5.12 per thousand gallons for the City of Lockhart. For Alternative 2B, the cost of treated water at the water treatment plant is $2.66 per thousand gallons based on the year 2000 normal usage. The cost of treated water delivered to the participants ranges from $3.32 per thousand gallons to $5.78 per thousand gallons. As in Alternative 1, the more distant participants (i.e. City of Lockhart and Creedmoor-Maha WSC) incur higher costs due to the additional expense required to transmit water longer distances.

Table 4-5
Project Cost Estimate - Alternative 2A

Facility	Capital Cost[1]	Annual Debt Service[2]	Annual O&M Cost[3]	Total Annual Cost[4]
Raw Water Supply System				
San Marcos River Source				
Intake/Pump Station	$1,042,000	$98,000	$33,000	$131,000
Raw Water Pipeline	$534,000	$51,000	$30,000	$81,000
Raw Water Purchase[5]	$0	$0	$73,000	$73,000
Off-Channel Reservoir				
Dam/Spillway[6]	$3,229,000	$305,000	$32,000	$337,000
Reservoir Land (300 acres)[7]	$750,000	$71,000	$0	$71,000
Guadalupe River Source				
Intake/Pump Station	$0	$0	$0	$0
Raw Water Pipeline	$0	$0	$0	$0
Raw Water Purchase	$0	$0	$0	$0
Subtotal	$5,555,000	$525,000	$168,000	$693,000
Regional Water Treatment Plant				
Water Treatment Plant (6 mgd)[8]	$7,235,000	$683,000	$270,000	$953,000
Subtotal	$7,235,000	$683,000	$270,000	$953,000
Regional Water Distribution System				
Western Distribution System	$8,453,000	$798,000	$142,000	$940,000
Eastern Distribution System	$5,436,000	$513,000	$56,000	$569,000
Subtotal	$13,889,000	$1,311,000	$198,000	$1,509,000
TOTAL	$26,679,000	$2,519,000	$636,000	3,155,000

Notes:
1) Capital cost includes 15% for construction contingencies, 15% for permitting, engineering, legal, and financial services.
2) Annual debt service based on an interest rate of 7 percent and a financing period of 20 years.
3) Annual O&M costs includes general operation and maintenance expenses and cost of power at $0.075 per kilowatt-hour.
4) Total annual cost is the sum of annual debt service and annual O&M cost.
5) Raw water purchase for San Marcos River water includes purchase of Canyon Lake yield at an amount equal to 25 percent of the annual amount used from the San Marcos River for mitigation of downstream water rights.
6) Off-channel reservoir dam/spillway cost are based on an off-channel reservoir storage capacity of 2,060 acre-feet.
7) Off-channel reservoir land cost based on purchase of the watershed area (300 acres) in order to control land use in the contributing area.
8) Water treatment plant size of 6 mgd based on initial capacity (Phase 1). Water treatment plant proposed to be constructed in phases based on actual growth rates.

Table 4-6
Project Cost Estimate - Alternative 2B

Facility	Capital Cost[1]	Annual Debt Service[2]	Annual O&M Cost[3]	Total Annual Cost[4]
Raw Water Supply System				
San Marcos River Source				
Intake/Pump Station	$839,000	$79,000	$20,000	$99,000
Raw Water Pipeline	$451,000	$43,000	$16,000	$59,000
Raw Water Purchase[5]	$0	$0	$37,000	$37,000
Off-Channel Reservoir				
Dam/Spillway[6]	$2,314,000	$218,000	$23,000	$241,000
Reservoir Land (300 acres)[7]	$750,000	$71,000	$0	$71,000
Guadalupe River Source				
Intake/Pump Station	$878,000	$83,000	$65,000	$148,000
Raw Water Pipeline	$4,436,000	$419,000	$56,000	$475,000
Raw Water Purchase[8]	$0	$0	$146,000	$146,000
Subtotal	$9,668,000	$913,000	$363,000	$1,276,000
Regional Water Treatment Plant				
Water Treatment Plant (6 mgd)[9]	$7,235,000	$683,000	$270,000	$953,000
Subtotal	$7,235,000	$683,000	$270,000	$953,000
Regional Water Distribution System				
Western Distribution System	$8,453,000	$798,000	$142,000	$940,000
Eastern Distribution System	$5,436,000	$513,000	$56,000	$569,000
Subtotal	$13,889,000	$1,311,000	$198,000	$1,509,000
TOTAL	$30,792,000	$2,907,000	$831,000	$3,738,000

Notes:
1) Capital cost includes 15% for construction contingencies, 15% for permitting, engineering, legal, and financial services.
2) Annual debt service based on an interest rate of 7 percent and a financing period of 20 years.
3) Annual O&M costs includes general operation and maintenance expenses and cost of power at $0.075 per kilowatt-hour.
4) Total annual cost is the sum of annual debt service and annual O&M cost.
5) Raw water purchase for San Marcos River water includes purchase of Canyon Lake yield at an amount equal to 25 percent of the annual amount used from the San Marcos River at a rate of $53 per ac-ft for mitigation of downstream water rights.
6) Off-channel reservoir dam/spillway cost are based on an off-channel reservoir storage capacity of 1,065 acre-feet.
7) Off-channel reservoir land cost based on purchase of the watershed area (300 acres) in order to control land use in the contributing area.
8) Raw water purchase for Guadalupe River water includes purchase of Canyon Lake yield at an amount equal to 2,761 acre-feet per year (50% of the regional need in the year 2020) at a rate of $53 per ac-ft.
9) Water treatment plant size of 6 mgd based on initial capacity (Phase 1). Water treatment plant proposed to be constructed in phases based on actual growth rates.

Table 4-7
Alternative 2A
Summary of Costs by Study Participant

Participant	Projected Usage from Regional System in Year 2000 Normal (acft/yr)	Drought (acft/yr)	Annual Cost: Raw Water Supply[1]	Water Treatment Plant[2]	Regional Distribution System[3]	Total[4]	Cost Per Thousand Gallons in Year 2000: Normal	Drought
Crystal Clear WSC	210	307	$55,200	$81,500	$45,300	$182,000	$2.66	$1.82
Martindale WSC	216	216	$56,800	$83,800	$67,200	$207,800	$2.95	42.95
City of Lockhart	448	448	$117,900	$173,800	$456,300	$748,000	$5.12	$5.12
Elim WS	372	487	$97,900	$144,300	$142,400	$384,600	$3.17	$2.42
Maxwell WSC	249	399	$65,500	$96,600	$73,600	$235,700	$2.90	$1.81
City of Kyle	160	281	$42,100	$62,100	$108,300	$212,500	$4.08	42.32
County Line WSC	82	118	$21,600	$31,800	$51,100	$104,500	$3.91	$2.72
Plum Creek WSC	336	336	$88,400	$130,400	$181,300	$400,100	$3.65	$3.65
Goforth WSC	394	394	$103,700	$152,900	$218,400	$475,000	$3.70	$3.70
Creedmoor-Maha WSC	167	167	$43,900	$64,800	$164,700	$273,400	$5.02	$5.02
Total	2,634	3,153	$693,000	$1,022,000	$1,508,600	$3,223,600	$3.76	$3.14

