Freestone County Regional Water Supply Study

September 1997

Prepared for

Trinity River Authority of Texas in Conjunction with the Texas Water Development Board Contract #96-483-153

Participants:

City of Fairfield
Fairfield Industrial Development Corporation
City of Teague
City of Streetman
City of Wortham
Pleasant Grove Water Supply Corporation
Texas Department of Criminal Justice
Boyd Prison Unit

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EXECUTIVE SUMMARY

The Trinity River Authority and the Texas Water Development Board are sponsors of this feasibility study of a regional water supply system in Freestone County. The local participants in the study are Fairfield, Teague, Streetman, Wortham, the Fairfield Industrial Development Corporation, Pleasant Grove Water Supply Corporation, and the Texas Department of Criminal Justice Boyd Prison Unit. In 1995, the participants provided a total average-day supply of 1.411 million gallons per day (MGD) to about 10,044 people. The average-day water use of the water suppliers participating in this study is projected to increase from 1.411 MGD in 1995 to 2.14 MGD in 2020. Most of this increase is for industrial use projected by the City of Fairfield. The peak-day requirements of the participants are estimated to be 4.66 MGD as of 2000 increasing to 5.32 MGD by 2020. (For most participants, peak-day requirements are based on the TNRCC requirements for system capacity of 0.6 GPM per connection.)

Since it is not certain which water suppliers will choose to participate in the regional system or what portion of their needs the system will provide, two scenarios were developed reflecting different levels of participation in the system. The maximum participation scenario is the maximum level of participation in the regional system which might reasonably be expected. This scenario assumes that all of the participants will use the regional system to supply all of their water use. In this scenario, the regional system is sized to deliver the projected peak-day requirements of the participants, totaling 5.32 MGD in 2020. The lesser participation scenario assumes that the regional system will supply only the average-day demands of the participants. Demands above the average-day level will be met by the participants' existing sources of supply. (Wortham is an exception, and it is assumed that the regional system would supply all of Wortham's peak-day requirements.) The capacity required for the regional system in this scenario is 2.53 MGD in 2020. In the lesser participation scenario, it is important to note that mixing groundwater and treated surface water may produce water quality concerns and should be researched further before this option is pursued.

This study is a *regional* water planning study, and the main emphasis is placed on water sources that could supply a regional system. Groundwater is not a likely supply source for a regional water system. If groundwater is to remain the source for the participants, each participant should continue to use local groundwater supplies. It would not be necessary or economical to build long distance pipelines connecting the participants when each one has their own source relatively nearby. Therefore, groundwater was given some attention in this study but was not investigated in depth.

Several sources of water supply were investigated during this study. The best options for regional water supply were found to be treated water from Corsicana and raw water from Richland-Chambers Reservoir. Treated water from Corsicana might be purchased from either of two delivery points. Layouts for regional systems were developed for each of these supply sources and for both participation scenarios. Cost estimates for the needed facilities were developed for each of these options. The cost of continuing to use current groundwater sources was also estimated. Life cycle costs were developed for each scenario, including debt service, water purchase costs, water treatment costs, operation and maintenance costs (including electricity for pumping), and inflation.

The least expensive water supply option for the participants is to remain on groundwater. (Wortham would have to develop their groundwater supply since they are currently using surface water.) The average present worth cost from 1999 to 2028 for groundwater is $1.20 per thousand gallons. The initial year present worth cost is $0.40 per thousand gallons and increases to $1.34 in

2028. Groundwater development would best be pursued by the individual suppliers in Freestone County rather than by a regional entity. Disadvantages of groundwater include some quality concerns and the on-going need to invest money in well replacement and new wells for additional supplies.

The most promising option for a regional water system for both the maximum and lesser participation scenarios is the Richland-Chambers Reservoir supply scenario. The average present worth cost from 1999 to 2028 for the Richland-Chambers Reservoir maximum participation scenario is $2.87 per thousand gallons. The initial year present worth cost of $4.49 per thousand gallons decreases to $2.07 in 2028. The average present worth cost from 1999 to 2028 for the Richland-Chambers Reservoir lesser participation scenario is $2.15 per thousand gallons. The initial year present worth cost of $3.24 per thousand gallons decreases to $1.67 in 2028. All of these costs are for treated water delivered to the participants and do not include internal distribution costs of the participants. Table ES-1 summarizes key information for groundwater supplies and the two Richland-Chambers Reservoir scenarios.

The most likely form of financing for a regional system would be through the Texas Water Development Board's loan program for water supply projects. The most feasible managing entity for the system would be the Trinity River Authority.

The next step in the development of the regional system is commitment from potential participants. If Freestone County water suppliers wish to pursue a regional water supply system, additional steps would include:

- Development of water supply contracts
- Preliminary design and permitting
- Engineering design

- Land and right-of-way acquisition
- Construction of pipelines and pump stations
- Construction phase engineering services
- Design, assembly, and start-up of water treatment plant

Table ES-1
Cost Information for Most Promising Alternatives

	Richland - Chambers		Groundwater
	Maximum Participation	Lesser Participation	
Capital Cost (1997 Prices)	$23,525,000	$16,677,000	$19,250,000
Capital Cost When Constructed	$24,466,000	$17,344,000	$34,230,000
Projected Initial Year Water Cost - Cost per Thousand Gallons - Present Worth Cost per Thousand Gallons	 $ 4.86 $ 4.49	 $ 3.51 $ 3.24	 $ 0.43 $ 0.40
Average Present Worth Water Cost, 1999 - 2028	$ 2.87	$ 2.15	$ 1.20

1. INTRODUCTION

In 1989, 1990 and 1995 the Trinity River Authority (TRA) performed preliminary feasibility studies for a regional water supply system in Freestone County [1,2,3,4] *. In early 1995, TRA contacted water suppliers in Freestone County to determine whether there was still interest in a regional system. Several suppliers expressed interest, and TRA applied for a regional planning grant from the Texas Water Development Board (TWDB) to fund part of the cost of an in-depth feasibility study of a regional system. A 50 percent grant was awarded for this project, and the Freestone County Regional Water Supply Study is the resulting regional planning effort. The study is funded by the TWDB (through the TRA), the City of Fairfield and the Fairfield Industrial Development Corporation. In December 1995, TRA authorized Freese and Nichols to conduct the study, and this report presents our results.

Participating Water Suppliers

Entities initially participating in the study were the City of Fairfield, the City of Teague, the City of Streetman, Pleasant Grove Water Supply Corporation, and the Department of Criminal Justice's Boyd Unit Prison (which is supplied by a water system jointly owned by Teague and Fairfield). All of these participants use local groundwater as their sole source of water supply. In the fall of 1996, the City of Wortham was added as a participant in the study. Wortham asked to join the study because of a critical water shortage under drought conditions in the summer of 1996.

Table 1.1 gives the number of connections served, the number of people served, and the 1995 average-day water use for the local participants. These water suppliers provided about 1.4 million

* Numbers in parentheses match references listed in Appendix A.

gallons per day (MGD) to 10,044 people in 1995. About 70 percent of the total was provided by Fairfield and Teague. Figure 1.1 shows the approximate service areas for the local participants.

Table 1.1
Basic Data on Participating Water Suppliers

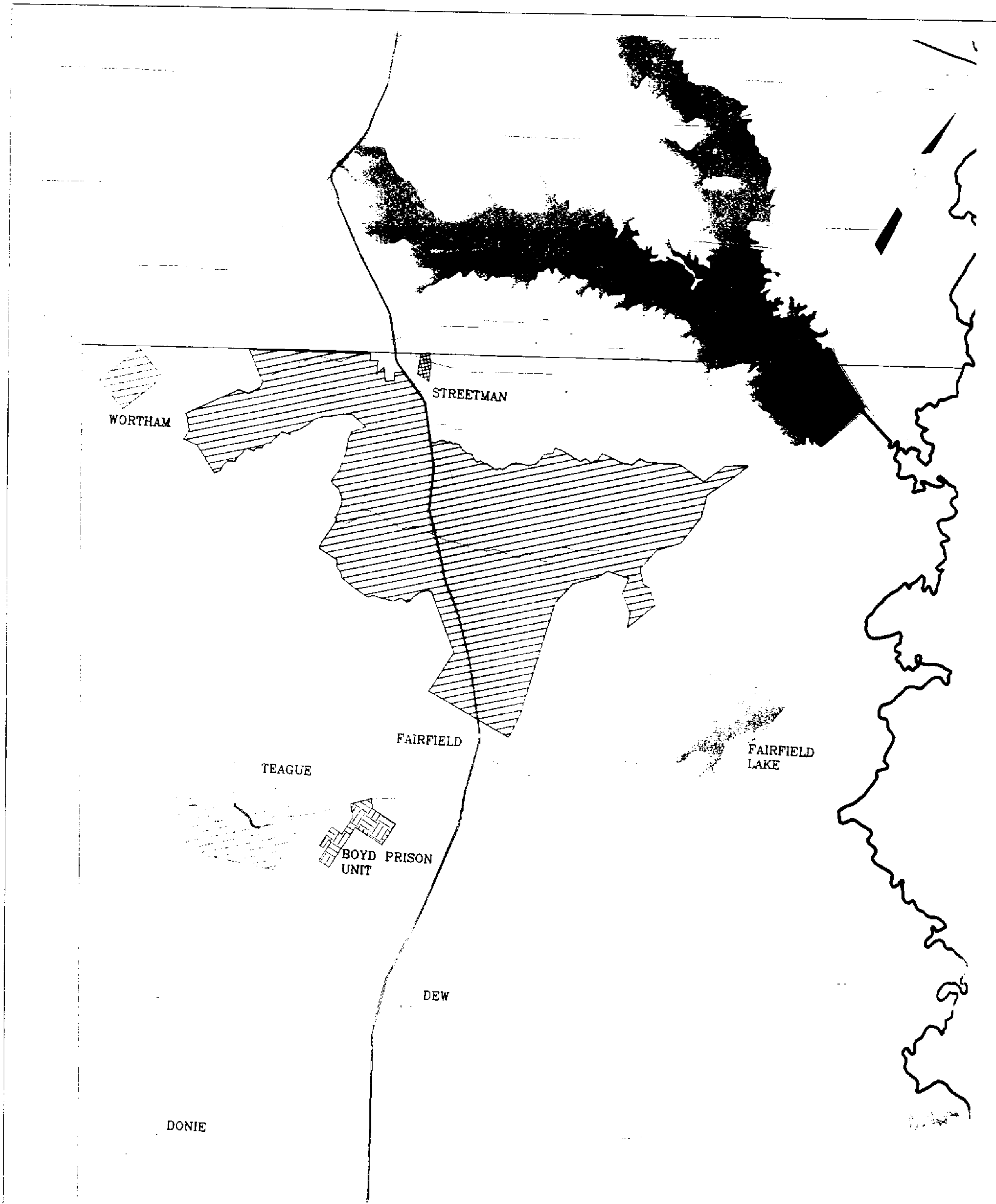
	Number of Connections in 1995	Approximate 1995 Population	Average-Day Use in 1995 (MGD)
Fairfield	1,460	3,325	0.547
Teague	1,687	3,268	0.289
Streetman	300	295	0.040
Wortham	658	1,020	0.220
Pleasant Grove WSC	322	800	0.132
TDCJ Boyd Prison Unit	*	1,336	0.183
TOTAL	4,427	10,044	1.411

* There are no individual meters at the prison unit.

Scope of Services

The scope of services for this study is included as Appendix B of this report. Major tasks of the study are:

- Project start-up, research, and data collection
- Projections of population and water demands
- Investigation of water supply sources
- Analysis of water transmission, treatment and distribution
- Institutional organization and financing
- Project implementation plan and schedule
- Project report



LEGEND

SERVICE AREAS

- CITY OF FAIRFIELD
- CITY OF TEAGUE
- PLEASANT GROVE WSC
- CITY OF STREETMAN
- CITY OF WORTHAM
- BOYD PRISON UNIT

Trinity River Authority of Texas
FREESTONE COUNTY REGIONAL WATER STUDY

FREESE & NICHOLS
CONSULTING ENGINEERS
FORT WORTH, TEXAS

FIGURE 1.1

SERVICE AREA FOR PARTICIPANTS

Report Organization

Section 2 of this report discusses the projected water needs in Freestone County. Section 3 reviews the existing sources of water supply and existing transmission and treatment facilities. Section 4 discusses the potential sources of water supply considered in this study. Section 5 presents the assumptions and considerations in the design and cost of alternative regional water supply systems. Section 6 presents suggestions on the management of a regional system, and Section 7 is a development plan for the regional system.

2. PROJECTED WATER NEEDS

The amount of water supplied from a regional system will depend on the total water needs in the region and on the portion of those needs to be provided by the regional system.

Projected Water Needs of the Participants

In 1995, the six participants in this study used an annual average of 1.411 MGD. Projections of future population and water use are based on information provided by the participants and the Texas Water Development Board (TWDB). Since the population projections from the participants and the TWDB are similar, TWDB numbers are used. Table 2.1 shows the projected population for the milestone years of the study. (In all of the tables in this report, the 1996 numbers are projections rather than historical numbers, since the projections were made prior to the end of 1996.)

Table 2.2 shows historical per capita municipal water use data for the participants. The Texas Water Development Board projects declining per capita municipal demands as the most likely scenario for Freestone County, as shown in Table 2.3. For this rural area with relatively low demands, we feel that a continual decline in per capita municipal use is unlikely. For this study, we adopted the constant per capita use values shown in Table 2.4. Table 2.5 shows projections of average-day water needs in years of average rainfall for the participants. Table 2.6 shows projections of average-day water needs in years of below average rainfall. Table 2.5 and 2.6 include water use for industrial development in Fairfield projected by the City of Fairfield. The average-day water demand for the region is projected to increase from 1.42 MGD in 1996 to 2.14 MGD by the year 2020. Most of this increase is for the projected industrial use in Fairfield.

Table 2.1 Population Projections							
	1996	1998	2000	2005	2010	2015	2020
Fairfield	3,408	3,574	3,740	3,868	3,995	4,208	4,420
Teague	3,458	3,489	3,521	3,562	3,602	3,618	3,633
Streetman	295	300	300	300	300	300	300
Wortham	1,069	1,125	1,180	1,221	1,262	1,330	1,397
Pleasant Grove WSC	800	800	800	800	800	800	800
Boyd Prison Unit	1,336	1,336	1,336	1,336	1,336	1,336	1,336
Total	10,366	10,624	10,877	11,087	11,295	11,592	11,886

Table 2.2 Historical per Capita Water Use (Gallons per Capita per Day)											
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	10-Year Average
Fairfield	160	166	172	148	156	144	156	149	151	163	157
Teague	110	99	110	91	140	100	104	92	108	84	104
Streetman	88	106	109	102	118	134	121	121	133	165	120
Wortham	138	143	150	117	126	164	178	175	201	218	161
Pleasant Grove WSC	66	76	114	119	126	122	99	107	121	165	112
Boyd Prison Unit	---	---	---	---	---	---	---	145	133	137	138

Table 2.3 TWDB Projected Most Likely per Capita Water Use (Gallons per Capita per Day)						
	2000	2010	2020	2030	2040	2050
Average Rainfall						
Fairfield	136	129	121	118	115	114
Teague	99	93	87	84	80	79
Wortham	125	118	111	107	105	104
Below Average Rainfall						
Fairfield	152	143	136	132	129	128
Teague	125	118	111	108	104	103
Wortham	145	137	130	126	123	122

Table 2.4
Per Capita Water Use Projections
Used in Freestone County Regional Water Study
(Gallons per Capita per Day)

	Average Rainfall	Below Average Rainfall
Fairfield	150	170
Teague	110	130
Streetman	125	160
Wortham	150	220
Pleasant Grove WSC	120	130
Boyd Prison Unit	170	185

Table 2.5
Projected Average-Day Water Demands - Average Rainfall
(Million Gallons per Day)

	1996	1998	2000	2005	2010	2015	2020
Fairfield (Municipal)	0.51	0.54	0.56	0.58	0.60	0.63	0.66
Fairfield (Industrial)	0.00	0.00	0.30	0.30	0.50	0.50	0.50
Teague	0.38	0.38	0.39	0.39	0.40	0.40	0.40
Streetman	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Wortham	0.16	0.17	0.18	0.18	0.19	0.20	0.21
Pleasant Grove WSC	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Boyd Prison Unit	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Total	**1.42**	**1.46**	**1.80**	**1.82**	**2.06**	**2.10**	**2.14**

Table 2.6
Projected Average-Day Water Demands - Below Average Rainfall
(Million Gallons per Day)

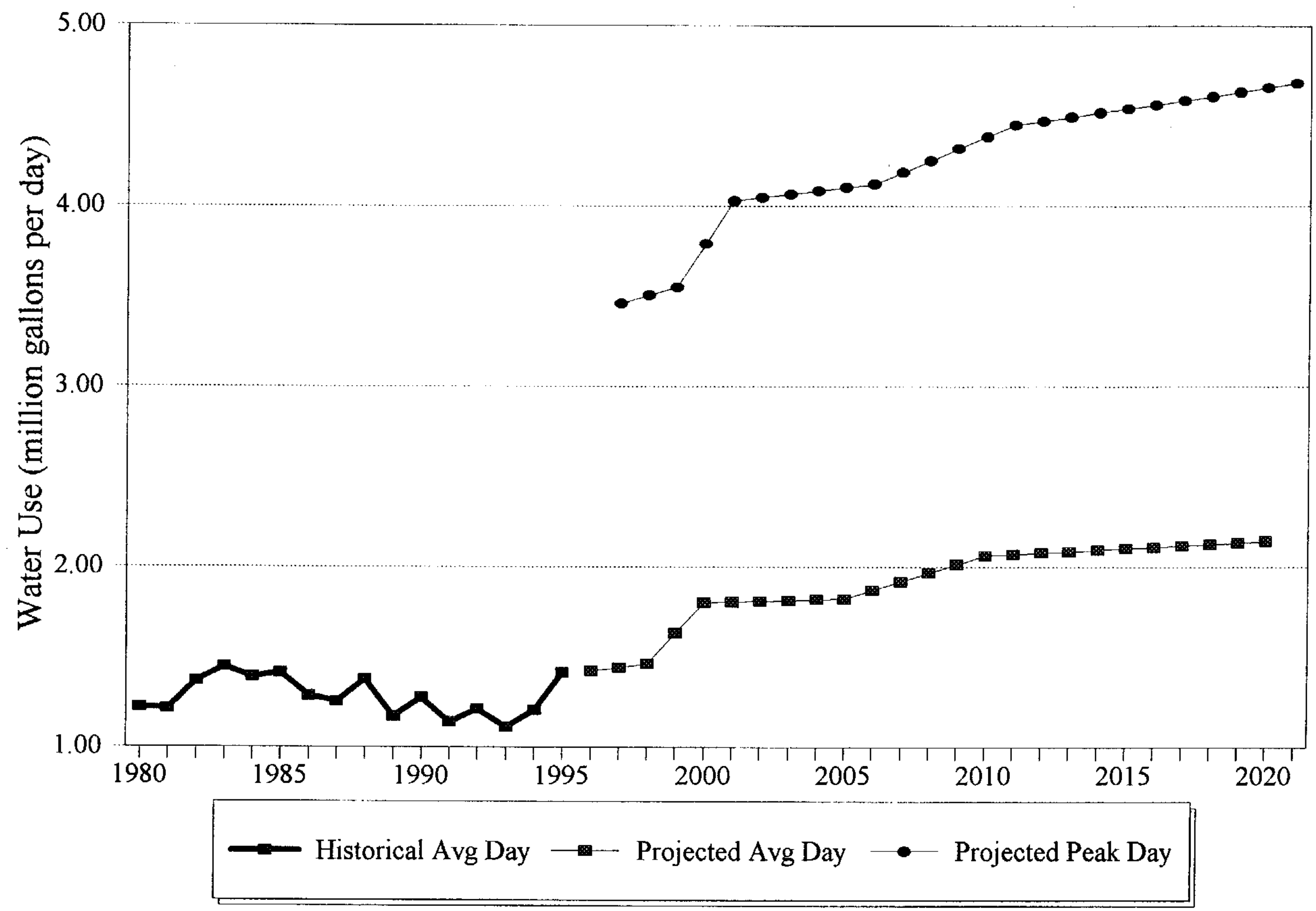
	1996	1998	2000	2005	2010	2015	2020
Fairfield (Municipal)	0.58	0.61	0.64	0.66	0.68	0.72	0.75
Fairfield (Industrial)	0.00	0.00	0.30	0.30	0.50	0.50	0.50
Teague	0.45	0.45	0.46	0.46	0.47	0.47	0.47
Streetman	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Wortham	0.24	0.25	0.26	0.27	0.28	0.29	0.31
Pleasant Grove WSC	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Boyd Prison Unit	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	**1.67**	**1.71**	**2.06**	**2.09**	**2.33**	**2.38**	**2.43**

Tables 2.7, 2.8, and 2.9 deal with peak-day water requirements for the study participants. The Texas Natural Resource Conservation Commission (TNRCC) requires that a water system have pumping capacity equal to the largest historical peak-day demand or 0.6 gallons per minute (gpm) per connection, whichever is greater. Table 2.7 gives projected peak-day demands for the participants, assuming that the peak-day municipal demand is 2.67 times the average-day demand and that the peak-day industrial and prison unit demands are 1.25 times the average-day demands. (The 2.67 ratio of peak-day demand to average-day demand is based on historical data from Fairfield.) Table 2.8 gives the TNRCC pumping requirements for the participants based on 0.6 gpm per connection. (This requirement is assumed not to apply to the prison, since it does not have numerous connections.) Table 2.9 lists the greater of the values from Tables 2.7 and 2.8, which represents the required supply capacity for each of the study participants. For all participants except Fairfield and the prison, the capacity requirement is set by TNRCC regulation rather than expected peak day use. The total peak supply capacity required for all the study participants in 2020 is 5.32 MGD. Figure 2.1 shows the historical average-day needs, the projected average-day needs, and the projected peak-day needs for the water suppliers participating in this study.

Scenarios for the Amount of Water Supplied by the Regional System

All of the local water suppliers participating in this study have existing sources of supply, which are described in Section 3. If a regional water supply system is developed, some of the suppliers may continue to use these existing sources for part of their water needs. To develop preliminary designs and cost estimates for the regional system, it is necessary to assume a level of participation by the suppliers. For this report we have created two scenarios for system development: one assumes the maximum level of participation that might be expected, and the other

Figure 2.1
Historical & Projected Water Use



assumes a lesser level of participation. It is unlikely that either scenario will correspond exactly to the actual use of the system when it is built, but the scenarios give some idea of the possible layouts and costs of a regional system with a range of participation.

Table 2.7
Projected Peak-Day Water Demands
(Million Gallons per Day)

	1996	1998	2000	2005	2010	2015	2020
Fairfield (Municipal)	1.36	1.43	1.50	1.55	1.60	1.69	1.77
Fairfield (Industrial)	0.00	0.00	0.38	0.38	0.63	0.63	0.63
Teague	1.02	1.02	1.03	1.05	1.06	1.06	1.07
Streetman	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Wortham	0.43	0.45	0.47	0.49	0.51	0.53	0.56
Pleasant Grove WSC	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Boyd Prison Unit	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Total	**3.46**	**3.55**	**4.03**	**4.12**	**4.45**	**4.56**	**4.68**

Table 2.8
TNRCC Pumping Requirements at
0.6 GPM per Connection

	1996	1998	2000	2005	2010	2015	2020
Fairfield (2.28 persons/connection)							
Number of Connections	1,495	1,568	1,640	1,696	1,752	1,846	1,939
Requirement (MGD)	1.29	1.35	1.42	1.47	1.51	1.59	1.68
Teague (1.937 persons/connection)							
Number of Connections	1,785	1,801	1,818	1,839	1,860	1,868	1,876
Requirement (MGD)	1.54	1.56	1.57	1.59	1.61	1.61	1.62
Streetman (1.96 persons/connection)							
Number of Connections	151	153	153	153	153	153	153
Requirement (MGD)	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Wortham (assumed 2 persons/connection)							
Number of Connections	535	563	590	611	631	665	699
Requirement (MGD)	0.46	0.49	0.51	0.53	0.55	0.57	0.60
Pleasant Grove WSC (2.48 persons/connection)							
Number of Connections	323	323	323	323	323	323	323
Requirement (MGD)	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Total Number of Connections (w/out Prison)	**4,289**	**4,408**	**4,524**	**4,622**	**4,719**	**4,855**	**4,990**
Total TNRCC Requirement (MGD) (w/out Prison)	**3.70**	**3.81**	**3.91**	**4.00**	**4.08**	**4.18**	**4.31**

Table 2.9 Peak-Day Water Supply Requirements (Million Gallons per Day)							
	1996	1998	2000	2005	2010	2015	2020
Fairfield	1.36	1.43	1.88	1.93	2.23	2.32	2.40
Teague	1.54	1.56	1.57	1.59	1.61	1.61	1.62
Streetman	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Wortham	0.46	0.49	0.51	0.53	0.55	0.57	0.60
Pleasant Grove WSC	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Boyd Prison Unit	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Total	**4.06**	**4.18**	**4.66**	**4.75**	**5.09**	**5.20**	**5.32**

Note: The peak-day water supply requirements are the greater of the values in Tables 2.7 and 2.8.

The maximum participation scenario assumes that all of the participants will use the regional system to supply all of their water needs. This means that the regional system must have a delivery capacity equal to the peak-day water supply requirements given in Table 2.9. The 2020 delivery capacity for this scenario is 5.32 MGD. Storage within the participants' individual systems will provide additional capacity to meet peak-hour demands.

The lesser participation scenario assumes that the participants will use the regional system to supply up to their average-day demand. Demands above the average-day level will be met by the participants' existing sources of supply, with the exception of Wortham. Because of the uncertainty of Wortham's present water supply, we assume that Wortham will receive all of its water supply from the regional system. In this scenario, the regional system will be designed to deliver the 2020 peak-day requirement of 0.60 mgd for Wortham and the 2020 average-day requirements for other participants of 1.93 mgd. The total system capacity in this scenario is 2.53 mgd. As with the other scenario, storage within the participants' individual systems will provide additional capacity to meet peak-hour demands.

Water Conservation and Emergency Water Demand Management Plan

Appendix C is the proposed water conservation and emergency water demand management plan for portions of Freestone County. This plan was prepared by the Trinity River Authority of Texas. Each participant in the regional system will be required by the contract with the regional entity to adopt this plan. The water conservation portion of the plan outlines the principal water conservation methods that can be used to more efficiently use water resources:

- Public education and information
- Plumbing codes for new construction
- Retrofit programs for existing buildings
- Conservation oriented water rate structure
- Universal metering and meter repair
- Water conserving landscaping
- Leak detection and repair
- Means of implementation and enforcement

The plan presents practical ways in which these methods can be implemented in Freestone County. The emergency water demand management plan sets guidelines for identifying emergency conditions and steps to take once those emergencies are declared. The plan contains the following elements:

- Trigger Conditions
- Drought Contingency Measures
- Information and Education
- Initiation Procedures
- Termination of Notification Actions
- Implementation and Enforcement

The plan also contains samples of an ordinance and a resolution that could be used by the participants to adopt the plan.

3. EXISTING SOURCES OF SUPPLY AND FACILITIES

Existing Sources of Supply

All of the participants except Wortham use groundwater as their only source of supply. Table 3.1 lists the number of wells and total pumping capacity of the participants using groundwater.

Table 3.1
Existing Groundwater Supply of Participants

	Number of Wells	Total Current Pumping Capacity in MGD	Firm Capacity in MGD
Fairfield	3	1.66	1.15
Teague	3	1.25	0.84
Streetman	3	0.21	0.12
Pleasant Grove WSC	4	0.58	0.37
Boyd Prison Unit	2	0.58	0.17

Wortham's water supply comes from Lake Wortham, located just east of the city. The firm yield of this lake is not known because no operation studies were performed when the lake was built and there are no data available to perform those studies now. The lake met the needs of the city until 1996, when there was a critical water shortage during drought conditions. This shortage indicates that Lake Wortham is not a reliable source in time of drought, and the city is considering other options for water supply. In September 1996, the city hired KSA Engineers, Inc., to study water supply alternatives for Wortham [5]. Wortham also joined this Freestone County regional water supply study to investigate its options in a regional system.

Facilities Which Might Be Used in a Regional System

Each participant has individual supply lines leading directly from its current source of supply to its system. Generally, these lines are not large enough or properly located to carry supply for a regional system.

There is an existing large-diameter petroleum pipeline owned by Chevron that runs from Navarro Mills Lake to Wortham Lake (about 20 miles). Chevron periodically takes this line out of service since they have a parallel line which can meet most of their needs. The line was out of service in the summer of 1996 and was used on an emergency basis to deliver raw water from Navarro Mills Lake to Wortham Lake. Chevron is not likely to sell the pipeline since it is used to meet their peak needs, but the pipeline easement might be shared. The option to share the easement could be pursued in an effort to bring some savings to the cost of a new pipeline along that route if water is purchased from the City of Corsicana.

The City of Wortham owns and operates a water treatment plant which is now used to treat water from Wortham Lake. The plant does not have enough capacity to treat water for the entire regional system. The cost of expanding this conventional plant would be substantial. Furthermore, the plant is not in a logical location to serve the regional system, since it is not near the source of raw water (Richland-Chambers Reservoir) or near the center of demand for the regional system.

4. POTENTIAL WATER SUPPLY SOURCES

The scope of services for this project (Appendix B) identifies the potential sources of supply to be considered in this study. They are: 1) Tarrant Regional Water District's Richland-Chambers Reservoir, 2) City of Corsicana potable water; and 3) up to two additional sources of water including groundwater, reclaimed water, or other existing surface water sources. This section describes the alternative water sources.

Raw Surface Water

Richland-Chambers Reservoir

Tarrant Regional Water District owns and operates Richland-Chambers Reservoir. The dam is located in the northeast corner of Freestone County, and the reservoir extends into southeast Navarro County. The District has the right to divert and use 210,000 acre-feet per year from the reservoir. Most of the water currently used from the reservoir is delivered by pipeline to the District's major customers in Tarrant County. The District has indicated that it is willing to sell enough raw water to meet the needs of a regional system for Freestone County.

The District's current charge for raw water is $0.64208 per thousand gallons. This rate is projected to remain steady for several years at around $0.63 per thousand gallons. The District requires new customers to pay a one-time premium based on the purchaser's ultimate average-day demand. The premium rate for fiscal year 1997 is $121,555 per MGD and is projected by the District to increase to $261,653 per MGD in 2001.

Using water from Richland-Chambers would require the following new facilities:

- An intake structure and pump station at the reservoir

- A water treatment plant with ground storage
- A high service pump station
- 38 miles of pipeline
- A booster pump station with ground storage

The City of Corsicana had water rights in Lake Corsicana, which was inundated by the construction of Richland-Chambers Reservoir. As a result, Corsicana now has the right to divert up to 13,650 acre-feet per year (12.1 MGD) from Richland-Chambers Reservoir. The city might be willing to sell some of this raw water from Richland-Chambers Reservoir to a regional system supplying Freestone County. At this time, Corsicana is undecided on what rate they would charge for this raw water. Purchasing Richland-Chambers water from Corsicana could possibly reduce the raw water cost. If and when a Freestone County regional system is formed and if Richland-Chambers is chosen as the water source, the possibility of purchasing raw water from Corsicana should be explored further. For this study, we have assumed that the raw water will be purchased from the District, since those costs are known.

Lake Fairfield

Lake Fairfield is a 50,600 acre-foot reservoir owned and operated by Texas Utilities Electric Company (TU). TU holds the right to use 14,150 acre-feet per year for industrial use. TU was contacted about the possibility of being a wholesale water provider for a regional system, and they indicated that they could not provide the water from Lake Fairfield at this time.(6)

Treated Surface Water

The City of Corsicana is the most logical option for buying treated water because they are the nearest supplier, they already supply water to much of Navarro County, they have reliable raw water supplies, and they are interested in supplying water to a regional system in Freestone County.

City of Corsicana - Navarro Mills Delivery Point

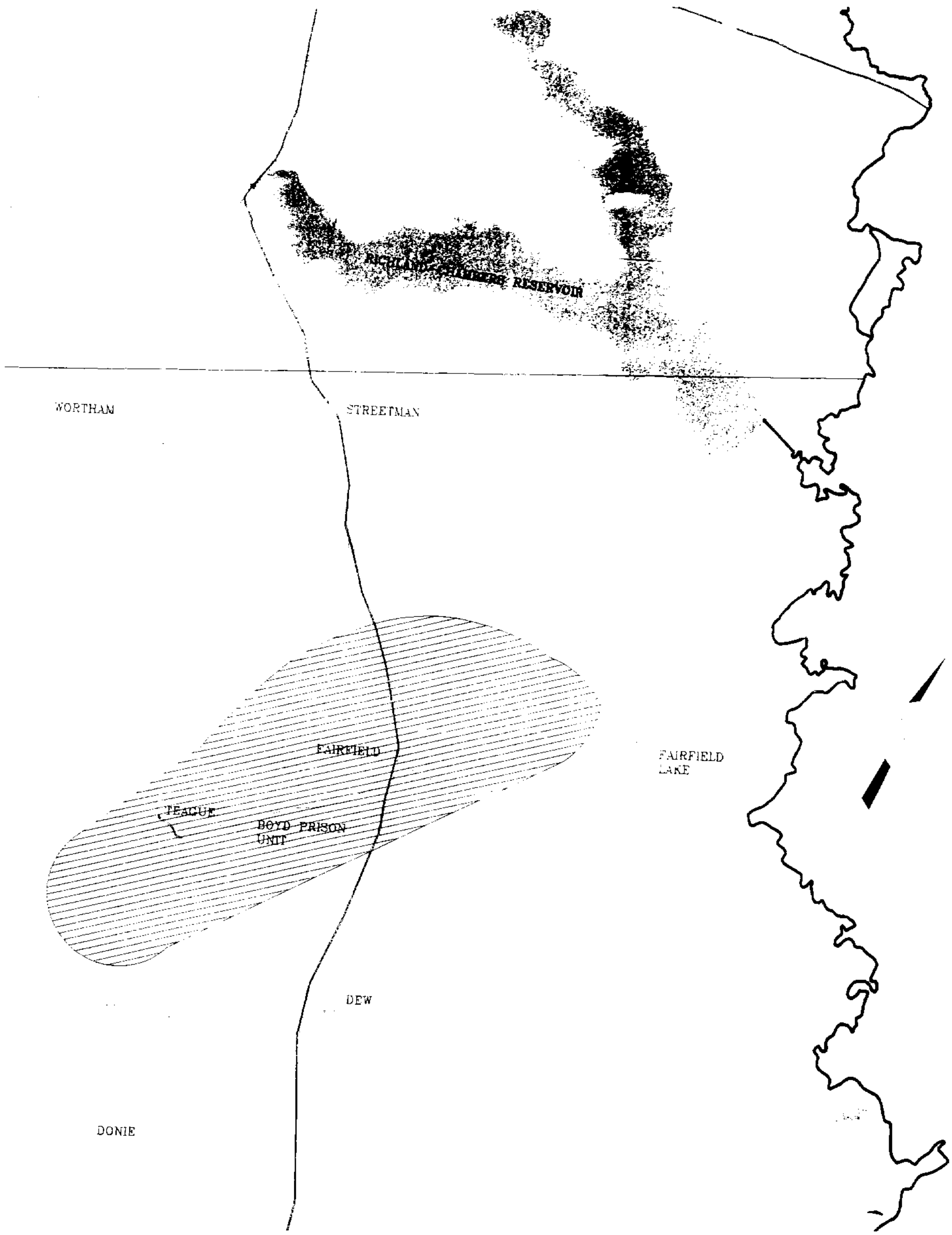
Navarro Mills Lake is a 63,300 acre-foot reservoir located at the eastern edge of Navarro County, about 15 miles east of the City of Corsicana. The Trinity River Authority owns the rights to most of the firm yield and sells that water to several entities, including the City of Corsicana. Corsicana has a contract with TRA to buy 17,460 acre-feet per year (15.6 MGD) from Navarro Mills Lake. Corsicana owns and operates a water treatment plant just downstream from Navarro Mills Dam. Treated water is delivered from the plant to the city in a 30-inch pipeline paralleling Highway 31. The city is willing to sell treated water from the Navarro Mills plant to a regional system in Freestone County. The route for this option would be from the Navarro Mills Lake water treatment plant to the City of Wortham then on to the remainder of the participants. A regional system buying treated water from Corsicana at the Navarro Mills plant would require 63 miles of pipeline and three pump stations. Corsicana would sell treated water to a regional system at its wholesale rate, which is currently $1.68 per thousand gallons.

City of Corsicana - Airport Delivery Point

Corsicana might also sell treated water to a regional system from a point near the Corsicana Airport south of Corsicana. There is currently a 12-inch water line from the city to the airport, and Corsicana's water distribution master plan includes a parallel 12-inch line. This alternative might require the regional system to share in the cost of installing the parallel line or participate in installing a larger line to the airport. The amount of that cost sharing is not known now. Buying treated water from Corsicana at the airport delivery point would require 50 miles of pipeline and three pump stations. The current cost of treated water from Corsicana would remain $1.68 per thousand gallons.

Groundwater

Freestone County overlies the Carrizo-Wilcox Aquifer. In a 1991 report[7], the Texas Water Development Board states that for the aquifer as a whole, projected future water requirements do not approach the amount considered available. However, due to the complex distribution of sands and clays, hydraulic characteristics vary significantly from one area to another[7]. Locally, abnormally high levels of some constituents may occur, with excessive iron concentration as the most common problem[7]. The TWDB study covers all or part of 17 counties, so it is not specific about what areas in Freestone County have good availability from the aquifer and where iron contamination exists. Another TWDB report[8] from 1991 identifies a significant portion of Freestone County as experiencing a groundwater level decline between 20 and 40 feet from 1980 to 1990. This area is shown in Figure 4.1. A 1996 evaluation of well fields for the city of Fairfield and the Boyd Prison Unit[9] states that locally, the aquifer is moderately developed, fully saturated, and can sustain additional development. Additional well supplies to furnish the projected needs are available from properly located, spaced and designed wells. The report recommends that well fields in that area continue developing sands at suitable sites in just the lower portion of the Wilcox (to avoid iron contamination), screening sands at depths of 500 feet to 800 feet. As wells must be drilled deeper,



LEGEND

GROUNDWATER DECLINE OF 20' - 40'

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FIGURE 4.1
GROUND WATER DECLINE IN FREESTONE COUNTY, 1980-1990

the cost to develop, operate, and maintain them will increase.

Each participant except Wortham has existing groundwater supplies. Fairfield experienced iron contamination in the last well it drilled and needs a new supply well and a back-up well at the present time. The 1996 well field evaluation[9] identified an area southeast of the city where a new well could be drilled. According to Fairfield, the estimated cost of the new well is around $600,000. Several miles of transmission lines may also have to be built for this source. Fairfield has hired LBG-Guyton, Inc., to drill two test wells to confirm the suitability of this area for a new well. The results of those test wells will not be available until after this report is published. The other participants in this study are not improving their groundwater supply systems at the present, but will have to do so at some point in the future.

5. LAYOUT AND COST OF REGIONAL WATER SUPPLY SYSTEM ALTERNATIVES

As discussed in Section 4, the most promising sources of water for Freestone County are raw water from Richland-Chambers Reservoir, treated water from the City of Corsicana, and groundwater. The two surface water sources lend themselves to development of a regional system, with a centralized water source and an extensive distribution network for treated water. A regional system does not seem to be the best way to develop a groundwater supply, since the yield of individual wells is relatively small and development of a concentrated well field in Freestone County does not appear to be practical. Groundwater would probably best be developed by the individual water suppliers drilling wells as near to their demands as practical. We will estimate the cost of a groundwater supply for Freestone County developed by individual suppliers for comparison with the cost of the regional surface water supply alternatives.

Each of the entities which might be served by a regional system has an existing water supply system. As discussed in Section 2, a regional system could be designed to replace these existing water supply systems and provide the full water needs of the participants. Alternatively, the regional system could provide a base supply, leaving the participants to rely on existing water supply sources to meet additional needs during times of high water use.

Several terms used in the following sections may need defining.

- The **average-day** water use is defined as the total year's water used divided by the number of days in the year.
- The **peak-day** water use is the amount of water used during the highest use day of the year. This generally occurs during the summer. According to state standards,

any water system must have a water source with the capacity to provide a system's peak-day water need.

- The **firm capacity** of a water system is the highest rate at which that system can pump water to the customers with the largest pump or well out of service. The TNRCC requires that a water system have firm pumping capacity equal to the largest historical peak-day demand or 0.6 gallons per minute per connections, whichever is greater.

Supplies for the Maximum Participation and Lesser Participation Scenarios

Table 5.1 shows the projected average-day and peak-day needs for the maximum participation scenario, which is a regional system supplying all of the water needs of the participants in this study. Table 5.2 shows the projected average-day and peak-day supply for the lesser participation scenario, which is a regional system designed to provide a base supply, with peaking from existing wells owned and operated by the participants. (For the lesser participation scenario, it is assumed that the regional system would supply peak demands for Wortham, which currently utilizes a surface water supply and does not have wells. The regional system would provide projected normal year average-day needs for other participants.) In the lesser participation scenario, it is important to note that the mixing of groundwater and treated surface water may produce water quality concerns. This water quality analysis was beyond the scope of this project, but should be researched before this option is pursued.

Table 5.1 **Projected Supplies from the Freestone County Regional System in the Maximum Participation Scenario (Million Gallons per Day)**			
Year	Projected Supplies		
	Average Day	Dry-Year Average Day	Peak Day
1996	1.42	1.67	4.06
1998	1.46	1.71	4.18
2000	1.80	2.06	4.66
2005	1.82	2.09	4.75
2010	2.06	2.33	5.09
2015	2.10	2.38	5.20
2020	2.14	2.43	5.32

Table 5.3 shows the projected peak-day water requirement for each study participant as of the year 2020. In the maximum participation scenario, the regional system would meet the entire water requirements. In the lesser participation scenario, the regional system would meet the requirements up to the projected normal year average-day demand for each participant, with the participants meeting the rest of their requirements from their own facilities. (It is assumed that the regional system would meet Wortham's total peak-day water requirement.)