Notes:
1) Includes annual costs for debt service, O&M (including power), and raw water purchase. Raw water supply system facilities include intake/pump station on the San Marcos River, raw water pipeline, raw water purchase from Canyon Lake for mitigation of downstream water right impacts, off-channel reservoir storage (2,060 ac-ft), and purchase of off-channel reservoir watershed area (300 acres).
2) Annual cost includes the annual debt service and O&M (including power) for a water treatment plant with an initial capacity of 6 mgd. O&M costs based on normal water demand in the year 2000.
3) Annual cost for regional distribution system includes annual debt service and O&M (including power) for pump stations, pipelines, and appurtenant facilities to deliver water to each participant at existing ground storage tanks. O&M costs based on year 2000 normal water usage. The costs for the regional distribution system were prorated to each participant for only the facilities required to deliver water to their system.
4) Sum of annual costs for raw water supply, water treatment plant, and regional distribution system. Annual debt service based on an interest rate of 7.0% over a 20 year period. Cost for treated water from the regional water treatment plant for each participant is $2.00 per thousand gallons based on normal usage.

Table 4-8
Alternative 2B
Summary of Costs by Study Participant

Participant	Projected Usage from Regional System in Year 2000		Annual Cost				Cost Per Thousand Gallons in Year 2000	
	Normal (acft/yr)	Drought (acft/yr)	Raw Water Supply[1]	Water Treatment Plant[2]	Regional Distribution System[3]	Total[4]	Normal	Drought
Crystal Clear WSC	210	307	$100,400	$81,500	$45,300	$227,200	$3.32	$2.27
Martindale WSC	216	216	$103,300	$83,800	$67,200	$254,300	$3.61	$3.61
City of Lockhart	448	448	$214,100	$173,800	$456,300	$844,200	$5.78	$5.78
Elim WS	372	487	$177,800	$144,300	$142,400	$464,500	$3.83	$2.93
Maxwell WSC	249	399	$119,000	$96,600	$73,600	$289,200	$3.56	$2.22
City of Kyle	160	281	$76,500	$62,100	$108,300	$246,900	$4.74	$2.70
County Line WSC	82	118	$39,200	$31,800	$51,100	$122,100	$4.57	$3.18
Plum Creek WSC	336	336	$160,600	$130,400	$181,300	$472,300	$4.31	$4.31
Goforth WSC	394	394	$188,300	$152,900	$218,400	$559,600	$4.36	$4.36
Creedmoor-Maha WSC	167	167	$79,800	$64,800	$164,700	$309,300	$5.68	$5.68
Total	2,634	3,153	$1,259,000	$1,022,000	$1,508,600	$3,789,600	$$4.42	$3.69

Notes:
1) Includes annual costs for debt service, O&M (including power), and raw water purchase. Raw water supply system facilities include intake/pump station on the San Marcos River, raw water pipeline, raw water purchase from Canyon Lake for mitigation of downstream water right impacts, off-channel reservoir storage (1,065 ac-ft), and purchase of off-channel reservoir watershed area (300 acres).). The raw water supply system also includes an intake/pump station at the GBRA Hydro-Canal location, raw water pipeline, and raw water purchase from Canyon Lake for 50% of the year 2020 annual need.
2) Annual cost includes the annual debt service and O&M (including power) for a water treatment plant with an initial capacity of 6 mgd. O&M costs based on normal water demand in the year 2000.
3) Annual cost for regional distribution system includes annual debt service and O&M (including power) for pump stations, pipelines, and appurtenant facilities to deliver water to each participant at existing ground storage tanks. O&M costs based on year 2000 normal water usage. The costs for the regional distribution system were prorated to each participant for only the facilities required to deliver water to their system.
4) Sum of annual costs for raw water supply, water treatment plant, and regional distribution system. Annual debt service based on an interest rate of 7.0% over a 20 year period. Cost for treated water from the regional water treatment plant for each participant is $2.66 per thousand gallons based on normal usage.

4.5 Summary

The results of the analyses show that development of a regional water supply system for all of the participants (Alternative 1) would offer significant economic benefits to all of the study participants. Table 4-9 and Table 4-10 compare the unit cost of water for Alternative 1 and Alternative 2 for each of the study participants outside of the City of San Marcos service area. Depending on the source of raw water, cost reductions ranging from 10% to 29% may be realized by development of a regional system in conjunction with the City of San Marcos (Alternative 1) as compared to development of a separate regional system without the City of San Marcos (Alternative 2). Over the 20-year planning period, total savings range from $19,280,000 to $31,780,000 for all 11 participating entities, depending on the raw water supply. The magnitude of the individual cost reductions generally depend on the participant's location in relation to the regional water treatment plant and the volume of water taken from the regional facility.

Table 4-11 compares the unit cost of water for the City of San Marcos for a regional system (Alternative 1) to the unit cost of water for a system serving only the City's needs. The City of San Marcos is estimated to use almost 70% of the water produced from the regional system. The table shows that cost reductions ranging from 8% to 9% may be achieved by the City with implementation of a regional system rather than an individual system. Over the 20-year planning period, this amounts to savings ranging from $6,320,000 to $7,670,000 for the City of San Marcos alone, depending on the raw water supply.

Table 4-9
Cost Comparison
for Study Participants Outside of the City of San Marcos Service Area
A) Raw Water Supply from the San Marcos River Only

Participant	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System with City of San Marcos Participating	
	Alternative 1 (with City of San Marcos)		Alternative 2 (without City of San Marcos)			
	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
Crystal Clear WSC	$1.46	$2.14	$1.82	$2.66	20%	20%
Martindale WSC	$2.43	$2.43	$2.95	$2.95	18%	18%
City of Lockhart	$4.60	$4.60	$5.12	$5.12	10%	10%
Elim WS	$2.02	$2.65	$2.42	$3.17	17%	17%
Maxwell WSC	$1.49	$2.38	$1.81	$2.90	18%	18%
City of Kyle	$2.02	$3.55	$2.32	$4.08	13%	13%
County Line WSC	$2.35	$3.39	$2.72	$3.91	14%	13%
Plum Creek WSC	$3.13	$3.13	$3.65	$3.65	14%	14%
Goforth WSC	$3.17	$3.17	$3.70	$3.70	14%	14%
Creedmoor-Maha WSC	$4.50	$4.50	$5.02	$5.02	10%	10%

Table 4-10
Cost Comparison
for Study Participants Outside of the City of San Marcos Service Area
B) Raw Water Supply from San Marcos River (50%) and Canyon Lake (50%)

Participant	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System with City of San Marcos Participating	
	Alternative 1 (with City of San Marcos)		Alternative 2 (without City of San Marcos)			
	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
Crystal Clear WSC	$1.61	$2.35	$2.27	$3.32	29%	29%
Martindale WSC	$2.64	$2.64	$3.61	$3.61	27%	27%
City of Lockhart	$4.81	$4.81	$5.78	$5.78	17%	17%
Elim WS	$2.19	$2.86	$2.93	43.83	25%	25%
Maxwell WSC	$1.62	$2.59	$2.22	$3.56	27%	27%
City of Kyle	$2.14	$3.76	$2.70	$4.74	21%	21%
County Line WSC	$2.50	$3.60	$3.18	$4.57	21%	21%
Plum Creek WSC	$3.34	$3.34	$4.31	$4.31	23%	23%
Goforth WSC	$3.39	$3.39	$4.36	$4.36	22%	22%
Creedmoor-Maha WSC	$4.71	$4.71	$5.68	$5.68	17%	17%

Table 4-11
Cost Comparison for City of San Marcos

Raw Water Supply Source	Cost of Water Per Thousand Gallons				Cost Reduction for Regional System including the ten Participants	
	Alternative 1 (Regional System)		Individual System (San Marcos only)			
	Drought Usage	Normal Usage	Drought Usage	Normal Usage	Drought Usage	Normal Usage
A) San Marcos River Only	$1.12	$1.64	$1.22	$1.78	8%	8%
B) San Marcos River/Canyon Lake	$1.27	$1.86	$1.39	$2.03	9%	8%

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5.0 IMPLEMENTATION

5.1 Selected Alternative

Alternative 1, a regional water supply system to serve all of the study participants, is the most economical alternative to meet their long-term water supply needs and was selected for identification of key implementation issues. Alternative 1 would cost 10% to 29% less than Alternative 2 for participants outside San Marcos, and it would reduce the City of San Marcos' costs by 8% to 9% over an individual system. A summary of cost savings for the 20-year planning period for each entity is shown in Table 5-1 which shows cost savings ranging from $390,000 for County Line WSC to $7,670,000 for the City of San Marcos.

Table 5-1
Summary of 20-Year Cost Savings by Implementation of Regional Water Supply System

Participant	Raw Water Supply from San Marcos River Only	Raw Water Supply from San Marcos River and Canyon Lake
City of San Marcos	$6,320,000	$7,670,000
Crystal Clear WSC	$1,050,000	$1,950,000
Martindale WSC	$1,100,000	$2,060,000
City of Lockhart	$2,270,000	$4,240,000
Elim WS	$1,580,000	$2,950,000
Maxwell WSC	$1,250,000	$2,320,000
City of Kyle	$930,000	$1,710,000
County Line WSC	$390,000	$730,000
Plum Creek WSC	$1,580,000	$2,960,000
Goforth WSC	$1,930,000	$3,540,000
Creedmoor-Maha WSC	$880,000	$1,650,000
Total	$19,280,000	$31,780,000

Notes:
1) Based on average water use during the 20-year period of 2000-2020 and projected normal usage for each participant
2) Cost savings assume that the difference in costs for Alternative 1 and Alternative 2 remain consistent for the 20-year period.
3) Costs based on 1995 dollars and do not account for inflation.

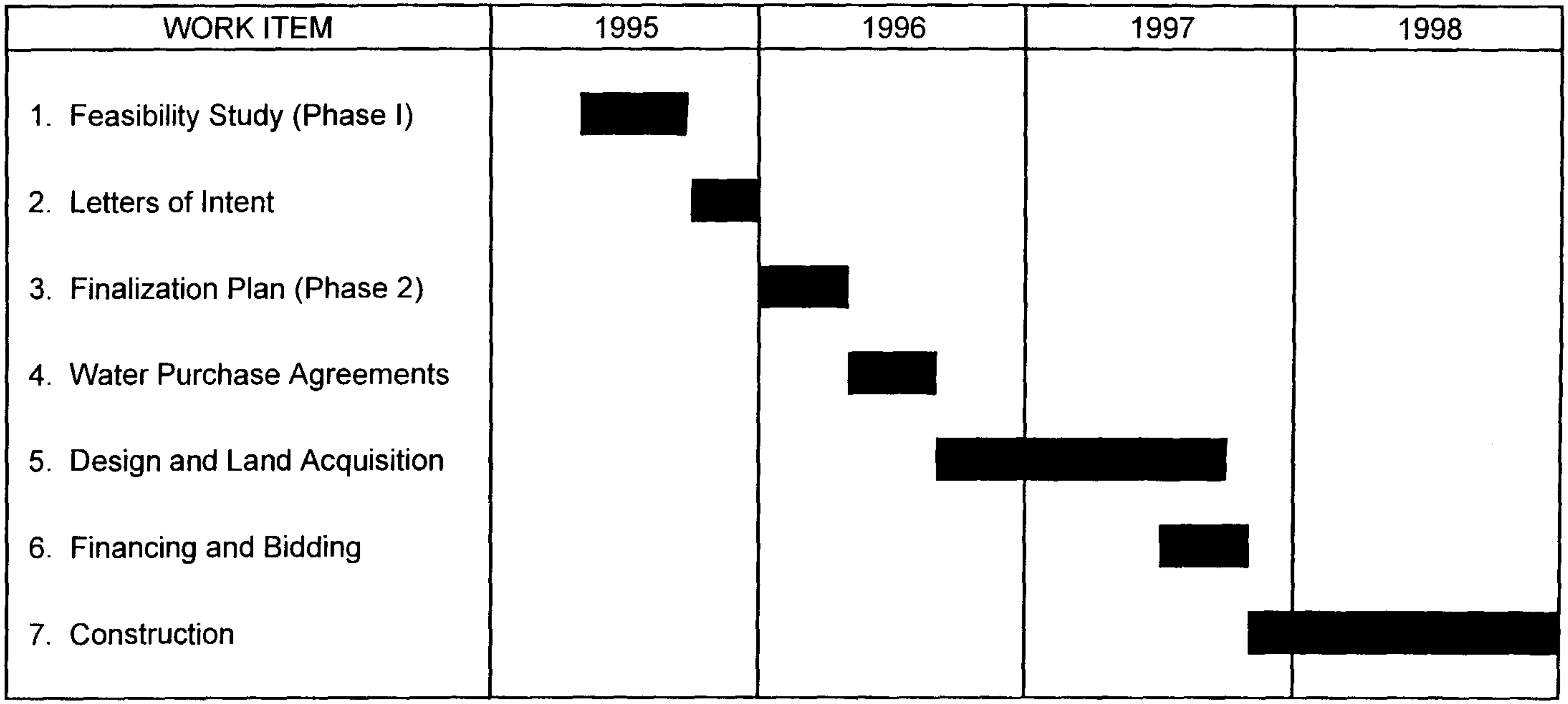
5.2 Implementation of Alternative

The initial costs to existing customers to implement the regional surface water supply system are considerable, especially in comparison to the cost of their current groundwater supply. A surface water supply is generally more expensive than groundwater due to the increase in costs for water treatment, water transmission, and reservoir storage.