Table 5.2 Projected Supplies from the Freestone County Regional System in the Lesser Participation Scenario (Values in MGD)									
Year	Projected Total Requirements			Regional System Supplies			Local Supplies		
	Average Day	Dry-Year Average Day	Peak Day	Average Day	Dry-Year Average Day	Peak Day	Average Day	Dry-Year Average Day	Peak Day
1996	1.42	1.67	4.06	1.17	1.38	2.50	0.25	0.29	1.56
1998	1.46	1.71	4.18	1.20	1.42	2.50	0.26	0.29	1.68
2000	1.80	2.04	4.66	1.48	1.70	2.50	0.32	0.34	2.16
2005	1.82	2.09	4.75	1.49	1.73	2.50	0.33	0.36	2.25
2010	2.06	2.33	5.09	1.69	1.92	2.50	0.37	0.41	2.55
2015	2.10	2.38	5.20	1.72	1.96	2.50	0.38	0.42	2.70
2020	2.14	2.43	5.32	1.75	2.00	2.50	0.39	0.43	2.82

Table 5.3 2020 System Capacity Needs (Values in MGD)				
	Projected 2020 Peak-Day Requirements	Maximum Participation	Lesser Participation	
		Peak-Day Supply from Regional System	Peak-Day Supply from Regional System	Peak-Day Supply from Groundwater
Fairfield	2.40	2.40	1.14	1.26
Teague	1.62	1.62	0.39	1.23
Streetman	0.13	0.13	0.04	0.09
Wortham	0.60	0.60	0.60	0.00
Pleasant Grove WSC	0.28	0.28	0.10	0.18
Boyd Unit Prison	0.29	0.29	0.23	0.06
Total	5.32	5.32	2.50	2.82

Assumptions in the Layout and Cost of a Regional System

Water Treatment Plant

We have assumed that the water treatment plant for a regional system will be a high-rate package plant such as Micro-floc's Trident plant. Such package plants are significantly less expensive than conventional treatment plants and have been used successfully in other systems. Since the raw water in Richland-Chambers Reservoir does not present unusual treatment challenges, a package plant seems to be a good choice for this application. The TNRCC requires a pilot study to assure that the proposed package plant is capable of treating the source water, and the cost of such a study is included in the cost estimate.

Water Transmission System

Wherever possible, water transmission pipelines have been routed within existing highway rights-of-way. The use of the highway rights-of-way would save the expense and effort of right-of-way acquisition. The disadvantage of this approach is that the pipeline must be relocated at the expense of the regional system in the event of a conflict with future roadway expansions. (Lines along Interstate Highway 45 may be an exception. Current policy is for the federal or state government to cover the cost of relocating utility lines in interstate rights-of-way.)

The pipelines are sized to give a maximum velocity of about 6 feet per second, with a minimum pipeline diameter of 8 inches. Pumping heads and energy requirements are based on a Hazen-Williams "C" factor of 120. All pump stations have ground storage for 8 hours of pumping at peak rates, and ground storage at delivery point is assumed to be provided by water purchasers. (The routes pass near the existing ground storage of the participants.)

Capital and Life Cycle Costs

Capital cost estimates are based on engineering judgment and recent experience with similar projects. Appendix D includes a more detailed discussion of the capital costs, including the unit costs used and the basis for those unit costs. Capital costs include a 15 percent allowance for contingencies and 12 percent for engineering and related costs.

Appendix E includes computations of life cycle costs from 1999 through 2028 for the various water supply scenarios. Life cycle costs for the regional system include debt service to pay for capital improvements, raw or treated water purchase, water treatment plant operation and maintenance, pump station and pipeline operation and maintenance (including power for pumping), and administration. In the lesser participation scenarios, total water supply costs include operation and maintenance costs for groundwater wells (including power for pumping). The text of Appendix E includes a description of the development of life cycle costs, and Table 5.4 lists key assumptions used to develop life cycle costs.

The life cycle costs developed for this study represent the estimated cost of delivering potable water to suppliers. They do not include internal distribution and administrative costs and do not represent water rates for retail customers. They are intended to give a valid comparison of the relative cost of various alternative sources of water supply.

Table 5.4 Key Assumptions in the Development of Life Cycle Costs for Regional Supply System	
Length of Bond Issue	30 Years
Interest Rate for Bonds	6% Per Year
Inflation Rate	4% Per Year
Cost per Kilowatt-Hour of Electricity	$0.07
Wire-to-Water Pump Station Efficiency	70%
Discount Rate to Compute Present Worth of Future Costs	4% per Year
1997 Cost of Treated Water from Corsicana	$1.68 Per Thousand Gallons
1997 Cost of Raw Water from Richland-Chambers Reservoir	$0.64208 Per Thousand Gallons

Richland-Chambers Reservoir

Developing a water supply from Richland-Chambers Reservoir would require construction of an intake and pump station in the lake, a raw water pipeline from the lake to a water treatment plant, a treatment plant, and treated water transmission pump stations and pipelines to the customers. Figure 5.1 shows the layout for a regional water system obtaining water from Richland-Chambers Reservoir under the maximum participation scenario. The diversion from the lake is located near Streetman, as is the 6.0 MGD water treatment plant. The main treated water transmission line is a 20-inch pipeline through Streetman and the Pleasant Grove Water Supply Corporation to Fairfield, with smaller lines serving Wortham, Teague, and the Boyd Prison unit. Figure 5.2 is a layout of a regional water system obtaining water from Richland-Chambers Reservoir for the lesser participation scenario, with a 3.0 MGD water treatment plant. The size of the treatment plant, pump stations, and pipelines is smaller than in the maximum participation scenario because the regional system does not provide the entire peak-day supply for the participants.

Table 5.5 presents a summary of cost information for supplies from Richland-Chambers

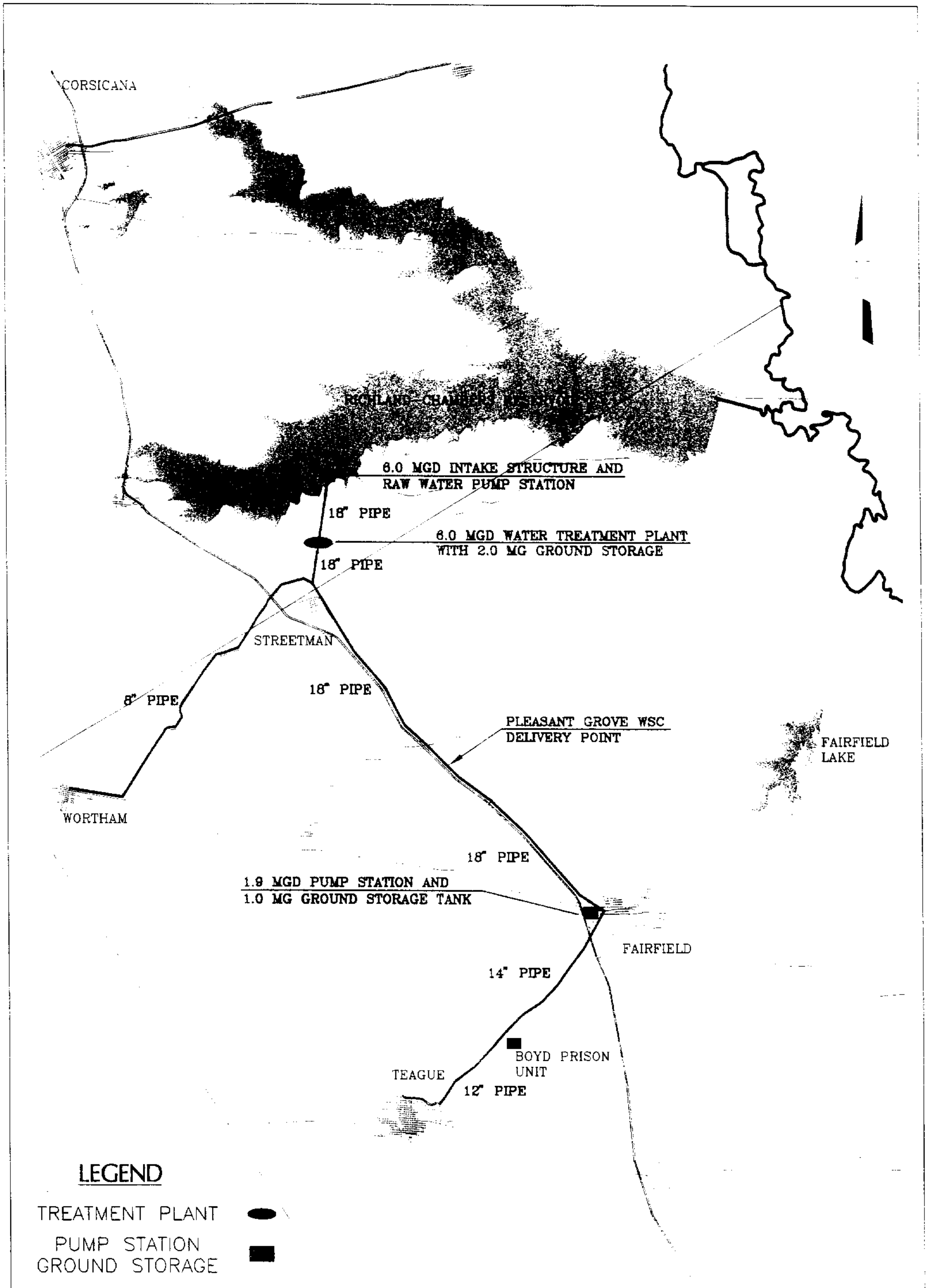

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FIGURE 5.1
RICHLAND – CHAMBERS SUPPLY, MAXIMUM PATICIPATION SCENARIO

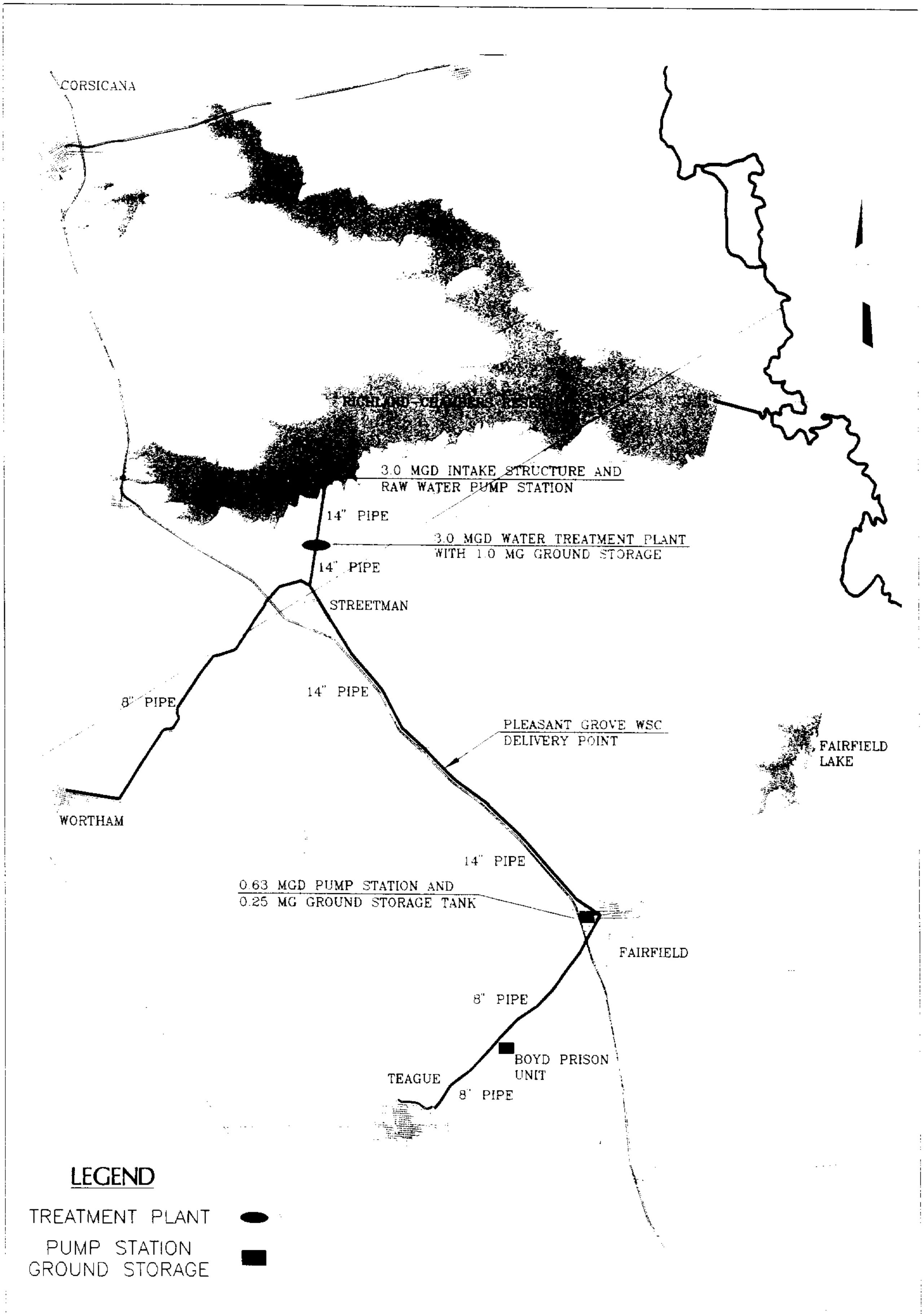

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FIGURE 5.2
RICHLAND – CHAMBERS
SUPPLY, LESSER
PATICIPATION SCENARIO

Reservoir. Figure 5.3 shows the projected present worth unit costs from 1999 through 2028. The unit costs of the lesser participation scenario are lower than those of the maximum participation scenario, but the lesser participation system would require participants in the regional system to maintain their existing wells for peaking.

Table 5.5
Summary of Cost Information for Supplies from Richland-Chambers Reservoir

	Maximum Participation	Lesser Participation
Capital Cost (1997 Prices)	$23,525,000	$16,677,000
Capital Cost When Constructed	$24,466,000	$17,344,000
Projected Initial Year Water Cost - Cost per Thousand Gallons - Present Worth Cost per Thousand Gallons	 $ 4.86 $ 4.49	 $ 3.51 $ 3.24
Average Present Worth Water Cost from 1999 to 2028	$ 2.87	$ 2.15

City of Corsicana

Purchasing treated water from Corsicana for a regional water system would require pump stations and pipelines from the source of supply in Corsicana to the participants in the regional system. For this study, we considered two system layouts: (1) delivering water from the City of Corsicana's water treatment plant near Navarro Mills Lake, and (2) delivering water from near the airport south of Corsicana. Delivery from the airport would allow a shorter pipeline from Corsicana to the regional system's customers and thus save money. However, further analysis of Corsicana's internal water distribution system would be needed to see what improvements, if any, would be needed to implement this option. It is likely that Corsicana would require the regional system to participate in the cost of these improvements if this alternative is adopted.

Figure 5.3: Projected Present Worth of Unit Cost
Richland-Chambers System

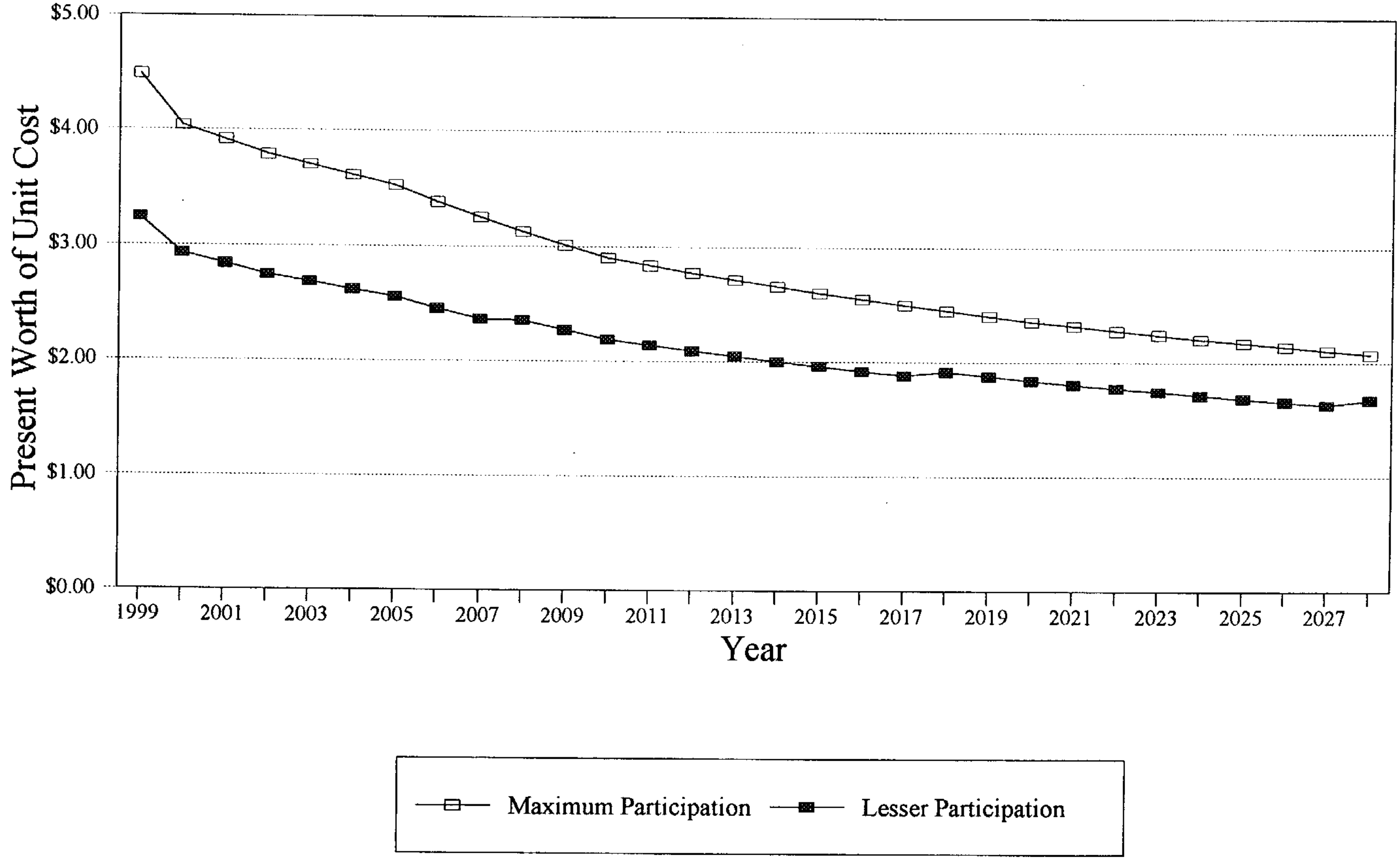

Figure 5.4 gives a layout for a regional water system obtaining water from Corsicana near Navarro Mills Lake under the maximum participation scenario. Figure 5.5 gives a similar layout for the lesser participation scenario. In each case, the main water line runs from Corsicana's water treatment plant to Wortham and on to Fairfield, with branches to other system customers. The main line is 20 inches in diameter for the maximum participation scenario and 14 and 12 inches in diameter for the lesser participation scenario. Figures 5.6 and 5.7 show similar layouts for systems obtaining treated water near the airport in Corsicana. For these systems, the main treated water transmission pipeline runs from the airport through Streetman and Pleasant Grove Water Supply Corporation to Fairfield, with branches to other users. Table 5.6 summarizes the cost information for these systems. Figure 5.8 shows the projected present worth unit costs for water from the City of Corsicana. As with the Richland-Chambers alternative, the lesser participation scenario is less expensive but requires peaking supplies from the participants in the regional system.

Table 5.6
Summary of Cost Information for Supplies from Corsicana

	Take Point at Treatment Plant		Take Point near Airport	
	Maximum Participation	Lesser Participation	Maximum Participation	Lesser Participation
Capital Cost (1997 Dollars)	$19,883,000	$14,558,000	$17,013,000	$12,491,000
Capital Cost When Constructed	$20,678,000	$15,140,000	$17,694,000	$12,991,000
Projected Initial Year Water Cost - Cost per Thousand Gallons - Present Worth Cost per Thousand Gallons	 $ 5.06 $ 4.67	 $ 3.96 $ 3.66	 $ 4.68 $ 4.33	 $ 3.63 $ 3.36
Average Present Worth Water Cost from 1999 to 2028	$ 3.25	$ 2.71	$ 3.08	$ 2.50

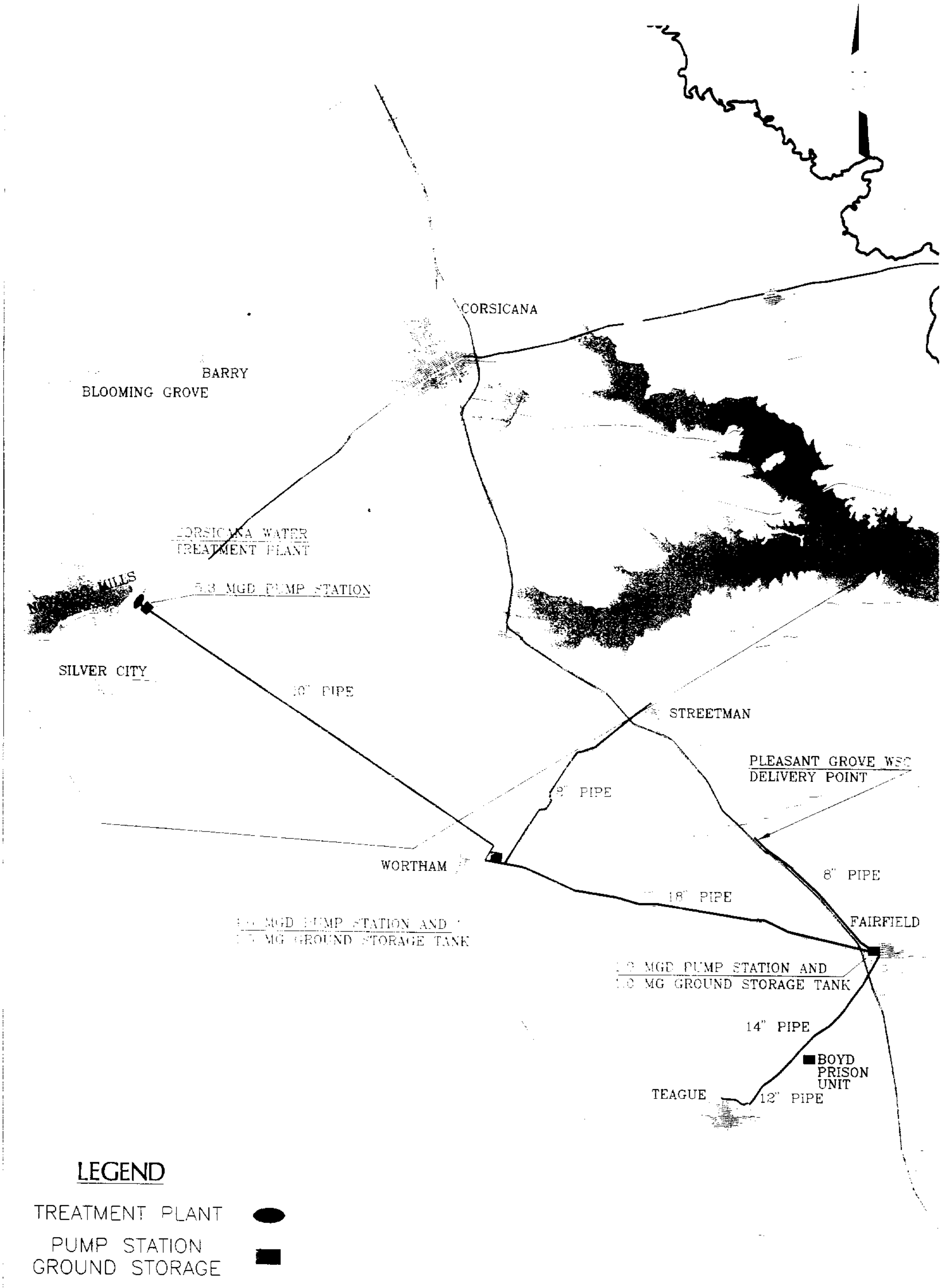

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FIGURE 5.4
NAVARRO MILLS SUPPLY, MAXIMUM PARTICIPATION SCENARIO

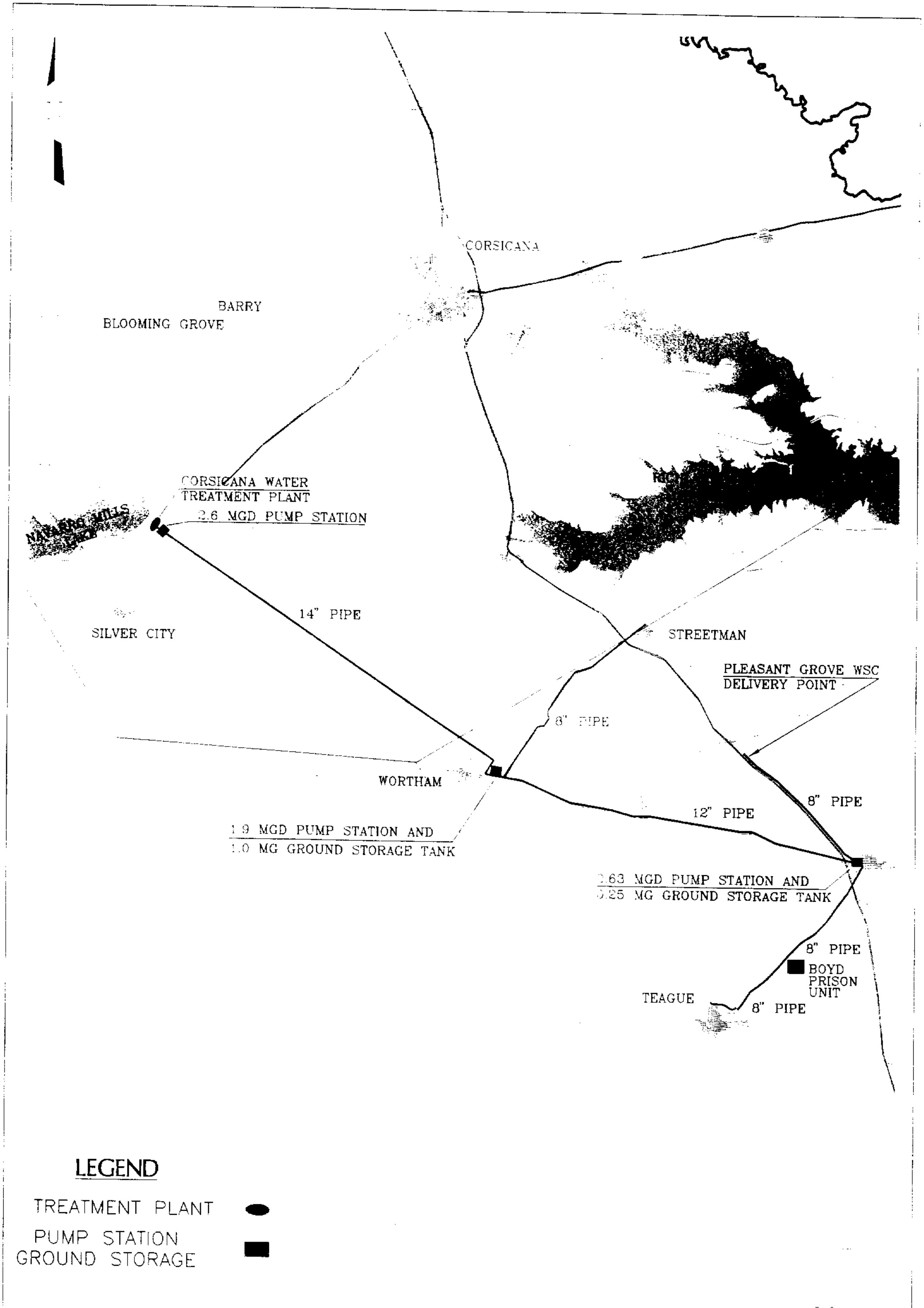

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FIGURE 5.5
NAVARRO MILLS SUPPLY, LESSER PARTICIPATION SCENARIO

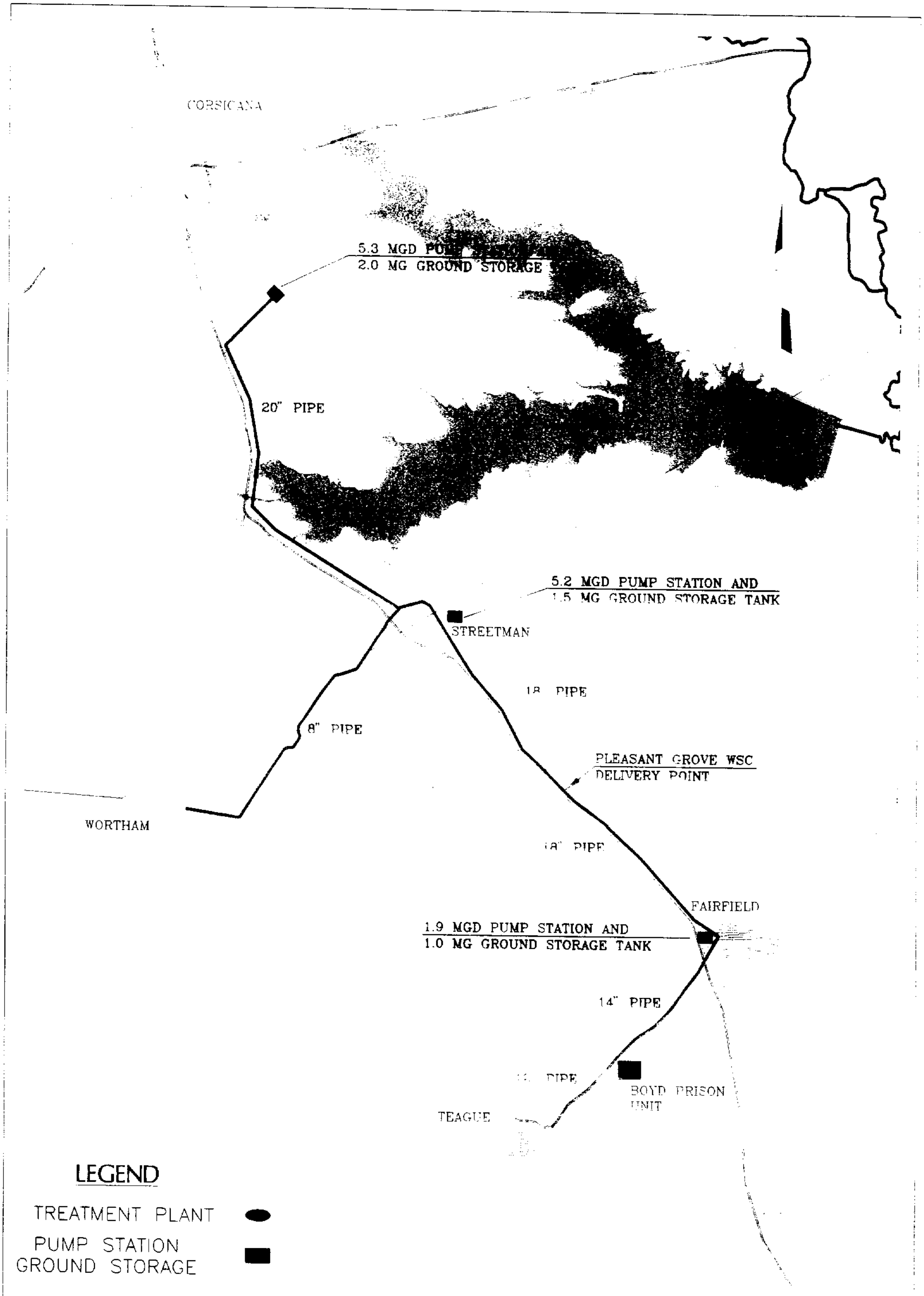

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FIGURE 5.6
CORSICANA AIRPORT SUPPLY, MAXIMUM PARTICIPATION SCENARIO

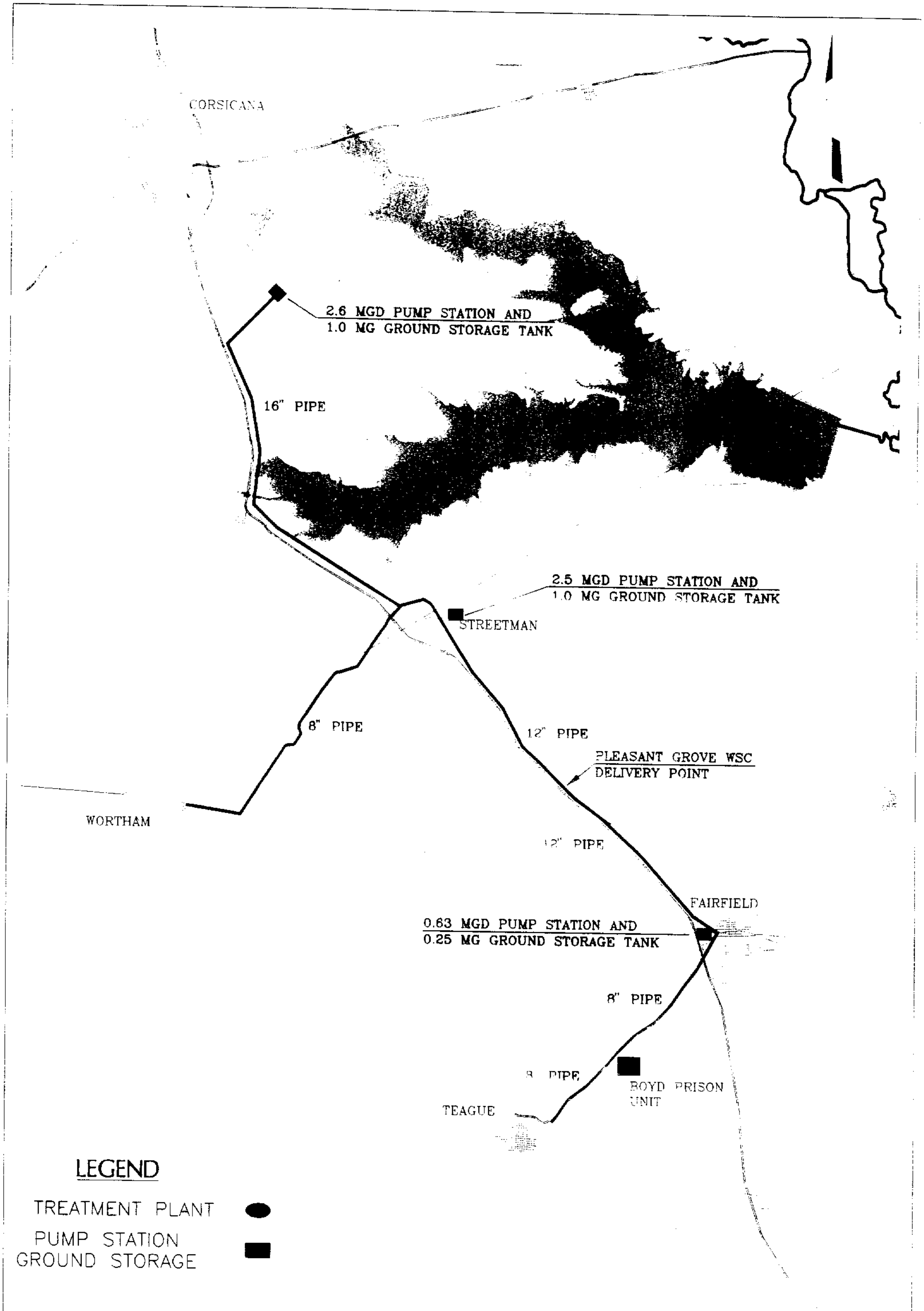

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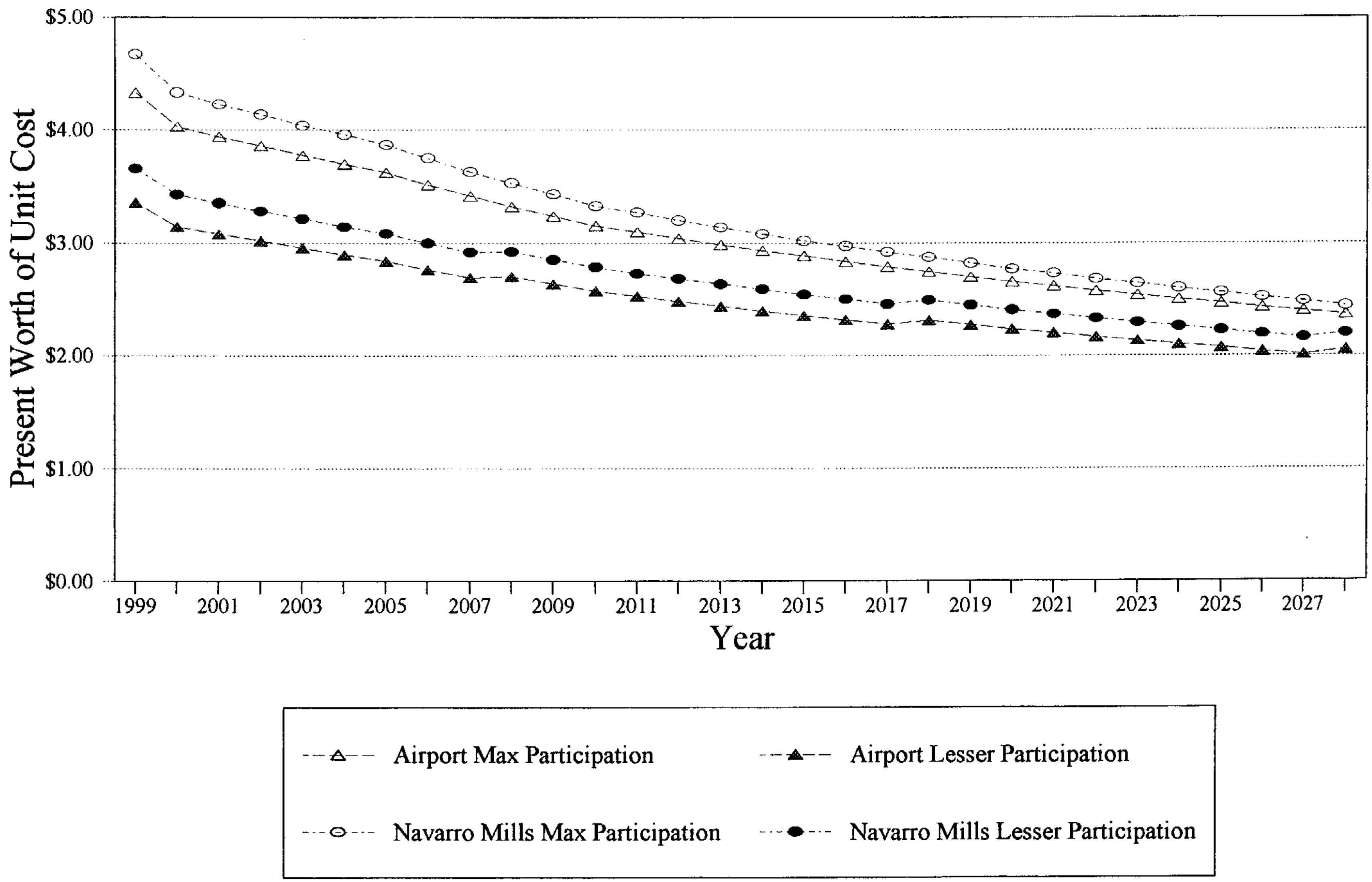
FIGURE 5.7
CORSICANA AIRPORT SUPPLY, LESSER PARTICIPATION SCENARIO

Figure 5.8: Projected Present Worth of Unit Cost
Corsicana Airport and Corsicana Navarro Mills Systems



Groundwater

With the exception of Wortham, the study participants currently obtain their water supply from groundwater in the Carrizo-Wilcox aquifer. Wortham is considering development of a groundwater supply[6], and Fairfield is in the process of developing additional groundwater supplies[9]. The other potential participants in a regional water supply system are not currently improving their groundwater supplies but will need to do so in the future if a regional surface water supply system is not developed. Table 5.7 shows the current number of wells and firm pumping capacity for each participant, along with the projected 2020 peak-day water requirements and the approximate number of additional wells needed by 2020, if any. To provide enough firm capacity to meet the 2020 demand, the study participants will need to develop an additional 9 wells. They will also need to develop replacement wells as their existing wells are taken out of service.

Table 5.7
Additional Wells Needed to Meet Projected 2020 Peak-Day Requirements
(Values in MGD)

	Number of Existing Wells	Current Firm Capacity	Projected 2020 Peak-Day Requirement	Additional Capacity Needed	Additional Wells Needed
Fairfield	3	1.15	2.40	1.25	3
Teague	3	0.84	1.62	0.78	2
Streetman	3	0.12	0.13	0.01	1
Wortham	2 Proposed	0.25 Projected	0.60	0.35	2
Pleasant Grove WSC	4	0.37	0.28	0	0
Boyd Prison Unit	2	0.17	0.29	0.12	1
Total	**15 + 2 Proposed**				**9**

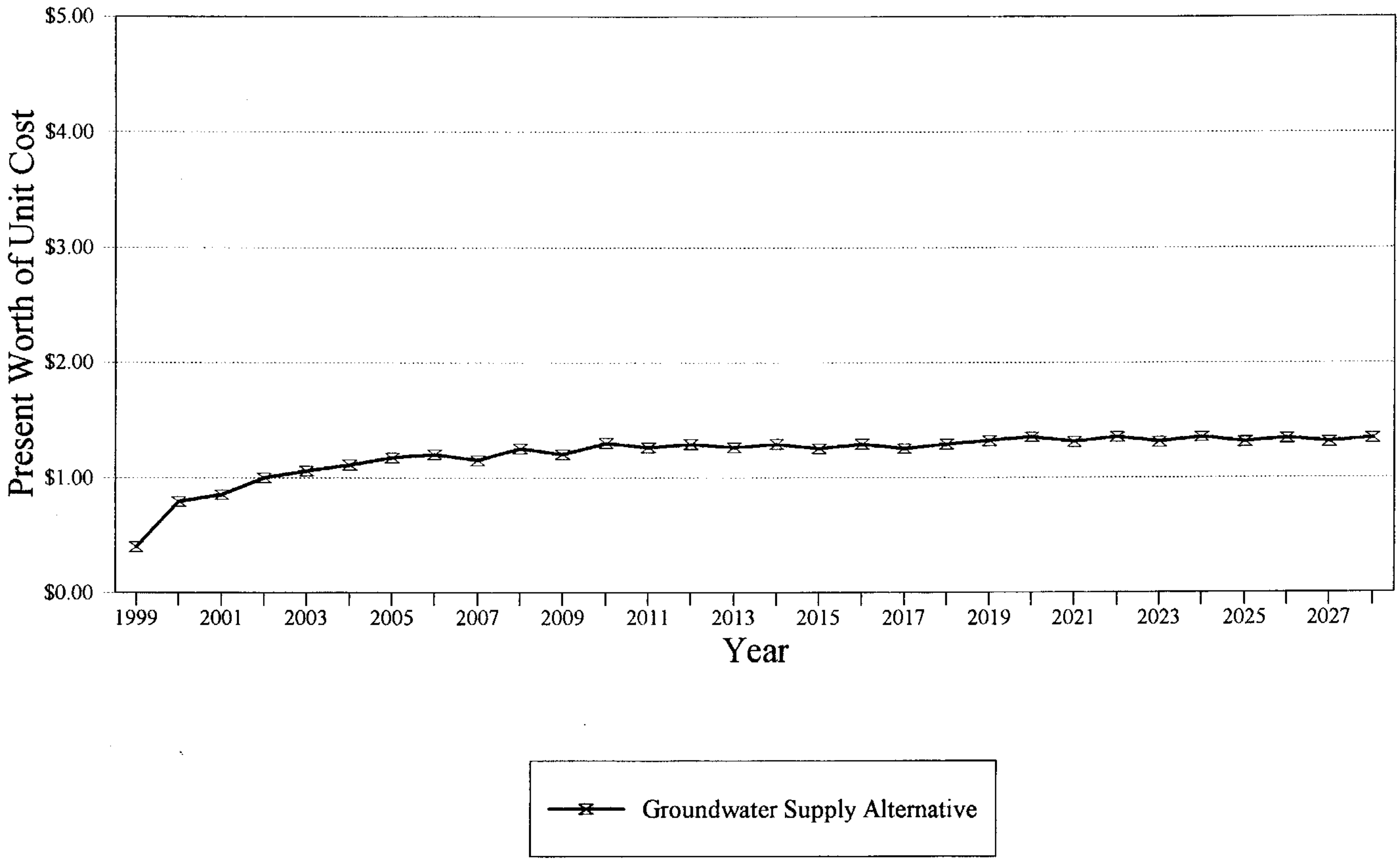
We assume that each water supplier would continue to operate its own water supply system if groundwater is used as the source of supply. For the purpose of comparison with regional system costs, we have estimated the combined life cycle cost of groundwater supply for all the participants in this study. Table 5.8 lists the assumptions in the development of these life cycle costs, which are computed in Appendix E. Table 5.9 summarizes the cost information for the groundwater supply alternative. Figure 5.9 shows the projected present worth unit costs for groundwater supplies. These costs include some expenditures for water treatment (chlorination and iron removal). The cost of treatment may be higher or lower in different areas depending on the quality of the groundwater in the different areas of Freestone County.