The selected alternative proposes to use raw water from the San Marcos River or a combination of raw water from the San Marcos River and the Guadalupe River. The actual source and quantity from each source is dependent on environmental restrictions, water rights purchases or agreements, and the ultimate outcome of management of the groundwater resources in the study area (i.e. Edwards Aquifer and Barton Springs - Edwards Aquifer).

Alternative 1 could be operational by the end of 1998 provided contractual arrangements between GBRA and participating project sponsors are reached in a timely fashion. Because the cost of water to each entity depends on the number and location of final project sponsors, a two step process has been included in the schedule (Figure 5-1). This process allows interested entities to make a preliminary commitment to see who will be participating and then make a final commitment once the project costs are better defined. The preliminary commitment would be in the form of "letter of intent" which would outline the major elements of the project along with the responsibility of each entity who will be participating in implementing the plan. Upon finalization of the "letter of intent", development of a final plan would essentially modify the initial plan developed in this study based on an amended list of project sponsors. In the development of the final plan, revised project facilities and cost estimates will be based on those entities included in the "letter of intent." Upon completion of the final plan, revised cost estimates will be presented to each entity, and each participating entity would sign a water purchase agreement with GBRA. Once water purchase agreements have been finalized, then design, land acquisition, financing, and bidding would be initiated. Construction could begin by late 1997 and be completed by the end of 1998.

Actual increases in rates for each participant required to pay for the new regional water supply system will be dependent on the number of participating entities, the actual cost of the project, and the actual terms of financing.



HDR

HDR Engineering, Inc.

GUADALUPE -BLANCO RIVER AUTHORITY
REGIONAL WATER SUPPLY STUDY

SCHEDULE OF IMPLEMENTATION

Date DEC. 1995

Figure 5-1

5.3 Final Plan Cost Considerations

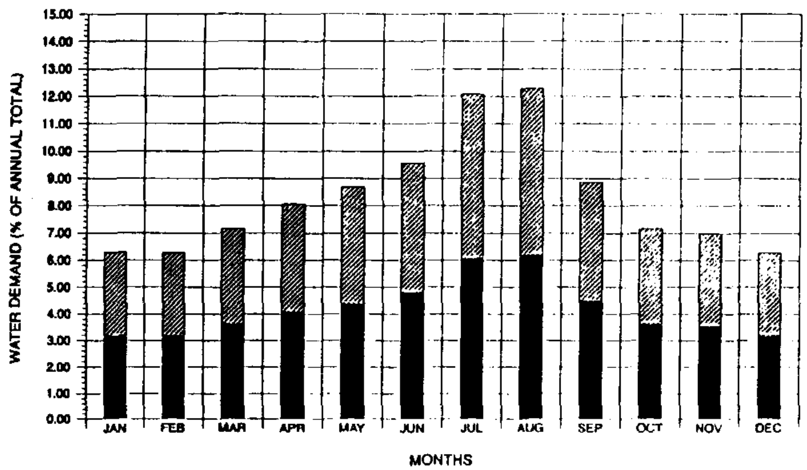
Several factors will influence the ultimate cost to each participant for implementation of the regional water supply system. These factors include:

- number of participating entities;
- base loading of surface water supply system versus summer peaking of the system;
- potential for utilizing system interconnections; and
- interest rate and bond repayment provisions.

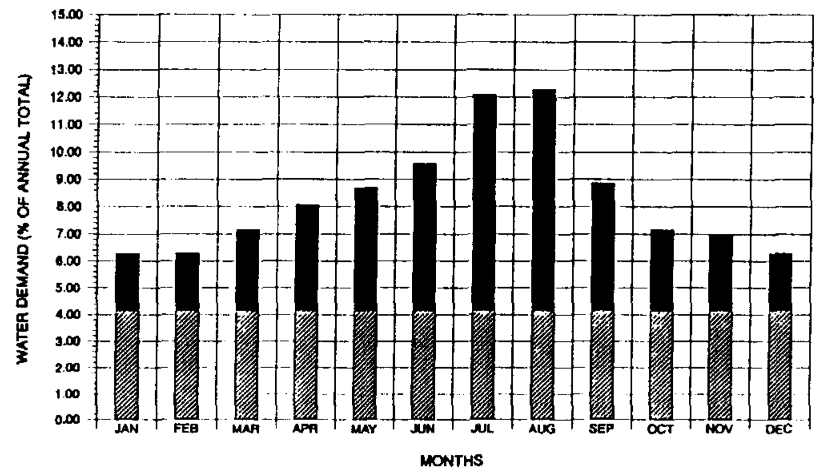
The number of participating entities will influence the overall project costs. If the number of entities is reduced, costs to the remaining participants will likely be higher due to an increase in the prorata share of the fixed costs of the system and a reduction in the economy of scale of some of the facilities.

The potential for base loading of the surface water supply system can provide significant cost savings to all of the participating entities. The regional water treatment plant, pump stations, and distribution pipelines were all sized to deliver peak day surface water needs. Peak day needs were assumed to be prorated between surface water and groundwater sources. Figure 5-2 shows a typical municipal monthly demand pattern with conjunctive use between surface water and groundwater. Option 1 shows a demand pattern with needs prorated between surface water and groundwater sources as assumed in this study. However, significant cost savings may be achieved if the surface water supply system could be base loaded and groundwater is used to meet peak summer needs, as shown in Option 2. By base loading the surface water supply, the capacity of the water treatment plant can be reduced, as well as the pump stations and pipelines for the regional distribution system. In addition, base loading of the water treatment plant can reduce operating expenses and produce a more consistent quality of water. One primary disadvantage of Option 2 is that summer peaking from the groundwater system would likely have a greater impact on springflows and aquifer levels during severe drought conditions and implementation of this type of plan would be dependent on the ultimate aquifer management plan. Option 3 shows a demand pattern with base loading of the groundwater supply and summer peaking from the surface water supply system. Implementation of this type of plan would likely increase costs for the regional facilities due to higher peaking factors for the surface

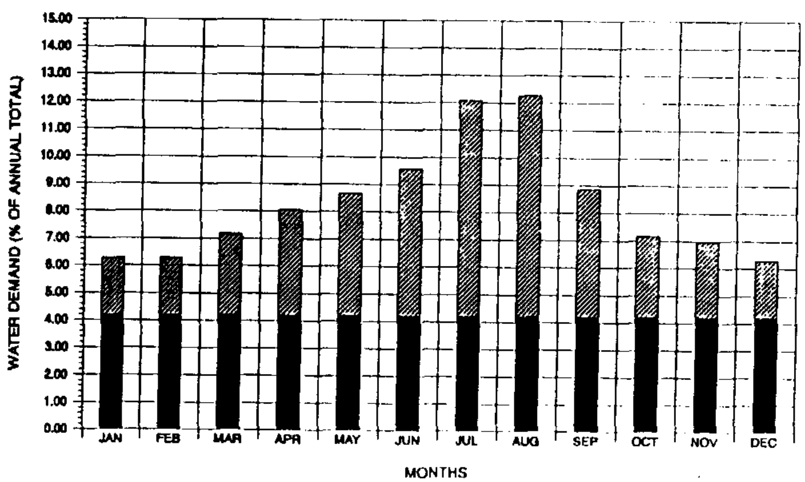
OPTION 1



OPTION 2



OPTION 3



GROUNDWATER

SURFACE WATER

HDR

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REGIONAL WATER SUPPLY STUDY

CONJUNCTIVE USE OPTIONS

Date DEC. 1995

Figure 5-2

water supply system than either Option 1 or Option 2. The primary advantage of Option 3 would be that the impact of pumping on springflows and aquifer levels during severe drought conditions would be lessened as compared to Option 1 or Option 2.

Using existing system interconnections to transfer regional system water from one system to another could produce cost savings to some of the participating entities. For example, if an interconnection with adequate capacity to transfer water to meet peak day needs were in place between the City of San Marcos and Elim WS - South, the regional distribution pipeline system to Elim WS - South could be eliminated. Likewise, interconnections between other systems along the western transmission system may also be able to transfer water from one entity to another, thereby eliminating, reducing in size, or delaying some of the regional distribution system. Evaluation of the use of interconnections to transfer treated water was beyond the scope of this study but deserves further consideration when a final plan is developed.

The actual terms of financing will determine the cost of water delivered to customers of the regional system. For this study, an interest rate of 7.0% and a financing period of 20 years was used to calculate annual debt service. Currently, interest rates in the range of 5.5% to 6.0% may be obtained, which would reduce the costs to each of the entities. An interest rate of 6.0% and a financing period of 20 years would reduce the annual debt service cost to each participant by about 8%. Similarly, an increase in the financing period would also reduce the annual debt service cost.

5.4 Financing Options

There are five major sources of financing for public water supply projects, including: (1) Bond Market; (2) Texas Water Development Fund; (3) State Participation Fund; (4) Community Development Block Grants; and (5) Rural Economic and Community Development Grants and Loans. Each source is discussed below.

5.4.1 Bond Market

Public agencies borrow funds in the financial markets through the issuance of bonds, then use the proceeds to construct public works projects such as water supply reservoirs, water wells, pipelines, treatment plants, pump stations, storage tanks, and associated capital equipment. The bond holders are repaid with interest, using revenues and/or fees collected from those who receive water, from taxes levied on property in the water service area, or from a combination of revenues, fees, and taxes. In cases where public entities issue bonds to supply water to the public, the bonds are classified under federal laws as "tax-exempt." On tax exempt bonds, the interest paid to bond holders is not classified as ordinary income; therefore, the bond holder does not have to pay income tax on the earnings from these investments. As a result, individuals and other investors are willing to lend their capital to governmental entities at lower interest rates than would be the case if the interest on those loans (bonds) were taxed by the federal government.

5.4.2 Texas Water Development Fund

The Texas Water Development Board (TWDB) has authority granted by Texas Constitutional Amendments and State Statutes to issue State of Texas General Obligation Bonds to provide loans to political subdivisions and special purpose districts for the construction of water supply, sewer, and flood control projects. The TWDB uses the proceeds of its bond sales to purchase the bonds (either general obligation or revenue) of cities and local water districts and authorities, which in turn use the borrowed funds to pay for construction of local projects. The local district or city repays the TWDB, with interest equal to the rate that the TWDB must pay on its bonds plus 0.5 percent, which the TWDB uses to retire the bonds it issued. The 0.5 percent assists the state in paying the cost of administering the loan program. This State of Texas water resources loan program enables some cities and local districts, especially smaller entities that do not have a credit rating, to utilize the credit of the state in financing projects and thereby obtain financing at lower interest rates than if they were to sell their bonds on the open bond market. In October of 1995, the interest rate on TWDB bonds was 6.54 percent (Note: The interest rate on TWDB bonds is specific to each TWDB bond sale and therefore varies as market conditions change).

To be eligible to borrow from the Texas Water Development Fund, the applicants must have: (1) authority to supply water; (2) a source of water; and (3) a water conservation plan, unless the applicant is exempted from this requirement. The conditions for exemption from a conservation plan are: 1) in cases of emergency; 2) for applications of $500,000 or less; or 3) if the applicant demonstrates, and the TWDB finds, that a conservation plan is not necessary to facilitate conservation. However, if the application is filed as an emergency case and is for a loan in excess of $500,000, a conservation plan must be developed and implemented within six months of the date of the TWDB's approval of the loan.

In the case of individual cities and individual special purpose districts and authorities, the applicants must be classified as "hardship cases." In order to be classified as a "hardship case," the TWDB must determine that the applicant cannot secure financing in the open market or elsewhere at a reasonable rate of interest. Smaller districts or smaller cities that do not have a credit history and a credit rating usually meet the "hardship" criteria. However, the applicant must present evidence that it can repay the loan for which it is applying.

If the project for which the loan is needed is regional (i.e. serves more than one entity or serves an area involving more than one county, city, special district, or other political subdivision), then the hardship requirement does not apply. In other words, water supply loans can be obtained for regional water supply projects even though the members are not classified as hardship cases. Likewise, a surface water supply system which is developed to replace groundwater in critical groundwater areas can be financed with a loan from the TWDB even though the members are not classified as hardship cases. Thus, it appears that surface water projects in the San Marcos area would be eligible for loans from the TWDB for financing up to 100 percent of the costs of such projects.

5.4.3 State Participation Fund

The concept of State Participation as it applies to water supply projects is as follows. A local area needs an additional water source, transmission pipelines, storage reservoir, and treatment plant to meet present and future water supply needs. The area's existing customer base can only support monthly rates required to repay loans for a project sized to meet present needs. However, if a project is built to only meet present needs, it may soon be inadequate. Thus, through the State Participation Fund, the local entity could plan a larger project, with phased construction of the separate elements to the extent possible, and apply to the TWDB for state participation in the project. Under this arrangement, the TWDB would become a "silent partner" in the project by entering into an agreement with the local entity to pay up to half of the project costs initially. The TWDB would hold the remaining project share until a future date, at which time the local entity would be required to buy the TWDB's share.