This study is a *regional* water planning study, and the main emphasis is placed on water sources that could supply a regional system. Groundwater is not a likely supply source for a regional water system. If groundwater is to remain the source for the participants, each participant should continue to use local groundwater supplies. It would not be necessary or economical to build long distance pipelines connecting the participants when each one has their own source relatively nearby. Therefore, groundwater was given some attention in this study but was not investigated in depth.

Table 5.8 **Assumptions in the Development of Life Cycle Costs for Groundwater**	
Assumption	Source
1997 Average Cost of New Well, Including Test Wells, Associated Pipeline, Etc.= $750,000	Appendix D
1997 Cost of Wortham's Wells and Pipeline = $2,000,000	Reference [5]
Length of Bond Issues to Finance New Wells = 30 Years	Experience
Interest Rate for Bonds = 6% Per Year	Current TWDB Rate
Inflation Rate = 4% Per Year	Experience
Average Life of Wells = 30 Years	Experience
1997 Operation and Maintenance Cost for Wells (including pumping) = $0.40 Per Thousand Gallons	Estimated

Table 5.9 **Summary of Cost Information for Groundwater Supply**	
Capital Cost (1997 Dollars)	$19,250,000
Capital Cost When Constructed	$34,230,000
Projected Initial Year Water Cost - Cost Per Thousand Gallons - Present Worth Cost per Thousand Gallons	 $ 0.43 $ 0.40
Average Present Worth Water Cost, 1999 - 2028	$ 1.20

Figure 5.9: Projected Present Worth of Unit Cost
Groundwater Supply Alternative



Comparison of Water Supply Alternatives

Table 5.10 summarizes the cost information for the three water supply alternatives under the maximum participation scenario and for groundwater supplies. Figure 5.10 shows the comparison of projected present worth unit costs. Table 5.11 and Figure 5.11 provide the same information for the lesser participation scenario. The following conclusions can be reached based on the analyses conducted for this study:

a. Groundwater is likely to be the cheapest source of water supply for Freestone County over the next 30 years.

b. Continued dependence on groundwater would require local water suppliers to develop a large number of new wells to meet projected water requirements and replace aging wells.

c. If Freestone County water suppliers elect to develop a regional water supply system, the most economical approach would be to divert raw water from Richland-Chambers Reservoir, treat it at a regional treatment plant, and distribute treated water to local suppliers.

d. The purchase and distribution of treated water from the City of Corsicana is projected to be more expensive than development of a regional water supply from Richland-Chambers Reservoir.

e. Developing a regional water system that meets all projected peak-day water requirements of the study participants is more expensive than the lesser participation scenario (providing a base supply from a regional system with peaking from local wells). However, the lesser participation scenario would require the participants in the regional system to continue to operate their local wells.

Table 5.12 and Figure 5.12 offer a direct comparison of cost data and projected present worth unit costs for the three most promising alternatives:

- Groundwater
- Richland-Chambers Reservoir with maximum participation
- Richland-Chambers Reservoir with lesser participation.

Table 5.10
Cost Information for Maximum Participation Alternatives

	Richland-Chambers Reservoir	Corsicana		Groundwater
		Navarro Mills	Airport	
Capital Cost (1997 Prices)	$23,525,000	$19,883,000	$17,013,000	$19,250,000
Capital Cost When Constructed	$24,466,000	$20,678,000	$17,694,000	$34,230,000
Projected Initial Year Water Cost - Cost per Thousand Gallons - Present Worth Cost per Thousand Gallons	$ 4.86 $ 4.49	$ 5.06 $ 4.67	$ 4.68 $ 4.33	$ 0.43 $ 0.40
Average Present Worth Water Cost, 1999 - 2028	$ 2.87	$ 3.25	$ 3.08	$ 1.20

Table 5.11
Cost Information for Lesser Participation Alternatives

	Richland-Chambers Reservoir	Corsicana	
		Navarro Mills	Airport
Capital Cost (1997 Prices)	$16,677,000	$14,558,000	$12,491,000
Capital Cost When Constructed	$17,344,000	$15,140,000	$12,991,000
Projected Initial Year Water Cost (including Local Groundwater) - Cost per Thousand Gallons - Present Worth Cost per Thousand Gallons	$ 3.51 $ 3.24	$ 3.96 $ 3.66	$ 3.63 $ 3.36
Average Present Worth Water Cost, 1999 - 2028	$ 2.15	$ 2.71	$ 2.50

Figure 5.10: Projected Present Worth of Unit Cost
Maximum Participation Scenarios

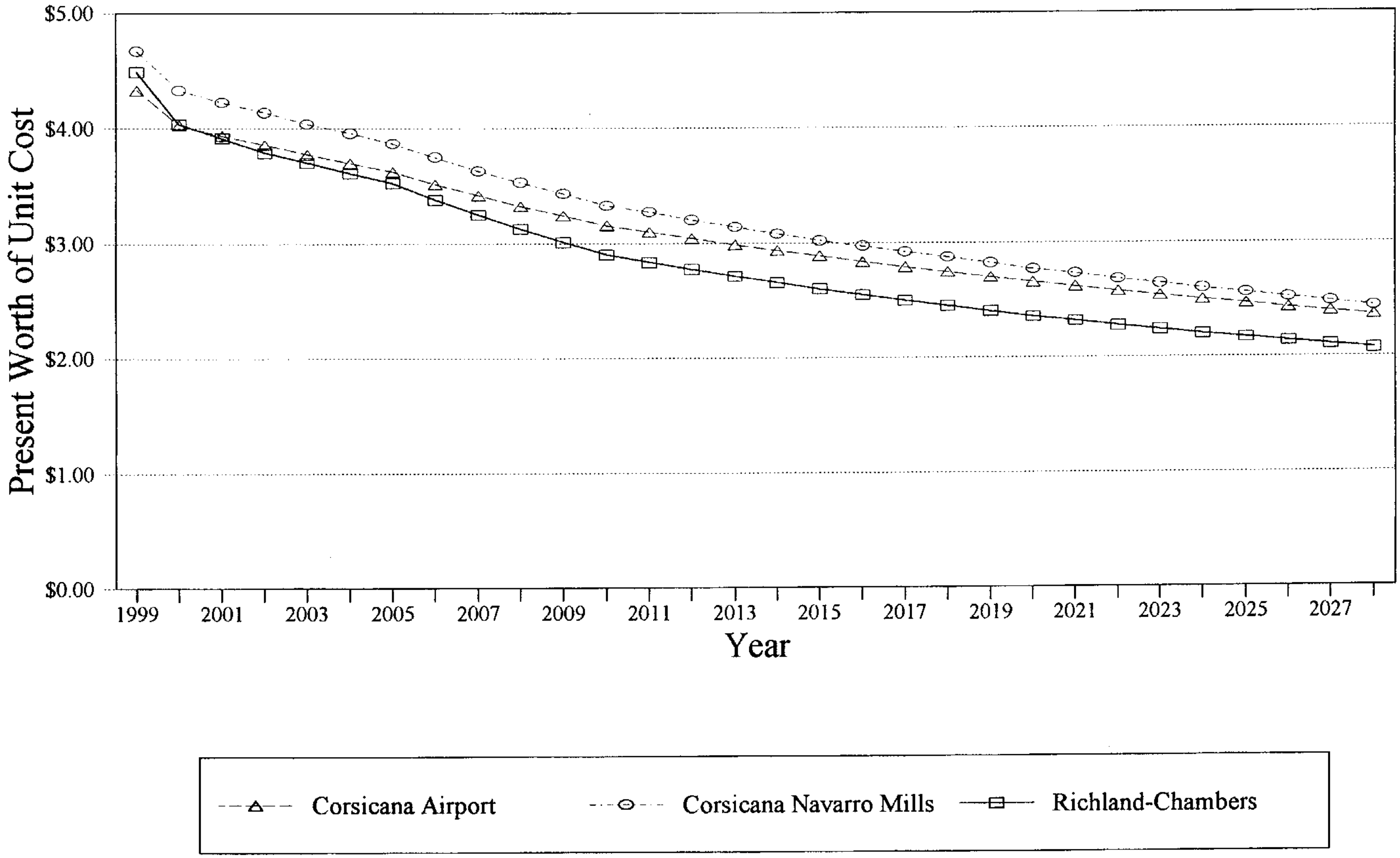


Figure 5.11: Projected Present Worth of Unit Cost
Lesser Participation Scenarios

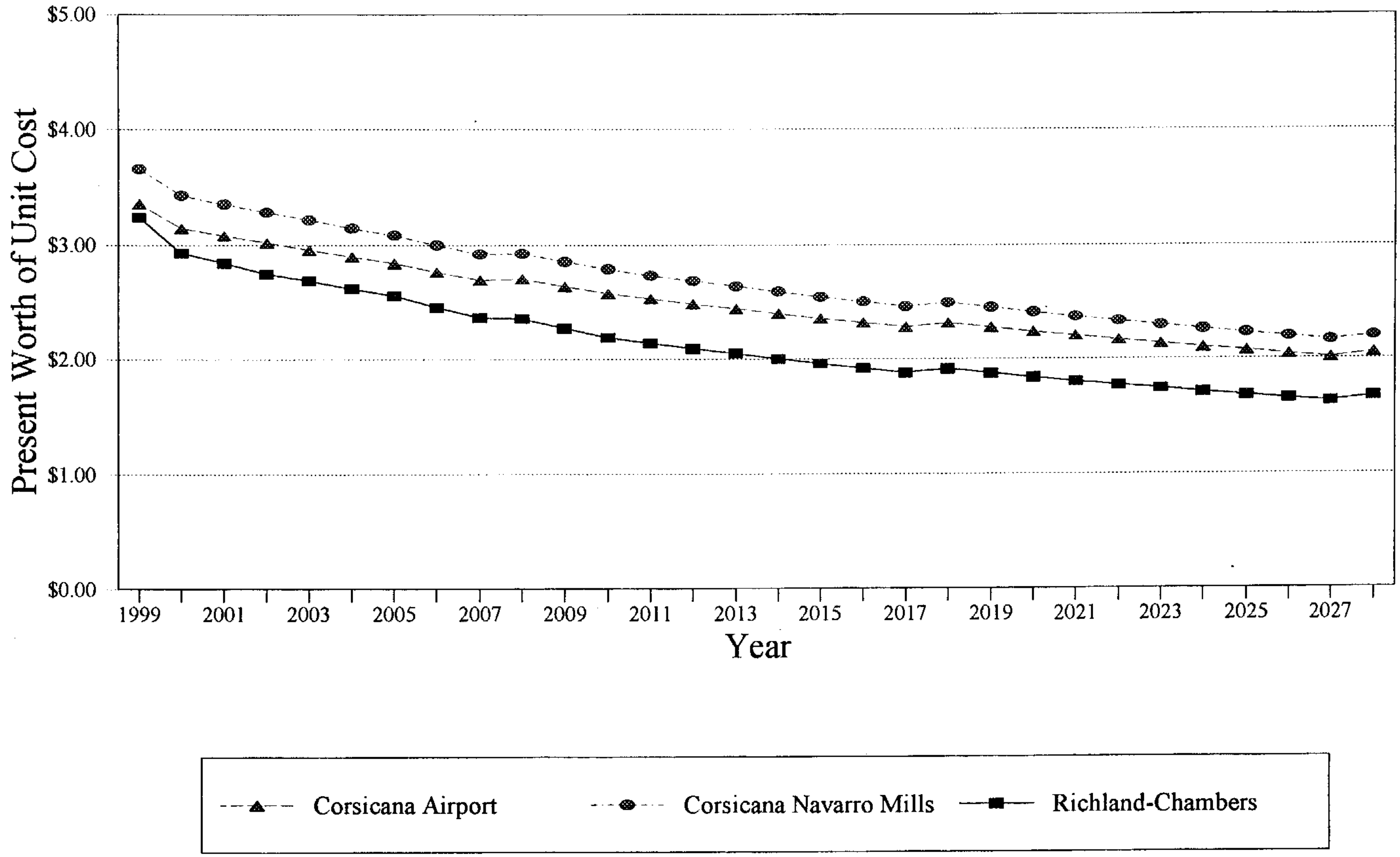
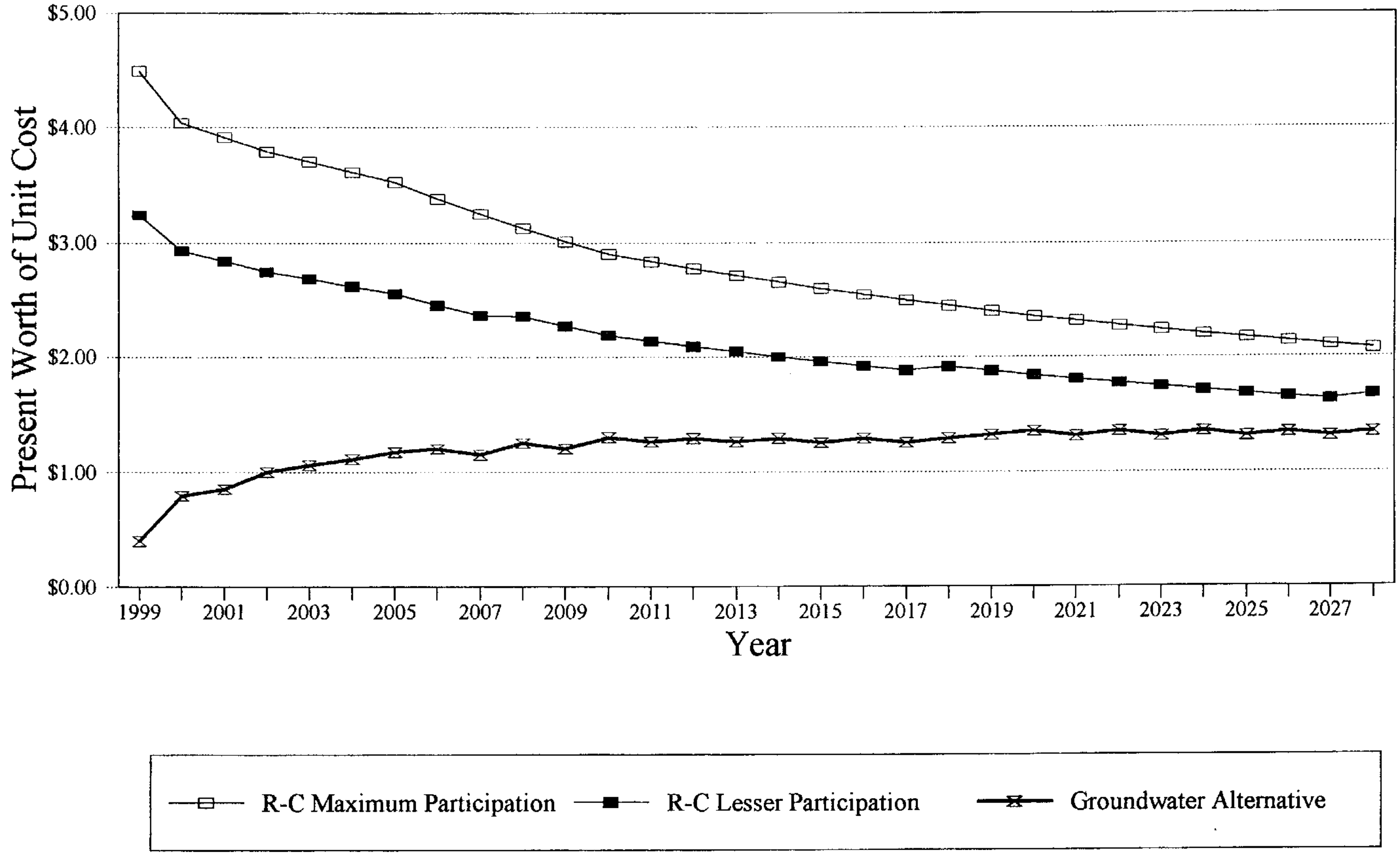


Table 5.12
Cost Information for Most Promising Alternatives

	Richland - Chambers		Groundwater
	Maximum Participation	Lesser Participation	
Capital Cost (1997 Prices)	$23,525,000	$16,677,000	$19,250,000
Capital Cost When Constructed	$24,466,000	$17,344,000	$34,230,000
Projected Initial Year Water Cost			
- Cost per Thousand Gallons	$ 4.86	$ 3.51	$ 0.43
- Present Worth Cost per Thousand Gallons	$ 4.49	$ 3.24	$ 0.40
Average Present Worth Water Cost, 1999 - 2028	$ 2.87	$ 2.15	$ 1.20

Figure 5.12: Projected Present Worth of Unit Cost
Groundwater and Richland-Chambers Systems



6. MANAGEMENT OF THE REGIONAL SYSTEM

Institutional Arrangements and Contracts

There are several options for the management of the regional system. The participants could join together to form a water supply district which would be operated jointly by all the participants, or one larger entity could assume the role of management and operation. This would require a major commitment of resources from the operating entity. The establishment of a regional district would probably require legislative action. The district would sell water to each participating entity.

Another option is to have the Trinity River Authority serve as the operating agency for the regional system. TRA has experience operating regional systems and is willing to provide this service. TRA charges an administrative fee for operating and maintaining regional systems, but this fee is fairly small when compared to the overall advantages. TRA operation would include the following advantages:

- An established and experienced agency in operating regional water systems and contracting for water sales.
- Elimination of the need for entity(s) to form a new agency.
- Elimination of the additional responsibility for the entities to operate a regional system.

In this study, we found that purchasing raw water from Tarrant Regional Water District out of Richland-Chambers Reservoir was the best option. The managing agency for the regional system would buy raw water from the District. The District has a standard contract form for water sales which identifies the volume, rate, delivery point, and payment terms. The District contracts on a take-or-pay basis. This means that each year the customer must set a minimum annual amount of water it intends to purchase. If actual usage is less than that amount, payment is still required for the set minimum amount. If actual usage is more than that set amount, all use will be charged at the per thousand gallon rate established by the District.

After water is purchased and treated, the managing entity will then sell treated water to the participants. TRA has standard contract forms for water sales agreements. The terms are similar to those described above for the District's contract.

Financing

There are several options for financing a regional system. The managing entity for the regional system can apply for loans through a number of independent financial lending agencies that specifically lend money for utility improvements. This is not likely to be the best option because open market interest rates of these agencies are usually higher than the Texas Water Development Board (TWDB) rates.

The Rural Economic Development Administration (REDA) has a loan and a grant program to help rural communities with water supply projects. There are some disadvantages to this program. The REDA will only fund projects to serve existing development. No growth can be planned for within the project. Since growth is anticipated in the study area, the REDA loan program does not seem to be a viable option. Also, there can be delays of up to several years in the approval process for REDA loans.

The TWDB is now in the process of initiating a Drinking Water State Revolving Fund (SRF), which should be in place by the fall of 1997. The interest rate for SRF loans is expected to be near the current sewer loan interest rate of 5 percent. The SRF will provide loans to finance water supply projects that will facilitate compliance with primary drinking water regulations or otherwise significantly further the health protection objectives of the Safe Drinking Water Act (SDWA). The focus of this program is to help systems that are not currently in compliance with the SDWA. All loan applicants are prioritized according to their need for improvements. This priority listing is based mainly on factors dealing with the water quality records of the utility, including the number of health, chemical, microbial, and coliform violations. The priorities do not address quantity problems. Wortham, which had severe water supply problems in 1996, is only about half-way down the list. Other parties in this study would probably rank even lower on the list, having few minor water quality problems. For these reasons, Freestone County is not likely to get SRF Financing.

The TWDB also provides financial assistance to political subdivisions for water supply projects through its standard loan program. The TWDB uses a combination of its strong credit rating for its programs and other available capital to offer interest rates that are generally lower than what a borrower could obtain from the open market or other lending institutions. The TWDB's general obligation bonds are rated A, AA, and AA+. As of April 1997, the TWDB's loan interest rate was 6 percent. This seems likely to be the best source of funding for the Freestone County regional system.

Because of the emergency situation during the summer of 1996, Wortham is eligible for some emergency funding (around $350,000) from the Texas Department of Housing and Community Affairs. This money could be directly applied to Wortham's portion of the capital costs resulting in a slightly lower water cost per thousand for Wortham. The other participants would have to pay the full cost.

Providing Service to New Participants

Once regional water supply systems are developed, new participants often decide they would like to purchase water. It is important to develop a procedure to consider such requests. Considerations include the following:

- The impact (positive or negative) on current participants.
- The equity of new participants receiving the benefit of past investments by initial participants.

In general, the addition of new customers should be evaluated on a case-by-case basis. It is often desirable to establish an equity payment or buy-in charge for new customers based on the investment of initial participants. Additional participants may be screened for suitability to be added to the system.