The terms and conditions of such an agreement are negotiated for each case. Typically, local entities are required to pay simple interest on the TWDB's share of the project cost from the beginning and to begin buying the TWDB's share, including accumulated interest, at a specified future date, usually within 8 to 12 years of project completion. By lending the state's credit to local areas, an optimal development plan for growing areas can be implemented at lower costs. However, the local beneficiaries of the program will be required to repay the TWDB, including interest and financing costs incurred. It is emphasized, however, the state participation fund is appropriate and reasonable only for additional project capacities that will be needed within the foreseeable future.

5.4.4 Community Development Block Grants

The Community Development Block Grant (CDBG) program was created by Congress in 1974. It is administered at the federal level through the U.S. Department of Housing and Urban Development (HUD). The program is divided into two major categories: (1) entitlement (cities over 50,000 and qualifying counties over 200,000 in population) and (2) non-entitlement (cities under 50,000 in population and counties not eligible for entitlement status). In the State of Texas, there are 47 entitlement cities, 5 entitlement counties, and approximately 1,313 non-entitlement cities and counties. Entitlement cities receive an annual allocation of funds directly from HUD for eligible activities, whereas non-entitlement localities generally have to compete on a statewide basis for funding.

In 1981, Congress transferred the responsibilities of administering several federal block grant programs to the states. This law authorized the states to administer the non-entitlement portion of the CDBG program. The State of Texas assumed administration of this program in federal fiscal year 1983. It is administered by the Texas Department of Housing and Community Affairs. The Texas Community Development Program provides grants and loans on a competitive basis to non-entitlement cities in Texas. Thus, an application for such funding would need to be made by participating entities for a relevant part of the regional water supply plan. Among the threshold requirements of applicants, there must be a particular problem that poses a serious and immediate threat to the health and safety of the public and the applicant must have the ability to levy a local property tax and/or local sales tax.

The Community Development Fund is the major funding category (about two-thirds of the total funding) under the Texas Community Development Program, and is the only category through which water supply projects could be eligible. Typical types of public works projects funded include water and sewer improvements, street and drainage improvements, community and senior centers, and handicapped accessibility projects. An annual competition, divided into regional allocations for eligible cities and counties in each of the state's 24 planning regions, is held. An application for the 1997 program would need to be filed with the Capital Area Planning Council. The notice for application and schedule for filing will be announced in September or October of 1996 for the 1997 competition. The applications are reviewed by Texas Department of Housing and Community Affairs staff, and the Capital Area Planning Council regional advisory committee. The committee, which is comprised of 12 locally elected officials appointed by the Governor for two-year terms of office, would meet publicly to review and score applications in accordance with previously established scoring criteria. Award recommendations are made to the Department of Housing and Community Development's Executive Director on the basis of scores of the regional review committee. The Executive Director makes final funding decisions on the basis of these recommendations.

5.4.5 Rural Economic and Community Development (RECD) Grants and Loans

The Rural Economic and Community Development Administration (formerly known as the Farmer's Home Administration) of the U.S. Department of Agriculture is authorized to provide financial assistance, in the forms of loans and grants, for water supply development in rural areas and towns with populations of 10,000 or less. Public entities, including cities, special purpose districts, and nonprofit corporations, are eligible for such assistance to restore a deteriorating water supply or to enlarge an inadequate system. Preference is given to entities in areas smaller than 5,500 people, to areas wanting to merge small facilities, and to serve low-income communities. To qualify for RECD financing, applicants must: (1) be unable to obtain funds elsewhere at reasonable rates and terms, (2) have legal authority to borrow and repay loans and operate water facilities, and (3) have a financially sound project based on revenues, fees, taxes, or other sources of income. Water systems must be consistent with state water development plans and comply with all local, state, and federal laws.

Funds from RECD for water systems may be used for construction or modification of facilities such as reservoirs, pipelines, wells, and pump stations; acquisition of water rights or water supplies; legal and engineering fees required for the project; rights-of-way and easements; and relocations of roads and utilities. RECD funds may be used in conjunction with funds from other sources, such as loans from the Texas Water Development Fund or bonds sold on the open market.

The maximum length or term for RECD loans is 40 years, the statutory limitations of the organization borrowing funds, or the useful life of the project, whichever is less. Interest rates are set periodically, in accordance with the law, and as of July, 1995, rates were 5.75 percent.

Grants may be made for up to 75 percent of eligible project costs for facilities serving low-income areas. RECD staff will advise applicants as to how to assemble information and file both grant and loan applications. Such applications are filed with the local RECD district office, which for the study area is located in Seguin, Texas. Preapplications to the district office are reviewed by the local area Council of Governments (Capital Area Planning Commission), and upon favorable review, a formal application together with an environmental assessment is filed through the local district office to the state office in Temple, Texas. Preapplication conferences with RECD staff are recommended to obtain specific details about making application for funds.

RECD grants and loan programs may be a viable financing option for some of the participants for water supply facilities. This source of funding could perhaps be combined with Texas Water Development Board loans to secure a surface water supply for the study area

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APPENDIX A

WATER CONSERVATION AND EMERGENCY DEMAND MANAGEMENT PLAN

WATER CONSERVATION

AND

EMERGENCY DEMAND MANAGEMENT PLAN

FOR

AUGUST 1995

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CHAPTER 1

INTRODUCTION

The _____________ owns and operates the water supply and distribution system within the certified service area. Drinking water is obtained from groundwater and delivered to customers through a distribution piping network.

This report outlines the water conservation and emergency demand management plan. Water used in residential and commercial sectors involves day-to-day living and business activities, and includes water used for drinking, bathing, cooking, toilet flushing, fire protection, lawn watering, swimming pools, laundry, dish washing, car washing, and sanitation. The objective of this conservation plan is to reduce the quantity required for each activity, where practical, through implementation of efficient water use practices. The Emergency Demand Management Plan provides procedures for both voluntary and mandatory actions to temporarily reduce water usage during a water shortage crisis. Emergency contingency procedures may include water conservation and prohibition of certain uses. Both are tools that officials will have available to effectively operate during a wide range of conditions within the public water supply service area.

PLANNING AREA AND PROJECT DESCRIPTION

The ______________ is located in south central Texas, southeast of the City of Austin. The water service area is shown in the attached _______(Figure 1).

The recent growth coupled with the need to provide water in the most efficient manner necessitated the development of a plan. The water conservation program is intended to reduce per capita consumption in the long term, as well as providing short term relief. An immediate effect of reduced water use is the prevention or at least the delaying of new construction.

GOALS

The present average daily water use is approximately _____ gallons per connection which is comparable to the statewide average of 360 - 460 gallons per connection. It is the goal to adopt a water conservation plan that will reduce daily water use per connection by _________(5 percent) within five years and __________ (10 percent) within ten years. Achieving this goal would in effect, increase the customer service capacity of the water facilities by an equivalent quantity.

The Emergency Demand Management Plan includes those measures that can significantly reduce water use on a temporary basis. These measures involve voluntary reductions, and water rationing. Because the onset of an emergency condition is often rapid, it is important advanced preparation is made. Further, the citizen and/or customer must know that certain measures not used in the water conservation plan may be necessary if a drought or other emergency condition occurs. It is the goal of the Emergency Demand Management Plan to reduce water used during an emergency situation or prolonged drought by a minimum of _______(5) percent. (See Attachment A)

UTILITY EVALUATION DATA

A detailed summary of utility evaluation data is included in Appendix A. This data substantiates the need to implement a water conservation program.

CHAPTER 2

WATER CONSERVATION PLAN

The Water Conservation Plan addresses aspects of water conservation, including public information and education, water conserving plumbing codes, water conservation retrofit programs, water conservation-oriented rate structures, universal metering and meter repair and replacement, water conserving landscaping, leak detection and water audits, and wastewater reuse and recycling. The following is a summary of each of these items.

Public Information And Education

The _______________ will promote water conservation by informing the public of methods to conserve water. The overall public education will be divided into three segments: a first-year program, a long-term program, and a new customer program. Information and education programs that are on-going and will be incorporated into this plan include:

- Educational packages developed by the State and GBRA that have been provided to the schools.
- Water conservation literature will be available for viewing at the billing office as listed in Attachment B.
- Water conservation techniques will be made available to customers every month when they pay their bills as well as to new customers who are tying into the system.

First-Year Program - the first-year program will include the distribution of educational material including brochures and newsletters or new releases to initially explain the program. Material will be provided at least __________ (two times) during this first year. This initial effort will be followed by helpful hints printed on the bill on ways to save water inside and outside the home.

Long-Term Program - the long-term program will include news releases to provide information on water conserving practices. At least once a year, a water conservation educational effort targeted to the individual user will be made with the use of mail outs, newspaper advertisements, radio advertisements or other suitable media sources. Mail outs will be utilized during extremely stressful periods.

New Customer Program - all new customers will be informed of the water conservation program by a special information packet or document. The packet will describe the conservation program and explain its goals and solicit the help and participation of the new customers.

Water Conserving Plumbing Codes
(Only for Entities with power to implement plumbing codes)

Amendment to the plumbing code will be adopted that will require the use of water saving fixtures for all new construction and for replacement of plumbing in existing structures (remodeling). The following summarizes the standards for residential and commercial fixtures.

Wall mounted toilets:	The maximum use will not exceed 2.0 gallons of water per flush
All other toilets:	The maximum use will not exceed 1.6 gallons of water per flush.
Tank-type urinal:	The maximum use will not exceed 1.0 gallons of water per flush
Flush valve urinal:	The maximum use will not exceed 1.0 gallons of water per flush
Shower head:	The maximum use will not exceed 2.75 gallons of water per minute
Faucets:	The maximum use will not exceed 2.2 gallons of water minute
Hot water piping:	All hot water lines will be insulated
Swimming pools:	New pools must have recirculation filtration equipment
Drinking water Fountains:	Must be self-closing

Water Conservation Retrofit Program

Retrofit of existing plumbing fixtures will be accomplished through the voluntary efforts of individual consumers for their homes and businesses. Adoption of the water conservation plumbing code (where applicable) will provide a gradual up-grading of plumbing fixtures in existing structures.

Water Conservation - Oriented Rate Structure

Presently it is advised to have at least a uniform (single) block rate structure. An increasing block structure is encouraged and should be investigated. However, the current rate of $_______/1000 gallons with a base of $______ is sufficient to preclude the waste of water and encourages water conservation.

Universal Metering and Meter Repair and Replacement

All water service connections to the City are metered. A schedule for testing meters is established as follows:

1. Production, master meters or meters greater than 1.5" test ______(once) per year.
2. Meters larger than 1" up to 1.5", test once every ______(three) years.
3. Meters 1" or less, test once every _______(ten) years.

Water Conserving Landscaping

Water conserving landscaping will be initiated through public information and education. These practices will be implemented as much as possible on public grounds in order to set an example for the general public. Builders, developers, nurseries and other businesses involved in outdoor landscaping will be encouraged to provide products that conserve water.

Leak Detection and Water Audits

The System should provide for a leak detection program and include:

- Monthly water use accounting by the billing computer and master meters identifies high water use and identifies areas with leaks.

- Constant monitoring of meters and storage tanks which identifies major watermain breaks.

- Visual inspection by meter readers and system employees who keep a constant watch for abnormal conditions indicating leaks.

Recyling and Reuse

Reuse will be encouraged by all available means whenever it is found to be fiscally, environmentally, and institutionally practical and prudent. Reuse of wastewater treatment plant effluent within the plant site process is easily accomplished and encouraged.

The use of wastewater treatment plant effluent for irrigation of feed crops is widely used. In areas of high rainfall and readily available groundwater, it is difficult to develop but in areas of low rainfall irrigation with effluent is economically feasible. Other uses of effluent should be encouraged.

Means of Implementation and Enforcement

The Water Conservation Plan that is adopted will be voluntary and enforced (though compliance is encouraged) by the following methods:

- Service tap applicants will be encouraged to utilize water conservation plumbing fixtures. Existing water system staff will be used to encourage that water saving plumbing devices are being installed in new buildings.

- The rate structure will encourage retrofitting of old plumbing fixtures which are using large amounts of water.

- Adoption of new plumbing regulations regarding water conserving plumbing fixtures (where applicable).

Annual Reporting

A report will be submitted annually to the Texas Water Development Board for the first 3 years. If sufficient compliance is demonstrated, the annual report can be eliminated.

The brief annual report will include the water conservation activities undertaken during the previous year relative to this plan and will include:

- Progress made in the implementation of the program
- Public response
- Effectiveness of plan in reducing water use

Contracts

In the future, any political subdivision or utility contracting with the __________ for treated water from the water treatment plant to adopt a water conservation plan acceptable to the Texas Water Development Board.

ATTACHMENT A

EMERGENCY DEMAND MANAGEMENT PLAN

Droughts and other uncontrollable circumstances can disrupt the normal availability of water supplies. During emergency conditions, consumer demand is typically higher than under normal conditions, system treatment, storage, and distribution failures can also present an emergency demand management situation.

It is important to distinguish emergency demand management planning from water conservation planning. While water conservation involves implementing permanent water use efficiency or reuse practices, emergency demand management planning establishes temporary methods or techniques designed to be used only as long as the emergency exists.

The Emergency Demand Management Plan will include the following six elements.

1. Trigger conditions signaling the start of an emergency period
2. Emergency contingency measures
3. Information and education
4. Initiation procedures
5. Termination notification actions
6. Implementation procedures

TRIGGER CONDITIONS

1. Mild Condition
   Mild conditions and contingency measures will be in effect when the daily water use equals or exceeds 90% of pumping capacity for seven consecutive days or the water level declines to _________ (660 feet within the southern Edwards aquifer at Index Well J-17 or ______ within the northern Edwards).