Water Rates

Wholesale treated water rates would be set annually by the managing entity, with input from customers. The rates would be based on water use and system costs. The life cycle costs in Appendix E include estimates of unit costs for the various alternatives. There are several points to consider when establishing these costs:

- These are preliminary estimates which would be replaced by more accurate figures as system design and construction proceed.
- Unit costs depend on water use. If use is less than projected, unit costs would be higher. (This could happen, for example, if Fairfield's industrial use develops more slowly than projected.)
- The costs are for wholesale treated water and do not include distribution and administrative costs for participants.

7. DEVELOPMENT PLAN FOR THE REGIONAL SYSTEM

Figure 7.1 shows future steps in the development of Freestone County Water Supply System and gives a possible timeline for that development. These time periods are approximate, and some of the steps shown may take more or less time than is allowed on the timeline. The remainder of this section is a discussion of the timeline shown on Figure 7.1 and the steps in the development of a regional water supply system. This section also estimates the cash flow needs throughout the project for the two Richland-Chambers scenarios. That information is presented in Tables 7.1, 7.2, and 7.3. The inflated costs presented in Table 7.1 do not exactly match those in the life cycle costs tables due to slight differences in timing of the various phases of the project.

Commitment by Participants

Commitments by participants to the regional system are needed as soon as possible. The size and cost of the proposed facilities and the locations to which water will be delivered depend on which water suppliers participate and how much water they buy from the system. Commitments are needed to give basic information so that the necessary engineering and environmental studies, financial planning, and detailed design of facilities can proceed. Once the water suppliers are committed to the regional system, institutional planning and contract development can begin, in parallel with financing of the regional system. The completion of contracts should precede detailed design of the water system, which will require much larger financial commitments than will the studies which are shown to continue while contracts are being developed. This scenario allows one year for this process. All other activities begin in Year 2 of the timeline.

Figure 7.1
Timeline for Development of the Freestone County Regional Water Supply System

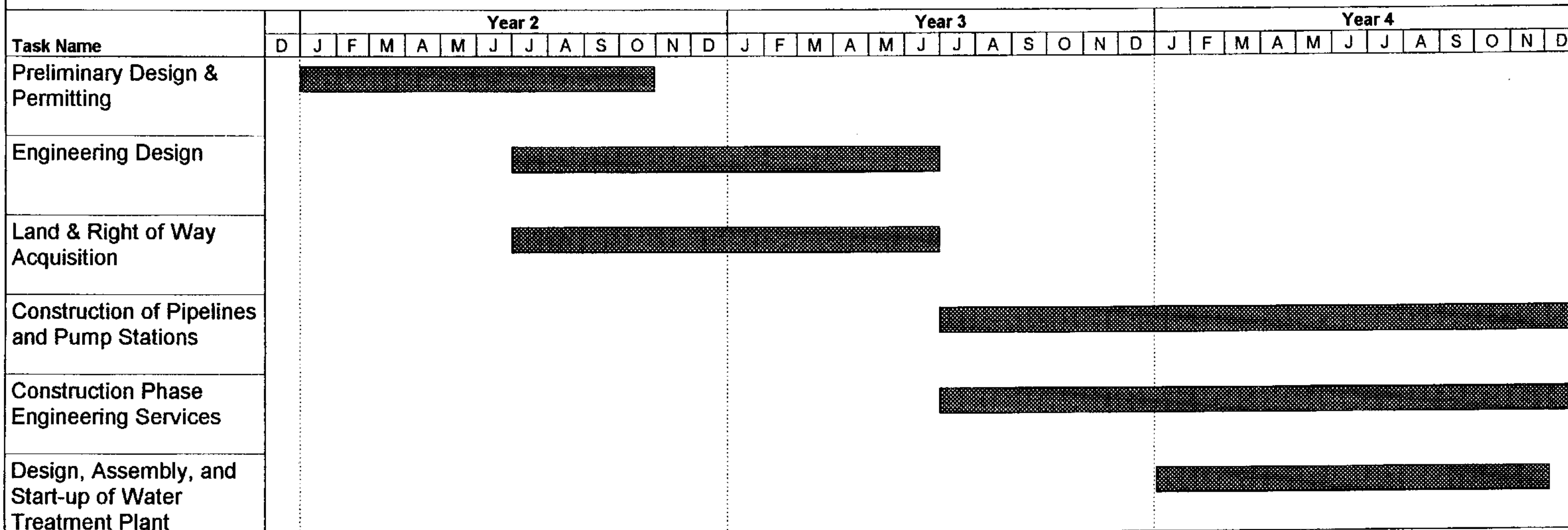


Table 7.1
Esimated Project Costs with Inflation

Richland-Chambers Maximum Participation Scenario

	Estimated Cost	Duration (Months after Project Initiation*)	Inflated Cost
Preliminary Design and Permitting	$706,200	1 to 10	$748,000
Buy-in Cost	$485,000	1 to 1	$506,000
Engineering Design	$1,215,500	7 to 18	$1,317,000
Land and Right of Way Acquisition	$132,000	7 to 18	$143,000
Construction of Pipelines and Pump Stations	$12,650,000	19 to 36	$14,393,000
Construction Phase Engineering Services	$729,300	19 to 36	$830,000
Design, Assembly, and Start-Up of Water Treatment Plant	$7,607,250	25 to 36	$8,741,000
	$23,525,250		$26,678,000

Richland-Chambers Lesser Participation Scenario

	Estimated Cost	Duration (Months after Project Initiation*)	Inflated Cost
Preliminary Design and Permitting	$559,400	1 to 10	$592,000
Buy-in Cost	$485,000	1 to 1	$506,000
Engineering Design	$848,500	7 to 18	$919,000
Land and Right of Way Acquisition	$132,000	7 to 18	$143,000
Construction of Pipelines and Pump Stations	$9,812,950	19 to 36	$11,165,000
Construction Phase Engineering Services	$509,100	19 to 36	$579,000
Design, Assembly, and Start-Up of Water Treatment Plant	$4,329,750	25 to 36	$4,975,000
	$16,676,700		$18,879,000

* Project is assumed to initiate after 1 year for commitment by participants and contracting.

Table 7.2
Cash Flow Projections

Richland-Chambers Maximum Participation Scenario

	Year 2											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting	$74,800	$74,800	$74,800	$74,800	$74,800	$74,800	$74,800	$74,800	$74,800	$74,800		
Buy-in Cost	$506,000											
Engineering Design							$109,750	$109,750	$109,750	$109,750	$109,750	$109,750
Land and Right of Way Acquisition							$11,917	$11,917	$11,917	$11,917	$11,917	$11,917
Construction of Pipelines and Pump Stations												
Construction Phase Engineering Services												
Design, Assembly, and Start-Up of Water Treatment Plant												
TOTAL	**$580,800**	**$74,800**	**$74,800**	**$74,800**	**$74,800**	**$74,800**	**$196,467**	**$196,467**	**$196,467**	**$196,467**	**$121,667**	**$121,667**

	Year 3											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting												
Buy-in Cost												
Engineering Design	$109,750	$109,750	$109,750	$109,750	$109,750	$109,750						
Land and Right of Way Acquisition	$11,917	$11,917	$11,917	$11,917	$11,917	$11,917						
Construction of Pipelines and Pump Stations							$799,611	$799,611	$799,611	$799,611	$799,611	$799,611
Construction Phase Engineering Services							$46,111	$46,111	$46,111	$46,111	$46,111	$46,111
Design, Assembly, and Start-Up of Water Treatment Plant												
TOTAL	**$121,667**	**$121,667**	**$121,667**	**$121,667**	**$121,667**	**$121,667**	**$845,722**	**$845,722**	**$845,722**	**$845,722**	**$845,722**	**$845,722**

	Year 4											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting												
Buy-in Cost												
Engineering Design												
Land and Right of Way Acquisition												
Construction of Pipelines and Pump Stations	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611	$799,611
Construction Phase Engineering Services	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111	$46,111
Design, Assembly, and Start-Up of Water Treatment Plant	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417	$728,417
TOTAL	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**	**$1,574,139**

Table 7.3
Cash Flow Projections

Richland-Chambers Lesser Participation Scenario

	Year 2											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting	$59,200	$59,200	$59,200	$59,200	$59,200	$59,200	$59,200	$59,200	$59,200	$59,200		
Buy-in Cost	$506,000											
Engineering Design							$76,583	$76,583	$76,583	$76,583	$76,583	$76,583
Land and Right of Way Acquisition							$11,917	$11,917	$11,917	$11,917	$11,917	$11,917
Construction of Pipelines and Pump Stations												
Construction Phase Engineering Services												
Design, Assembly, and Start-Up of Water Treatment Plant												
TOTAL	**$565,200**	**$59,200**	**$59,200**	**$59,200**	**$59,200**	**$59,200**	**$147,700**	**$147,700**	**$147,700**	**$147,700**	**$88,500**	**$88,500**

	Year 3											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting												
Buy-in Cost												
Engineering Design	$76,583	$76,583	$76,583	$76,583	$76,583	$76,583						
Land and Right of Way Acquisition	$11,917	$11,917	$11,917	$11,917	$11,917	$11,917						
Construction of Pipelines and Pump Stations							$620,278	$620,278	$620,278	$620,278	$620,278	$620,278
Construction Phase Engineering Services							$32,167	$32,167	$32,167	$32,167	$32,167	$32,167
Design, Assembly, and Start-Up of Water Treatment Plant												
TOTAL	**$88,500**	**$88,500**	**$88,500**	**$88,500**	**$88,500**	**$88,500**	**$652,444**	**$652,444**	**$652,444**	**$652,444**	**$652,444**	**$652,444**

	Year 4											
	January	February	March	April	May	June	July	August	September	October	November	December
Preliminary Design and Permitting												
Buy-in Cost												
Engineering Design												
Land and Right of Way Acquisition												
Construction of Pipelines and Pump Stations	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278	$620,278
Construction Phase Engineering Services	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167	$32,167
Design, Assembly, and Start-Up of Water Treatment Plant	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583	$414,583
TOTAL	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**	**$1,067,028**

Preliminary Design and Permitting

Several studies are needed before final design of the regional system facilities can begin. The site study and preliminary geotechnical analysis will select a site for the regional system water treatment plant. The final selection of a site will depend on the size of the facility and the location of its customers, so this study must await commitments to the system from potential customers. The treatability study is a detailed analysis of water treatment processes, including a small-scale pilot water treatment facility. This step can easily be done by the package treatment plant supplier which has a small pilot plant available for pilot studies. The environmental information is an assessment of the environmental impact of the project and its potential alternatives. This study is required in order to obtain funding from the Texas Water Development Board.

Archaeological investigations will begin as part of the site study and the environmental information document and may continue until construction begins. Surveying will begin as the plant location and the layout of facilities become clear and continue through the development of detailed designs for pipelines and pump stations.

Engineering Design

The engineering design report will follow the completion of the site study and the treatability study and serve as the first step in the detailed design of the water treatment plant. This study includes analyses of alternative designs and selection and documentation of the design approach. It also provides final decisions to allow ordering of items requiring long lead times for manufacture, such as pumps and certain other equipment. The engineering report should not be started until it is clear which water suppliers will participate in the initial development of the regional water system.

The size and location of the treatment plant and the location of delivery points for treated water should be firmly established in advance of this study.

The detailed design of pipelines and pump stations can begin at about the same time as the engineering design report. These facilities will probably be separated into a number of smaller construction contracts in order to enhance competitive bidding. The design and construction of these separate contracts will probably be spread out in time, with the intent of completing all facilities by the time the water treatment plant is placed in operation. Design of the water treatment plant can begin with the completion of the engineering design report. This includes the preparation of construction plans and specifications based on information developed in the site study, the treatability study, and the engineering design report.

Land and Right-of-Way Acquisition

As design proceeds, land and right-of-way acquisition for the treatment plant, pipelines, and pump stations should be accomplished in preparation for facility construction.

Construction of Pipelines and Pump Stations

Construction of pipelines and pump stations will probably require about a year and a half, as designs for the various contracts are completed and the projects are advertised and bid. Advertising and bidding for pipelines and pump stations is not shown as a separate item - it will occur as plans are completed for the various contracts.

Design, Assembly and Start-Up of Water Treatment Plant

The TNRCC will conduct an agency review of plant design for compliance with applicable regulations. If the project is financed through the Texas Water Development Board, that agency will also review the design of the water treatment plant and the other facilities. After the completion of the detailed design and the agency review, advertising and bidding for water treatment plant construction will require approximately two months. Construction of the plant is expected to require about six months, since it is a prefabricated item that only requires some assembly. Commissioning of plant is a period of operation after the completion of construction to test equipment and treatment processes and to familiarize plant operators with the facility. After commissioning, the plant will be placed in full operation.

The timeline shown on Figure 7.1 represents a relatively accelerated schedule for a project of this magnitude. There are some steps in the process which could take longer than shown and delay project completion. In particular, the time required for negotiation involving institutional and contractual questions cannot be accurately predicted.

APPENDIX A

LIST OF REFERENCES

APPENDIX A

LIST OF REFERENCES

(1) Trinity River Authority of Texas, Northern Region: *Preliminary Study of Richland-Chambers Water Supply Project for Richland, Streetman, Wortham, Fairfield, Winkler Water Supply Corporation and Community Water Supply,* December 1989.

(2) Trinity River Authority of Texas, Northern Region: *Preliminary Study of Richland-Chambers Water Supply Project for Richland, Streetman, Wortham, Fairfield, Winkler Water Supply Corporation, Community Water Supply, and Pleasant Grove Water Supply Corporation,* January 1990.

(3) Trinity River Authority of Texas, Northern Region: *Preliminary Study of Richland-Chambers Water Supply Project for Richland, Streetman, Wortham, Winkler Water Supply Corporation, Community Water Supply, and Pleasant Grove Water Supply Corporation,* January 1990.

(4) Trinity River Authority of Texas, Northern Region: *Preliminary Feasibility Study for the Formation of a Regional Water Supply System to Serve Streetman, Fairfield, Teague, and the State Prison and Other Areas of Freestone County,* March 1995.

(5) KSA Engineers, Inc.: *City of Wortham, Study of Water Supply Alternatives*, September 1996.

(6) Letter from Richard L. White, Vice President of Environmental Services TU Services to Bill Smith, Water Resources Planning Manager at Trinity River Authority, March 7, 1997.

(7) Texas Water Development Board: *Ground-Water Resources of the Carrizo-Wilcox Aquifer in the Central Texas Region*, September 1991.

(8) Texas Water Development Board: *Areas Experiencing Significant Ground-Water Level Decline, 1980-1990*, September 1991.

(9) R.W. Harden & Associates, Inc.: *Evaluation of Well Fields for City of Fairfield and Boyd Unit,* October 1996.

APPENDIX B

SCOPE OF SERVICES

ATTACHMENT B

SCOPE OF SERVICES

A. TASK I - PROJECT START-UP, RESEARCH AND DATA COLLECTION

1. PROJECT START-UP

a. Start-up Meeting

Meet with Trinity River Authority and representatives of the participants in the study area to establish work procedures, project controls, administrative requirements and to initiate work.

Meet with representatives of all entities in the study area to discuss the purpose and scope of the study, to identify data collection needs and to establish communication procedures for project input and review.

2. LITERATURE RESEARCH AND REVIEW

a. Identify Previous Studies and Reports

Identify from project participants, previous planning studies and reports pertinent to water supply, treatment and distribution in the study area.

b. Collect Studies and Reports

Collect any available existing studies and reports from project participants.

c. Review Previous Studies and Reports

Review the contents and findings of previous planning studies and reports made available by project participants.

d. Prepare Synopsis of Studies and Reports

Prepare a synopsis of each study and report which summarizes the conclusion, recommendations and plans developed by each study and report.

3. DATA COLLECTION

a. Prepare List

Prepare a list of data collection needs.

b. Notify Participants

Send letters to each participant in the study area requesting data on water supply sources, population, water use, water treatment, water distribution and other pertinent data including any water distribution system maps and lists of industrial user and major water users supplied by the participants.

c. Meet with Participants

Meet with each entity in the study area to obtain data and discuss individual systems, needs and projections.

d. Collect Physiographic Data

Collect hydrologic, topographic and other physical data pertinent to completing the planning studies.

B. TASK II - PROJECTIONS FOR POPULATION AND WATER DEMANDS

1. POPULATION PROJECTIONS

a. Compare Various Projections

Utilizing population data and projections collected from the project participants, the Texas Water Development Board, and the Heart of Texas Council of Governments, prepare a comparison of population projections to assist in selecting growth data for use in the planning study. The years to be studied are 1996, 1998, 2000, 2005, 2010, 2015 and 2020.

b. Select Study Projections

Select a series of population projections for use in the study. Preliminary approval of the population projections will be obtained from the TWDB before proceeding with completion of the water demand projections.

2. WATER SUPPLY DEMANDS

a. Per Capita Water Use

Analyze per capita water use data as provided by each participant and prepare estimates of per capita "municipal" water use for each milestone year in the study (1996, 1998, 2000, 2005, 2010, 2015 and 2020). Municipal water use includes all cities, water supply entities and rural domestic water use. Prepare estimates of average daily use, peak day use and peak hour use for data supplied by each participant.

b. Industrial/Agricultural Water Demands

Identify any industrial/agricultural water demands from information supplied by each participant which may significantly alter water supply demands for the milestone years. Insure that projected industrial/agricultural water demands are not duplicated in the municipal water supply demands.

c. Water Conservation Effects

Assess the potential for water conservation efforts to significantly alter water demands in the milestone years. Modify, if required, water supply demands in accordance with estimates of water savings due to conservation efforts.

d. Municipal Water Demands

Prepare municipal water demands for each milestone year for individual participants in the study area. Prepare estimates of average daily use, peak day use and peak hour use.

e. Total Water Demands

Prepare a summary of total water demands (municipal, industrial, agricultural), by entity, subareas and the total study area. Prepare estimates of average daily use, peak day use and peak hour use.

4. ADOPT STUDY PARAMETERS

a. Summary Paper

Prepare a summary paper of projected population and water use demands for each milestone year. Distribute summary paper to the participants in the study for review and comment.

b. Review Meeting

Hold a review meeting to receive comments on the summary paper.

c. Revise Summary Paper

In accordance with comments received in the review meeting, revise the summary paper.

d. Adopt Summary Paper

The summary paper will be approved and adopted for use in completion of the water supply planning study.

C. TASK III - WATER SUPPLY SOURCES

1. WATER SUPPLY SOURCES

a. Identify Sources

Identify potential water supply sources to meet the needs of the study area. These will include, but not be limited to:

(1) Tarrant County Water Control and Improvement District No. 1 Richland-Chambers reservoir;

(2) City of Corsicana potable water; and

(3) Up to two additional sources of water including groundwater, reclaimed water, or other existing surface water source.

b. Evaluate Source

(1) Availability

(2) Time of availability

(3) Conceptual cost of delivered water

(4) Assessment of potential working relationship and contractual terms which could be negotiated with the existing owner of Richland-Chambers Reservoir, the Tarrant County Water and Control and Improvement District Number One.

c. Meet with Existing Supplier

Meetings will be held with the Tarrant County Water and Control and Improvement District Number One to determine their ability and interest in providing water to the study area.

d. Review Meeting

Review conceptual finding with the project participants and identify the primary source for further evaluation.

D. TASK IV - WATER TRANSMISSION, TREATMENT AND DISTRIBUTION

1. RAW WATER INTAKE AND PUMP STATION

a. Determine conceptually desirable location for a raw water intake structure and raw pumping station.

b. The raw water intake location will be conceptually based upon alternative intake configurations, water quality considerations, depth of site and potential effects of reservoir draw down.

2. WATER TREATMENT PLANT

a. Determine conceptually desirable location of a water treatment plant. Phasing and future enlargement of the water treatment plant will be considered. Recommendation for total site size will be made. Factors affecting acquisition of the site will be defined.

b. Develop conceptual water treatment plant configuration. Available raw water quality data will be reviewed as a part of this configuration preparation. Conceptual treatment plant process design will be completed to identify water treatment requirements and to assist in establishing opinions of probable costs.

3. WATER TRANSMISSION LINES

a. After a general location for the water treatment plant has been identified and the water demands established, the sizes of the transmission lines will be established.

b. Phasing of construction of treatment lines will be considered.

4. ESTABLISH WATER SUPPLY DELIVERY POINTS

a. System criteria will be prepared for the proposed regional water supply system. The criteria will contain guidelines for flow rates, establish acceptable materials for pipelines, system operating pressure requirements, and other appropriate criteria.

b. A review will be made of available information and discussions held with representatives of water supply customers about the existing water distribution systems.

c. A preliminary water delivery point will be established for each entity to receive water from the regional system. The plan will not include a detailed evaluation of the individual water distribution system of each entity. Phasing and staging of facilities will be considered.

5. OPINION OF PROBABLE COST

a. Opinion of probable costs for construction, right-of-way, site acquisition, and operation and maintenance will be developed for the raw water intake and pump station water treatment plant, water transmission lines, and water delivery connection.

6. PLAN REVIEW

a. Establish System Criteria

System criteria will be prepared for the proposed regional water distribution system. The criteria will contain guidelines for flow rates, establish acceptable materials for pipeline use, system operating pressure requirements and other criteria as deemed appropriate for a regional system.

b. Water Distribution Plan

Studies will be made to prepare conceptual plans for a regional water distribution system. Conceptual sizing, location and capacity will be provided for water distribution lines. A take point will be established for each entity to receive water from the regional system. The plan will not include the detailed evaluation of the individual system of each entity. Phasing and staging of facilities will be considered.

c. Cost Estimates

A project cost estimate will be prepared for the water distribution system. The costs will include capital costs, right-of-way costs, operation and maintenance costs and other applicable costs.

7. WATER CONSERVATION PLAN

A water conservation plan will be prepared to promote water conservation and efficiency of use in the planning area. The plan will be prepared in accordance with guidelines established by the TWDB. The water conservation plan will include a drought contingency plan.