2. Moderate Condition
   Moderate conditions and contingencies will be in effect when the daily water use equals or exceeds 95% of treatment capacity for seven consecutive days or the water level declines to _________ (644 feet within the southern Edwards aquifer at Index Well J-17 or ______ within the northern Edwards.

3. Severe Condition
   Severe conditions or system limitation condition will be in effect when daily use equals or exceeds 100% of pumping capacity for seven consecutive days or the water level declines to __________ (628 feet within the southern Edwards aquifer at Index Well J-17 or ______ within the northern Edwards.

4. Critical Conditions
   Due to natural or other disasters, the public water supply is not dependable and should be used only as prescribed by the water supply entity.

EMERGENCY DEMAND MANAGEMENT MEASURES

The following actions will be taken when trigger conditions are reached.

1. Mild Condition
   Under mild conditions, the citizens will be notified that a trigger condition has been reached and will be asked to reduce water use and to otherwise conserve water.

2. Moderate Condition
   Citizens will be asked to continue implementation of water conservation measures. In addition, a mandatory lawn water schedule will be publicized.. The mandatory lawn watering schedule will permit watering only between the hours of 8 p.m. and 10 a.m. Five day blocks will be identified with houses ending in 0 and 9 watering the first day, 1 and 8 the second day, etc.

3. Severe Condition
   Outside water use not essential to public health or safety is prohibited.

4. Critical Conditions
   All uses of the public water supply will be banned except in cases of emergency.

EDUCATION AND INFORMATION

The purpose and desired effects of the Emergency Demand Management Plan will be communicated to the public through articles in local newspapers and supplemented by pamphlets and notices. When trigger conditions appear to be approaching, the public will be notified through mailouts or publication of articles in local newspapers, with information on water conserving methods.

Throughout the duration of emergency demand measure implementation, regular articles will appear to explain and educate the public on the purpose, cause, and methods, of conservation for that condition.

INITIATION PROCEDURES

Statements will be released to all media sources warning that a potential drought condition is approaching, or an emergency exists. Once a trigger condition is reached, formal notification will be made stating a particular emergency condition is in effect.

TERMINATION NOTIFICATION

Termination of the emergency demand management measures will take place when the trigger conditions which initiated the contingency measures have subsided.

MEANS OF IMPLEMENTATION

The Emergency Demand Management Plan will be implemented through a resolution by the Council or Board adopting this plan and the passage of an ordinance (ATTACHMENT H) for enforcement.

ATTACHMENT B

WATER CONSERVATION LITERATURE

Single copies of all of Water Conservation publications and materials can be obtained at no charge. Larger quantities can be obtained through special arrangement or at the cost of printing. To make a request, write: CONSERVATION, Texas Water Development Board, Capitol Station, P.O. Box 13231, Austin, Texas 78711-3231. Examples of available literature include: agricultural conservation, municipal conservation, water resource planning, and audio visuals.

ATTACHMENT C

PLAN ADOPTION RESOLUTION

WHEREAS, the ______________ is undertaking planning efforts to meet the demands of its citizens and customers for the present and future; and

WHEREAS, the ______________ has undertaken an expand and upgrade to the waste treatment capacity; and

WHEREAS, the _______________ believes it is in the long term best interest of the community to conserve potable water as well as use its water supply resources more efficiently; and

WHEREAS, the Texas Water Development Board loan requirements stipulate that uses their funds must have such a program, NOW, THEREFORE;

BE IT RESOLVED BY THE CITY COUNCIL OR BOARD OF _______________, TEXAS:

1. That the ___________ hereby adopts the Water Conservation Plan and Emergency Demand Management Plan attached hereto.

2. That this resolution shall take effect immediately.

PASSED AND APPROVED this ______ day of __________, 1995

ATTACHMENT D

ORDINANCE NO. ________

AN ORDINANCE ADOPTING A CITY OF ___________EMERGENCY DEMAND MANAGEMENT PLAN

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF ________, STATE OF TEXAS, THAT:

Section 1: Approval of the Plans. The City Council hereby approves and adopts as the Water Conservation and Emergency Demand Management Plan (hereinafter referred to as "the Plan" attached hereto as Exhibit "A" to be included in full as a part of this Ordinance. The City commits to implement the program according to the procedures set forth in the adopted plan.

Section 2: The City Manager of the designated representative is the designated official for implementation of emergency restrictions when the trigger conditions as delineated in the Plan are reached.

Section 3: Users of the water that do not comply with the plans shall be subject to a penalty and fine of not less than ____($10.00) per day nor more than _______($200.00) per day for each day of noncompliance to be established by the City Manger or the designated representative and/or disconnection or discontinuance of water services to such users by the City.

Section 4: The Council finds that all requirements as required by law as to notice, public meeting, and procedure have been met and the Council or Board hereby ratifies, approves and confirms said requirements.

Section 5: This Ordinance is hereby incorporated and made a part thereof of the City Code of the ______________.

AND IT IS SO ORDERED

PASSED AND APPROVED ON THIS THE _____ DAY OF _______,1995

ATTACHMENT E

ORDINANCE ________

AN ORDINANCE AMENDING _________ CODE OF ORDINANCE, CHAPTER ___, BUILDING AND CONSTRUCTION, ARTICLE ___, SECTION____. TECHNICAL CODES ADOPTED

WHEREAS, the Texas Water development Board has requested that water conservation standards included in the Texas Water Board's guidelines for Municipal Water Conservation Planning and Program Development be adopted;

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF _________, STATE OF TEXAS, THAT;

The City of _________ Code of Ordinances, Chapter ___, Building and Construction, Article ___. In General, Section _____, Technical codes Adopted, Standard Plumbing Code, 1982 edition, is hereby amended by adding the following:

The standards for residential and commercial fixtures shall be:

Wall mounted toilets:	The maximum use will not exceed 2.0 gallons of water per flush
All other toilets:	The maximum use will not exceed 1.6 gallons of water per flush.
Tank-type urinal:	The maximum use will not exceed 1.0 gallons of water per flush
Flush valve urinal:	The maximum use will not exceed 1.0 gallons of water per flush
Shower head:	The maximum use will not exceed 2.75 gallons of water per minute
Faucets:	The maximum use will not exceed 2.2 gallons of water minute
Hot water piping:	All hot water lines will be insulated
Swimming pools:	New pools must have recirculation filtration equipment
Drinking water Fountains:	Must be self-closing

THAT, this Ordinance is hereby incorporated and made a part of the City's Code.

APPENDIX A

UTILITY SURVEY

(Obtain current survey from Texas Water Development Board)

Regional Water Supply Study
San Marcos Area

Contract No. 95-483-077

The following map is not attached to this report.
It is located in the official file and may be copied upon request.

Map No. 1

Guadalupe – Balnco River Authority
Well Elevated Storage Tank

(San Marcos Area) October 1995

Please contact Research and Planning Fund Grants Management Division at (512) 463-7926 for copies.