8. PLAN REVIEW

a. Plan Summary

A summary will be prepared of the proposed water supply, water transmission, treatment and distribution plan. The plan will be distributed for review by the entities in the study area.

b. Review Meeting

A meeting will be held to review the summary with the entities and receive comments.

c. Revise Summary

The summary will be revised in accordance with comments received at the review meeting.

E. TASK V - INSTITUTIONAL ORGANIZATION AND FINANCING

1. INSTITUTIONAL ORGANIZATION

Institutional Organization Review

Review and summarize the types of institutional organizations which may be utilized to plan, finance, develop and operate and maintain feasible alternatives for water supply, transmission, treatment and distribution.

2. FINANCING ALTERNATIVES

Financing Alternatives Review

A summary will be made of the various financing alternatives available for use to implement the regional water supply system.

F. TASK VI - PROJECT IMPLEMENTATION PLAN AND SCHEDULE

1. PROJECT IMPLEMENTATION PLAN

A Project Implementation Plan will be prepared for the water supply system recommended for adoption. The Plan will indicate steps which should be used to plan, finance, develop, and operate and maintain the projects. The Plan will also contain a preliminary analysis of cash flow estimates for project development and start-up.

2. SCHEDULE

A schedule will be prepared to indicate the time frames for project implementation. Estimates of cash flow will be prepared in accordance with the schedule.

G. TASK VII - REPORT

1. DRAFT REPORT

A draft report of the study results and study methodology will be prepared. The draft report will contain the findings of the planning study and describe the alternatives considered to supply water to the study area. The draft report will contain the project recommended for implementation, the implementation plan and schedule, the organizational options available to implement the project, financing options and other pertinent information.

2. DRAFT REPORT REVIEW

Entities in the study area and other appropriate regional and state organizations will be provided draft copies of the report for review. Review comments will be accepted for consideration and, when appropriate, incorporated into the report.

3. PUBLIC MEETING

A public meeting will be held to review the draft report and receive public input and comments.

4. FINAL REPORT

A final report will be prepared based upon review of comments and public meeting comments. The final report will be published for adoption by the entities in the study area.

APPENDIX C

WATER CONSERVATION AND EMERGENCY WATER DEMAND MANAGEMENT PLAN

WATER CONSERVATION AND

EMERGENCY WATER DEMAND MANAGEMENT PLAN

FOR

PORTIONS OF FREESTONE COUNTY

SEPTEMBER 1997

Prepared by

Trinity River Authority of Texas

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I. INTRODUCTION

A. PURPOSE

Regulations promulgated by the Texas Water Development Board (TWDB) require a water conservation plan and an emergency water demand management plan be submitted for entities that receive planning grant financial assistance.

The objective of a water conservation plan is to conserve water supplies and to promote more efficient water use. Water conservation and efficient water use will help reduce the cost of developing new and more expensive water supplies.

Several conditions can cause water system emergencies and disrupt the normal availability and delivery of water supplies. Drought conditions typically develop over a sustained or lengthy time period. Other emergencies can develop more rapidly, such as weather disasters like flooding or tornadoes then can damage, destroy or contaminate all or part of a water system. Structural failures or mechanical problems within a water treatment, storage, or distribution system can create emergency situations.

An emergency water demand management plan should include short-term measures that a city or utility can use to cause a significant, but temporary reduction in water use in response to an emergency.

B. PLANNING AREA

The Trinity River Authority of Texas (Authority) is a governmental agency of the State of Texas created as a conservation and reclamation district under Article XVI, Section 59 of the Constitution pursuant to Chapter 518, Acts of the 54th Legislature of Texas, Regular Session, 1955, as amended. The Authority has specific authority to construct, own and operate water supply, treatment, and distribution facilities and sewage gathering, transmission, and disposal facilities, to charge for such services, and to make contracts in reference thereto with municipalities and others. In accordance with provisions of the Texas Water Code and the Texas Revised Civil Statues, the Authority has the legal authority to plan, develop, and operate regional water supply facilities.

The county seat of Freestone County is Fairfield, a centrally located town with a population of about 3,400 population, which is a major retail and commercial center for a large portion of the county. Other cities located in the planning area include Teague (population 3,300), Wortham (population 1,500) and Streetman (population 500). In addition, the Texas Department of Criminal Justice Boyd Prison Unit and the service area of the Pleasant Grove Water Supply Corporation (located between Streetman and Fairfield) are also included in the planning study. A map of the planning area is shown in Figure I. With the exception of the city of Teague, the planning area is located within the Trinity River Basin. A portion of the city of Teague is located in the Brazos River Basin. All of the planning area is located within Freestone County with the exception of a small portion of the city of Streetman that is located in Navarro County.

Most of the cities and rural areas of Freestone County rely upon wells for their water supply. One exception to this is the city of Wortham. Wortham relies upon a small surface impoundment to provide raw water for their surface water treatment plant. The drought conditions during the summer of 1996 produced severely low water levels in the surface impoundment creating emergency water conditions for Wortham.

Generally the supply of groundwater has been adequate to supply the needs of the county. While the quality of the groundwater has usually been adequate, there is a concern about future regulations that may eliminate the use of wells or require additional treatment which would cause groundwater costs to increase. In addition, there is a concern that the groundwater tables in the immediate area will continue to drop with the result being higher costs to produce new and additional wells located greater distances from the existing utility system. With the construction of Richland-Chambers reservoir in the area, a more long-term reliable supply of water may be available to supply portions of Freestone County.

II. WATER CONSERVATION PLAN

A. INTRODUCTION

The Trinity River Authority, as a governmental agency, has specific authority to construct, operate and maintain water supply, treatment, and distribution facilities for the benefit of contracting parties. If the Authority is successful in establishing a regional water supply system for the proposed service area described in the planning report, the Authority will implement this proposed water conservation plan.

The eight (8) principal water conservation methods to be considered in preparing a water conservation plan are as follows:

1. Public education and information
2. Plumbing codes for new construction
3. Retrofit programs for existing buildings
4. Conservation oriented water rate structure
5. Universal metering and meter repair
6. Water conserving landscaping
7. Leak detection and repair
8. Means of implementation and enforcement

B. GOALS

The objective of a water conservation plan is to reduce the per capita consumption of water. Many communities thought the United States have used conservation measures to successfully deal with various water and wastewater problems. It is anticipated that a short term goal of 5 percent reduction is anticipated. Because of the rural nature of the planning area, it is not anticipated that a large reduction in consumptive use be reduced. The majority of emphasis can probably be focused on public education and information, conservation, water rates, universal metering, leak detection and repair, and plumbing codes for new construction. A 20 percent reduction over a period of 50 years will be a reasonable goal to obtain.

C. PLAN ELEMENTS

If a regional water supply project is developed, the Authority will provide treated water to the contracting parties. The contracting parties will independently own and operate their respective water distribution systems. As a regional water provider, the Authority will not have the ability to implement most of the water conservation measures discussed in this Plan. Since the proposed contracting parties maintain legal jurisdiction within their respective service areas, the contracting parties will be responsible for implementing conservation measures as a part of this respective retail water supply operations. These requirements can be included in the proposed contracts to be executed by the Authority with the contracting parties. The Authority's role in this program will include the administration and promotion of the Plan, public education and information.

1. Public Education and Information

The Authority recognizes that water conservation significantly benefits individuals and communities in terms of long-term availability and costs. The most readily available and lowest cost method of promoting water conservation is to inform the retail water users about ways to save water in homes and businesses, in landscaping and lawn uses, and in recreational use. The Authority will provide the contracting parties with literature on conservation to be passed on to their respective retail customers in the following manner:

(a) Initial Year Program

The public education program during the initial year shall include all the activities outlined in the Long-Term Program, as described below, plus:

(1) Distribution of a fact sheet explaining the Water Conservation Plan shall be made available upon adoption of the Plan;

(2) Publication of newspaper articles in the local paper in conjunction with the semiannual distribution of educational materials; and

(3) One additional distribution of educational material in the form of a door-to-door handout, mail-out, or information added to the water bill.

(b) Long-Term Program

(1) Promote the use of Texas Water Development Board's water education material (Major Rivers) in area public schools.

(2) Distribution and promotion of educational materials available from the Texas Natural Resource Conservation Commission, American Water Works Association, and others will be made semiannually and timed to correspond with peak summer demand periods. One of these semiannual notifications may be made by publications in the newspaper; and

(3) New retail customers will be provided with water conservation literature, including specific methods and ways to save water when applying for service.

In addition to the above Education and Information program to be carried out by the contracting parties, the Authority will be available to present water conservation programs to local schools, civil organizations, and other groups.

(c) Plumbing Standards

The public education and information program will include literature describing water saving fixtures. The contracting parties will comply with the water saving performance standards as promulgated by the Texas Natural Resource Conservation Commission under 30 Texas Administrative Code Sections 290.251 - 290.266.Additionally, the contracting parties will be encouraged to adopt plumbing codes to fit each entity's needs.

(d) Retrofit Programs

The contracting parties will provide information concerning water saving devices for their retail water customers to use when replacing and installing plumbing fixtures, lawn water equipment, or water using appliances. The public information program will be utilized to inform water customers of the advantages of installing water saving devices.

(e) Water Rate Structures

The contracting parties will periodically review their respective retail water rate structures to insure that the prevailing rates encourage water conservation while covering the total cost of service and minimizing adverse impacts. The contracting parties will be encouraged to adopt rates which incorporate an increasing block rate, or a uniform rate, continuously increasing rates, peak or seasonal load rates, excess use fees, or other appropriate rate forms. The contracting parties shall not be allowed to have a declining block rate.

(f) Universal Metering and Meter Repair/Replacement

Master metering of the utility as well as metering all retail users can provide an accurate accounting of water uses throughout the system. Metering and meter repair and replacement, coupled with an annual water audit, can be used in conjunction with other programs such as leak detection and repair to save significant quantities of water. The contracting parties shall meter all retail water uses and will be encouraged to provide a master meter as well as metering of all utility, city, and other public facilities.

A regularly scheduled maintenance program of meter testing, repair, and replacement should be established in accordance with the following schedule:

(1) Production (master) meters - test once a year

(2) Meters larger than 1" - test once a year

(3) Meters 1" or smaller = test every 10 years

(g) Water Conserving Landscaping

In order to reduce the demands placed on a water system by landscape watering, the contracting parties, through their respective education and information programs, shall encourage customers and local landscaping companies to utilize water conserving landscaping and irrigation practices by the following methods:

(1) Encourage home owners and landscape architects/contractors to use low water using plants and grasses and efficient irrigation systems.

(2) Encourage irrigation contractors and commercial establishments to use drip irrigations systems when possible and to design all irrigation systems with water conservation features, such as large drop rather than fine mist sprinklers.

(3) Encourage local nurseries and other businesses to offer adapted, low water using plants and grasses and efficient landscape watering devices.

(h) Leak Detection and Repair

The contracting parties will continue their ongoing leak detection, location, and repair programs. Waterline leaks are detected by utility personnel while reading meters, maintaining their water and wastewater systems, and while performing other routine surveillance programs. Additionally, water audits shall be utilized to determine if leaks exist which have gone undetected. Utilize Texas Water Development Board's leak detection service on a routine frequency.

(I) Implementation and Enforcement

Generally, the Authority will provide overall guidance and assistance to the contracting parties in the implementation of this Plan. Specifically, the Authority, as a part of the Freestone County Water Project management, will provide public education/information services to the contracting parties and be responsible for the submission of an annual report to the Texas Water Development Board which shall include the following information:

(1) Progress made in the implementation of the program.

(2) Public information which has been distributed.

(3) Public response to the program.

(4) Effectiveness of the program.

The contracting parties shall be responsible for the implementation and enforcement of the specific water conserving activities contained within the Plan and for reporting such activities to the Authority along with an evaluation of the effectiveness of the program. This implementation and enforcement will be in accordance with the respective ordinances or resolutions as adopted by each contracting party. Sample copies of a resolution and an ordinance are provided in Appendix A & Appendix B

III. EMERGENCY WATER DEMAND MANAGEMENT PLAN

A. INTRODUCTION

Drought or a number of other uncontrollable circumstances can disrupt the normal availability of community or utility water supplies. Even though a political subdivision may have an adequate water supply, the supply could become contaminated, or a disaster could destroy the supply. During drought periods, consumer demand for water is often significantly higher than normal. Some older systems, or systems serving rapidly growing areas, may not have the capacity to meet higher than average demands without a system failure or other unwanted consequences. System treatment, storage, or distribution failures can also present a city or utility with an emergency demand management situation.

B. GOAL

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

C. PLAN ELEMENTS

The required water study includes more than one source of raw water. The specific trigger conditions will be specifically modified or adjusted based upon the raw water source that is eventually and developed selected. An effective emergency demand management plan should include the following six elements:

1. Trigger Conditions

The initiation of drought contingency measures by the customer cities must inherently be determined on a case-by-case basis with consideration given to weather conditions, time of year, prevailing system capacities, and prevailing contractual arrangements with each respective water supplier. The following trigger conditions in conjunction with other utility specific, real time factors to initiate drought contingency measures shall be utilized:

(a) Mild Conditions

Daily water demand reaches or exceeds 80% of the production capacity of the system for 5 consecutive days.

(b) Moderate Conditions

Daily water demand reaches or exceeds 90% of the production capacity of the system for 5 consecutive days.

(c) Severe Conditions

Daily water demand reaches or exceeds 100% of the production capacity of the system for 5 consecutive days; or the imminent or actual failure of a major component of the system is experienced which can cause an immediate health or safety hazard.

Update of Trigger Conditions

Annually, or upon any significant change in water supply or production capability, each contracting party shall review their water system capabilities in order to determine actual trigger conditions based upon the guidelines described in Trigger Conditions of this Plan.

2. Emergency Demand Management

Based upon the prevailing conditions, the following actions, as appropriate, shall be taken when trigger conditions are reached:

(a) Mild Conditions

(1) Inform the public through the local news media that a trigger condition has been reached, and that the public should look for ways to voluntarily reduce water use and provide specific steps which can be taken.

(2) Notify major commercial water users of the situation and request voluntary water use reductions.

(3) Publicize a voluntary lawn watering schedule.

(4) During winter months request water users to insulate pipes rather than running water to prevent pipes from freezing.

(b) Moderate Conditions

(1) Continue all relevant actions initiated in the preceding phase.

(2) Car washing (except for commercial car washes), window washing, and pavement washing shall be prohibited except when only a bucket is used.

(3) The following public water uses, not essential for public health or safety, shall be prohibited:

(aa) Street washing
(bb) Water hydrant flushing
(cc) Filling swimming pools
(dd) Athletic field watering

(4) A lawn watering schedule shall be developed and imposed.

A method of odd and even watering schedule should be developed that allows for less consumption and more efficient watering/irrigation.

(c) Severe Conditions

(1) Continue all relevant actions indicated in the preceding phases.

(2) All outdoor water use, not essential for public health or safety, shall be prohibited.

(3) Based upon prevailing conditions, establish maximum water use limits for commercial and residential users, and establish monetary fines or surcharges to be levied for exceeding water use limits.

3. Information and Education

Drought and/or emergency contingency measures will be conveyed to the public as a part of and in the same manner as the Water Conservation Plan. When trigger conditions appear to be approaching, the public will be informed through local newspaper articles and/or radio/television broadcasts. Throughout the period of a trigger condition, regular articles and/or broadcasts will be used to inform the public of the current condition and conservation measures for that condition.

4. Initiation Procedures

When a trigger condition has been reached and the City has been informed that emergency water demand measures may be necessary, the appointed representative will order the initiation of a public notification process. The public notification process will include the following items:

5. Termination Notification Actions

As drought or emergency conditions lessen, a determination will be made when a particular drought condition no longer exists. Upon such determination, the drought measures for and enforcement of that particular drought condition shall terminate. The public will be notified of the termination of any or all drought conditions and related drought measures in the same manner as described in Information and Education section above.

6. Implementation and Enforcement

The customer cities shall be responsible for the implementation and enforcement of specific water conserving activities contained within this plan for their respective jurisdictions. The customer cities will be responsible for reporting such activities to TRA along with an evaluation of the effectiveness of the program. Implementation and enforcement will be in accordance with the respective ordinances and/or resolutions adopted by the cities.

APPENDIX A

EXAMPLE

WATER CONSERVATION AND
EMERGENCY WATER DEMAND MANAGEMENT PLAN
RESOLUTION

A RESOLUTION ADOPTING THE DRAFT WATER CONSERVATION AND EMERGENCY WATER DEMAND MANAGEMENT PLAN

WHEREAS, the City of is undertaking planning efforts to meet the demands of its water customers for the present and future into the 21st century; and

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

WHEREAS, the Texas Water Development Board has reviewed the Water Conservation and Emergency Water Demand Management Plan for portions of Freestone County; and

WHEREAS, the Texas Water Development Board loan requirements stipulate that a city that uses these funds must have such a program; and

WHEREAS, the objective of the Water Conservation and Emergency Water Demand Management Plan is to reduce the quantity required for water use activities through efficient water use practices; and

WHEREAS, the Emergency Water Demand Management Plan provides procedures for voluntary and mandatory actions to be placed into effect to temporarily reduce the demand place on the City's available water system during a water shortage emergency.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF , TEXAS:

That the City Council approves the Draft Water Conservation and Emergency Water Demand Management Plan that is to be formally submitted to the Texas Water Development Board by Trinity River Authority of Arlington, Texas.

DULY PASSED BY THE CITY COUNCIL OF THE CITY OF , TEXAS ON THE ___________ DAY OF ____________________________, 199__.

____
, Mayor

ATTEST:

____
, City Secretary

APPENDIX ___

APPENDIX B

EXAMPLE

WATER CONSERVATION AND
EMERGENCY WATER DEMAND MANAGEMENT PLAN
ORDINANCE

ORDINANCE NO. ______________

AN ORDINANCE OF THE CITY OF , TEXAS, ADOPTING A Water CONSERVATION AND EMERGENCY Water DEMAND MANAGEMENT PLAN; PROVIDING FOR THE REPEAL OF ALL ORDINANCES IN CONFLICT; PROVIDING A SEVERABILITY CLAUSE: PROVIDING FOR A PENALTY OF FINE NOT TO EXCEED THE SUM OF FIVE HUNDRED DOLLARS ($500.00) FOR EACH OFFENSE; AND PROVIDING FOR AN EFFECTIVE DATE.

WHEREAS, it is necessary that a Water Conservation and Emergency Water Demand Management Plan be adopted by the City of ; and

WHEREAS, such a program has been formally submitted to the Texas Water Development Board for approval in connection with the Freestone County Water Supply Study; and

WHEREAS, the City Council of the City of believes that it is in the best interest of the City of to adopt such program; NOW, THEREFORE,

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF , TEXAS:

SECTION 1.

That the Water Conservation and Emergency Water Demand Management Plan for portions of Freestone County attached hereto as Exhibit "A" and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the City.

SECTION 2.

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

SECTION 3.

Should any paragraph. sentence, subdivision. clause, phrase or section of this ordinance be adjudged or held to be unconstitutional, illegal or invalid, the same shall not affect the validity of this ordinance as a whole or any part or provision thereof, other than the part so declared to be invalid, illegal or unconstitutional.

SECTION 4.

Any person, firm or corporation violating any of the provisions of the mandatory water use restrictions which have been formally initiated by the City and contained in the Water Conservation and Emergency Water Demand Management Plan as adopted hereby shall be deemed guilty of a misdemeanor and, upon conviction in the Municipal Court of the City of , Texas, shall be punished by a fine not to exceed the sum of Five Hundred Dollars ($500.00) for each offense, and each and every day any such violations shall continue shall be deemed to constitute a separate offense.

SECTION 5.

This ordinance shall take effect immediately from and after its passage and the publication of the caption, as the law in such cases provide.

DULY PASSED by the City Council of the City of , Texas, on the ____________ day of ______________________________, 199__.

APPROVED:

____
MAYOR

ATTEST:

____
CITY SECRETARY

APPROVED AS TO FORM:

____
CITY ATTORNEY

APPENDIX C

EXAMPLE

WATER CONSERVATION AND EMERGENCY WATER DEMAND MANAGEMENT PLAN

TRINITY RIVER AUTHORITY RESOLUTION

RESOLUTION NO. R-______

A RESOLUTION OF THE BOARD OF DIRECTORS OF THE TRINITY RIVER AUTHORITY OF TEXAS ADOPTING A WATER CONSERVATION PLAN FOR FREESTONE COUNTY WATER SUPPLY PROJECT.

PREAMBLE

WHEREAS, the Trinity River Authority of Texas ("Authority") was created as a conservation and reclamation district by Act of the 54th Legislature of the State of Texas; and

WHEREAS, the Trinity River Authority ("Authority"), acting on behalf of several water suppliers in Freestone County to prepare a regional water feasibility study for portions of Freestone County; and

WHEREAS, the Authority has prepared a water conservation plan to comply with regulations adopted by the Texas Water Development Board; and

WHEREAS, the objective of the water conservation plan is to reduce the quantity required for water use activities through efficient water use practices.

WHEREAS, the promotion of water conservation will represent a long-term benefit to the water supplies of Freestone County area;

NOW THEREFORE, BE IT RESOLVED BY THE DIRECTORS OF THE TRINITY RIVER AUTHORITY OF TEXAS:

(1) That the Board of Directors of the Trinity River Authority of Texas hereby adopts the Water Conservation Plan attached hereto, for the Freestone County Water Supply.

(2) That the Water Conservation Plan for the Freestone County Water Supply Project will be implemented by the Trinity River Authority of Texas after the Plan has been approved by the Texas Water Development Board.

Adopted this ________day of ____________, 1997.

____
DIRECTOR
MAURICE L. LOCKE,
President
Board of Directors
Trinity River Authority of Texas

ATTEST:

____
JAMES L. MURPHY, Secretary
Board of Directors

(SEAL)

APPENDIX D

CAPITAL COST ESTIMATES

APPENDIX D

CAPITAL COST ESTIMATES

Tables D-1 through D-6 present the cost estimates for all of the regional supply system scenarios.

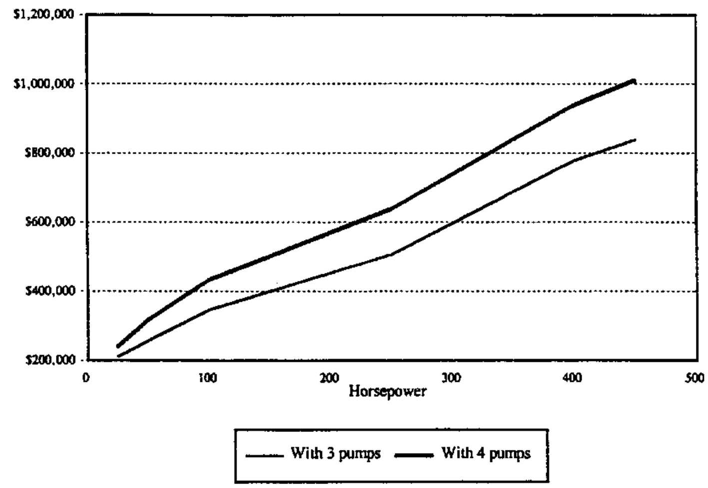
Pipelines

Pipeline costs are based on recent experience and bids from long distance, cross country pipelines. The unit cost used to calculate pipe cost was $2.50 per diameter inch per linear foot. For example, the cost of 10-inch pipe would be $25.00 per linear foot. This cost includes allowances for mobilization, contractor overhead and profit, highway crossings, other conflicts, and appurtenances such as air valves and blow-off valves. Allowances for contingencies (15 percent) and engineering costs (12 percent) are added to the estimated pipe costs. Right-of-way costs are included where necessary. Based a discussion between TRA's Manager of Land Rights and the Texas Department of Transportation, it was assumed that the pipeline could be placed in highway right-of-way where possible. This saves the cost of purchasing easement land. The transmission system was routed along highways whenever possible for this reason. If the highways are widened or rerouted in the future, the regional system must pay to move its water line to avoid conflict, except in the case of interstate highways where the state or federal government would pay. Estimates of land acquisition costs were provided by TRA's Manager of Land Rights.

Pump Stations

Pump station costs are estimated based on costs from recent projects and costs from suppliers. Individual estimates of pump stations were made for stations with pumps ranging from 25 to

Figure D-1
Horsepower vs. Pump Station Cost



450 horsepower. Each pump station includes a metal building with a slab, 3 pumps, miscellaneous valving and piping, electrical and instrumentation, a motor control center, and land acquisition including an access road. Similar cost estimates for pump stations with 4 pumps (and consequently lower horsepower pumps) are compared to the costs for stations with 3 pumps.

Allowances for mobilization (5 percent), contractor overhead and profit (15 percent), contingencies (15 percent), and engineering costs (12 percent) are added to the estimated pump station cost. Figure D-1 shows the resulting relationship of horsepower to cost (not including the allowances for contingencies and engineering).

Treatment Plant

Package treatment plants costs are based on information provided by the supplier, construction cost curves developed by Freese and Nichols from other projects, and bid tabulations from recently constructed projects. The construction cost for the smaller plant is estimated at $1.25 per gallon of capacity. With some economy of scale in the larger plant, its cost is estimated at $1.10 per gallon of capacity. Allowances for contingencies (15 percent) and engineering costs (12 percent) are added to those estimated costs.

Ground Storage Tanks

Costs for ground storage tanks were based on information provided by a tank contractor. Those prices included slab, delivery of tank, and painting or coating of the tank. We added 5 percent for mobilization and 15 percent for overhead and profit to those costs. We then revised those costs based on our experience with ground storage tank construction. As the tank sizes increase there is economy of scale, so the larger tanks are less expensive on a per gallon basis. As with all of the other item, allowances for contingencies (15 percent) and engineering costs (12 percent) are added to those estimated costs.

Groundwater Wells

Table D-7 is our estimate for the average cost of new groundwater wells for the participants, including an assumed 10,000 feet of 6-inch pipeline for transmission. The estimate is based on our engineering experience and on costs presented in KSA's report for Wortham(5). We included transmission costs in our estimate. The distances from the wells to the participants' distribution systems vary greatly between the participants. For example, the KSA report(5) indicated that Wortham would have to pump groundwater over 70,000 feet. Streetman already pumps their groundwater several miles. The recent groundwater report(9) estimated that Fairfield would have to develop new wells from 2,000 to 5,000 feet away from the city. Other participants' wells are located relatively near to their distribution systems. Given this variation, we used an assumed transmission distance of 10,000 feet. The flow and transmission line size will also vary for each of the participants. We assumed a 6 inch line would be adequate to carry most of the flows. The unit cost for the 6 inch pipe is a little higher than the 2.5 times the diameter used for larger pipelines. Contingencies of 15 percent are added to the estimate.

Table D-1
Facility Needs and Opinion of Probable Cost
Richland-Chambers System
Maximum Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Water Treatment Plant					
Treatment Plant	6 mgd	1	LS	$6,600,000	$6,600,000
Pilot Study for TNRCC Approval		1	LS	$15,000	$15,000
Subtotal					$6,615,000
Pipelines					
Intake to Shoreline	18"	1,000	LF	$300.00	$300,000
Shoreline to WTP	18"	9,500	LF	$45.00	$428,000
WTP to Fairfield	18"	86,300	LF	$45.00	$3,884,000
Streetman to Wortham	8"	53,300	LF	$20.00	$1,066,000
Fairfield to Boyd Unit	14"	24,700	LF	$35.00	$865,000
Boyd Unit to Teague	12"	25,500	LF	$30.00	$765,000
Subtotal					$7,308,000
Pump Stations (including Land)					
Richland-Chambers					
Intake Structure		1	LS	$650,000	$650,000
Dredging		67,000	CY	$10	$670,000
Pump Station	3 x 100 hp	1	LS	$346,000	$346,000
WTP					
Pump Station	3 x 300 hp	1	LS	$598,000	$598,000
Ground Storage	2,000,000 gal.	1	LS	$600,000	$600,000
Fairfield					
Pump Station	3 x 50 hp	1	LS	$258,000	$258,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
					$3,452,000
Connections to Distribution Systems					
		6	LS	$40,000	$240,000
Subtotal					$17,615,000
Contingencies				15%	$2,642,000
Engineering				12%	$2,431,000
Archeological Survey & Permit Applications					$220,000
Right-of-Way (Where Not on Highways)					$132,000
Subtotal					**$23,040,000**
Tarrant Regional Water District Buy-In Cost					
Based on Average Annual Use					
1998 - $153,190 / MGD					
1999 - $189,714 / MGD					
2000 - $226,501 / MGD		2.14	MGD	$226,501	$485,000
2001 - $261,653 / MGD					
TOTAL COST					**$23,525,000**

Table D-2
Facility Needs and Opinion of Probable Cost
Richland-Chambers System
Lesser Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Water Treatment Plant					
Package Plant	3 mgd	1	LS	$3,750,000	$3,750,000
Pilot Study for TNRCC Approval		1	LS	$15,000	$15,000
Subtotal					$3,765,000
Pipelines					
Intake to Shoreline	14"	1,000	LF	$300.00	$300,000
Shoreline to WTP	14"	9,500	LF	$35.00	$333,000
WTP to Fairfield	14"	86,300	LF	$35.00	$3,021,000
Streetman to Wortham	8"	53,300	LF	$20.00	$1,066,000
Fairfield to Boyd Unit & Teague	8"	50,200	LF	$20.00	$1,004,000
Subtotal					$5,724,000
Pump Stations (including Land)					
Richland-Chambers					
Intake Structure		1	LS	$650,000	$650,000
Dredging		67,000	CY	$10	$670,000
Pump Station	3 x 50 hp	1	LS	$258,000	$258,000
WTP					
Pump Station	3 x 100 hp	1	LS	$346,000	$346,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
Fairfield					
Pump Station	3 x 25 hp	1	LS	$210,000	$210,000
Ground Storage	250,000 gal.	1	LS	$105,000	$105,000
					$2,569,000
Connections to Distribution Systems					
		6	LS	$40,000	$240,000
Subtotal					$12,298,000
Contingencies				15%	$1,845,000
Engineering				12%	$1,697,000
Archeological Survey & Permit Applications					$220,000
Right-of-Way (Where Not on Highways)					$132,000
Subtotal					**$16,192,000**
Tarrant Regional Water District Buy-In Cost					
Based on Average Annual Use					
1998 - $153,190 / MGD					
1999 - $189,714 / MGD					
2000 - $226,501 / MGD		2.14	MGD	$226,501	$485,000
2001 - $261,653 / MGD					
TOTAL COST					**$16,677,000**

Table D-3
Facility Needs and Opinion of Probable Cost
Corsicana Navarro Mills System
Maximum Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Pipelines					
Navarro Mills to Wortham	20"	105,450	LF	$50.00	$5,273,000
Wortham to Streetman	8"	53,300	LF	$20.00	$1,066,000
Wortham to Fairfield	18"	87,500	LF	$45.00	$3,938,000
Fairfield to Pleasant Grove WSC	8"	36,000	LF	$20.00	$720,000
Fairfield to Boyd Unit	14"	24,700	LF	$35.00	$865,000
Boyd Unit to Teague	12"	25,500	LF	$30.00	$765,000
Subtotal					$12,627,000
Pump Stations (including Land)					
Navarro Mills					
Pump Station	3 x 250 hp	1	LS	$507,000	$507,000
Wortham					
Pump Station	3 x 200 hp	1	LS	$453,000	$453,000
Ground Storage	1,500,000 gal.	1	LS	$455,000	$455,000
Fairfield					
Pump Station	3 x 50 hp	1	LS	$258,000	$258,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
Subtotal					$2,003,000
Connections to Distribution Systems					
		6	LS	$40,000	$240,000
Subtotal					$14,870,000
Contingencies				15%	$2,231,000
Engineering				12%	$2,052,000
Archeological Survey & Permit Applications					$340,000
Right-of-Way (Where Not on Highways)					$390,000
TOTAL COST					**$19,883,000**

Table D-4
Facility Needs and Opinion of Probable Cost
Corsicana Navarro Mills System
Lesser Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Pipelines					
Navarro Mills to Wortham	14"	105,450	LF	$35.00	$3,691,000
Wortham to Streetman	8"	53,300	LF	$20.00	$1,066,000
Wortham to Fairfield	12"	87,500	LF	$30.00	$2,625,000
Fairfield to Pleasant Grove WSC	8"	36,000	LF	$20.00	$720,000
Fairfield to Boyd Unit & Teague	8"	50,200	LF	$20.00	$1,004,000
Subtotal					$9,106,000
Pump Stations (including Land)					
Navarro Mills					
Pump Station	3 x 150 hp	1	LS	$399,000	$399,000
Wortham					
Pump Station	3 x 100 hp	1	LS	$346,000	$346,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
Fairfield					
Pump Station	3 x 25 hp	1	LS	$210,000	$210,000
Ground Storage	250,000 gal.	1	LS	$105,000	$105,000
Subtotal					$1,390,000
Connections to Distribution Systems		6	LS	$40,000	$240,000
Subtotal					$10,736,000
Contingencies				15%	$1,610,000
Engineering				12%	$1,482,000
Archeological Survey & Permit Applications					$340,000
Right-of-Way (Where Not on Highways)					$390,000
TOTAL COST					**$14,558,000**

Table D-5
Facility Needs and Opinion of Probable Cost
Corsicana Airport System
Maximum Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Pipelines					
Corsicana to Streetman	20"	80,700	LF	$50.00	$4,035,000
Streetman to Wortham	8"	53,300	LF	$20.00	$1,066,000
Streetman to Fairfield	18"	77,300	LF	$45.00	$3,479,000
Fairfield to Boyd Unit	14"	24,700	LF	$35.00	$865,000
Boyd Unit to Teague	12"	25,500	LF	$30.00	$765,000
					$10,210,000
Pump Stations (including Land)					
Corsicana					
Pump Station	3 x 150 hp	1	LS	$399,000	$399,000
Ground Storage	2,000,000 gal.	1	LS	$600,000	$600,000
Streetman					
Pump Station	3 x 250 hp	1	LS	$507,000	$507,000
Ground Storage	1,500,000 gal.	1	LS	$455,000	$455,000
Fairfield					
Pump Station	3 x 50 hp	1	LS	$258,000	$258,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
					$2,549,000
Connections to Distribution Systems					
		6	LS	$40,000	$240,000
Subtotal					$12,999,000
Contingencies				15%	$1,950,000
Engineering				12%	$1,794,000
Archeological Survey & Permit Applications					$270,000
Right-of-Way (All of Route is Along Highways)					$0
TOTAL COST					**$17,013,000**

* There will be some additional cost for paying a portion of extending Corsicana's city line

Table D-6
Facility Needs and Opinion of Probable Cost
Corsicana Airport System
Lesser Participation Scenario
(1997 Prices)

Description of Facilities	Size	Quantity	Unit	Unit Price	Total
Pipelines					
Corsicana to Streetman	16"	80,700	LF	$40.00	$3,228,000
Streetman to Wortham	8"	53,300	LF	$20.00	$1,066,000
Streetman to Fairfield	12"	77,300	LF	$30.00	$2,319,000
Fairfield to Boyd Unit & Teague	8"	50,200	LF	$20.00	$1,004,000
					$7,617,000
Pump Stations (including Land)					
Corsicana					
Pump Station	3 x 50 hp	1	LS	$258,000	$258,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
Streetman					
Pump Station	3 x 150 hp	1	LS	$399,000	$399,000
Ground Storage	1,000,000 gal.	1	LS	$330,000	$330,000
Fairfield					
Pump Station	3 x 25 hp	1	LS	$210,000	$210,000
Ground Storage	250,000 gal.	1	LS	$105,000	$105,000
					$1,632,000
Connections to Distribution Systems					
		6	LS	$40,000	$240,000
Subtotal					$9,489,000
Contingencies				15%	$1,423,000
Engineering				12%	$1,309,000
Archeological Survey & Permit Applications					$270,000
Right-of-Way (All of Route is Along Highways)					$0
TOTAL COST					**$12,491,000**

* There will be some additional cost for paying a portion of extending Corsicana's city line

Table D-7
Facility Needs and Opinion of Probable Cost
Groundwater Scenario
(1997 Prices)

Description of Facilities	Quantity	Unit	Unit Price	Total
Groundwater Well				
Well and Pump	1	LS	$100,000	$100,000
Iron Removal /Chlorination	1	LS	$112,500	$113,000
Storage tank and Pumps	1	LS	$80,000	$80,000
Land Acquisition	1	LS	$10,000	$10,000
Engineering	1	LS	$170,250	$170,000
Subtotal				$473,000
Transmission				
6" Transmission Line	10000	LF	$18	$180,000
Subtotal				$653,000
Contingencies			15%	$98,000
TOTAL COST				$751,000
ROUNDED TOTAL COST				**$750,000**

APPENDIX E

PROJECT LIFE CYCLE COSTS

APPENDIX E

PROJECT LIFE CYCLE COSTS

Life cycle analyses were developed for each of the three supply alternatives for both the maximum participation and lesser participation scenarios. A life cycle analysis was also developed for the option of continuing to use groundwater to supply the study area. These analyses are presented in Tables E-1 through E-7. Basic assumptions for the life cycle costs are as follows:

a. All capital costs are in 1997 dollars.

b. The annual inflation rate for capital costs, pumping costs, and operation and maintenance costs is 4 percent.

c. The annual inflation rate for raw and treated water purchase is 3 percent per year.

d. The debt service interest rate is 6 percent, and the length of debt service for each project is 30 years.

e. For the scenarios of purchasing treated water from Corsicana, we used Corsicana's estimated 1999 rate of $1.96 per thousand gallons and 2000 rate of $2.00 per thousand gallons. The cost is inflated 3 percent per year after 2000.

f. The 1997 electricity cost for surface water pumping is $0.07 per kilowatt-hour.

g. The wire-to-water pumping efficiency rate is 70 percent.

h. The pump station O&M cost is 4 percent of the pump station capital cost.

i. The 1997 fixed O&M cost for the small package plant in the average-day scenarios is $200,000, and the variable cost is $0.10 per thousand gallons treated (not including power for pumping, which is computed separately).

j. The 1997 fixed O&M cost for the larger package plant in the maximum-day scenarios is $300,000, and the variable cost is $0.10 per thousand gallons treated (not including power for pumping, which is computed separately).

k. The 1997 cost for groundwater pumping is $0.40 per thousand gallons pumped. This is based on well data and energy costs.

l. The annual discount rate to calculate present worth is 4 percent.

The following is a description of the columns in the calculation of the life cycle costs for Tables E-1 through E-6. Some of these descriptions apply only to the maximum participation scenarios, and some apply only to the lesser participation scenarios.

Year: It is assumed the regional system will go on line in 1999. The costs analyses run through 2028 to correspond with the 30 year debt service.

Annual Supply: Regional System (MG): For the lesser participation scenario, this value is all of Wortham's use plus 80 percent use for other participants. (Daily records from Fairfield's water system show that 80 percent of the participants' annual water use can be provided by a system with capacity equal to the average-day use.) For the maximum participation, this value is 100 percent of the use by all participants.

Annual Supply: Groundwater (MG): For the lesser participation scenarios, this is total water use minus the amount supplied by the regional system.

Capital Costs, 1997 Prices: This is the initial 1997 capital cost of the transmission and treatment facilities for each scenario. For the Richland-Chambers Reservoir scenarios, the capital costs include the premium buy-in cost for Tarrant Regional Water District.

Capital Costs, After Inflation: The is the capital cost at 1997 prices inflated 4 percent per year from 1997. This is the amount that is financed to calculate debt service.

Cost of Supply from Regional System:

Debt Service: This is the capital cost financed at 6 percent for 30 years.

Raw Water Purchase: (Richland-Chambers Reservoir scenarios only.) Tarrant Regional Water District provided their raw water purchase rate through 2002. The rates per thousand gallons are: 1999 - $0.62617; 2000 - $0.61821, 2001 - $0.61531, 2002 - $0.60360. Thereafter they project the rate to be about $0.63 per thousand gallons. We have set their rate at $0.63 for 2003, increasing it 3 percent per year for inflation thereafter.

Treated Water Purchase: (Corsicana scenario only.) See item e above.

Water Treatment O&M Cost: (Richland-Chambers scenario only.) See items i and j above.

Electricity for Pumping: Based on 7 cents times the kilowatt-hours required to pump the surface water.

Other O&M: This is the non-electricity O&M costs for the pump stations. Based on previous pump station operation experience, this O&M is calculated as 4 percent of the capital cost of the pump stations, increasing by 4 percent per year for inflation.

Administration Cost: This is the estimated amount TRA would charge to operate the regional system. It is estimated as a portion of TRA's entire administration overhead cost for all of its operating facilities. For the scenarios with treatment plants, it is estimated in 1997 dollars at $50,000 for the maximum participation scenario and $30,000 for lesser participation. For the scenarios with pump stations and pipelines only, it is estimated at $10,000 and $5,000. It is increased 4 percent per year for inflation.

Total Cost: This is the sum of all the previous columns under Cost of Supply.

Unit Cost per 1000 Gallons: This is the total cost divided by the annual volume supplied by the regional system (in thousand gallons). These are the inflated costs, not present worth costs.

Present Worth of Unit Cost: (For maximum participation scenarios only) This is the unit cost discount 4 percent per year.

Groundwater: (Lesser participation scenarios only.)

Capital Expenditures (New Wells): Since the groundwater wells are not being used as heavily in this scenario, we have assumed that out of the 17 wells, one well would need replacing every 10 years. The 1997 capital cost of replacing a well is $750,000, which includes iron treatment and transmission facilities.

Debt Service: This is the capital expenditures financed at 6 percent for 30 years.

O&M Cost: See item k above.

Total Cost: This is the sum of all groundwater costs.

Regional System and Groundwater: (Lesser participation scenarios only.)

Total Cost: This is the sum of the total cost of the regional system and the total cost of the groundwater.

Unit Cost per 1000 Gallons: This is the total from above divided by the total annual volume of water supplied by the regional system and by groundwater.

Present Worth of Unit Cost: This is the unit cost per thousand gallons discounted 4 percent per year.

The following is a description of columns for groundwater only scenario life cycle costs in Table E-7:

Year: Analysis begins in the same year as the regional system analyses.

Annual Supply Groundwater (MG): Total annual volume of groundwater supplied by the cities to their customers.

Capital Expenditure: Estimated expenditures for new wells and replacement wells over the 30-year period from 1999 to 2028. Costs include transmission and treatment facilities. A recent study by KSA Engineers for the City of Wortham, *Study of Water Supply Alternatives,* recommends drilling two new wells by the year 2000. The cost estimate for these wells comes from this report. Other new wells will need to be drilled as demand increases and to meet TNRCC firm capacity requirements (see Table 5.7). Replacement wells will need to be drilled as existing wells cease to produce sufficient supply. Since a typical well lasts approximately 30 years and there are 15 existing wells in the system, an existing well in the system will need to be replaced about every two years.

Capital Cost: The capital cost of the two Wortham wells comes from the KSA report. Other capital costs are based on an estimate of $750,000 per well.

Capital Cost after Inflation: The capital costs after being inflated 4 percent per year from 1997. This value is used to calculate debt service.

Debt Service: Capital costs of the new and replacement wells financed at 6 percent for 30 years. This value does not include any existing debt service.

O&M Cost: The 1997 cost for groundwater pumping of $0.40 per 1000 gallons inflated by 4 percent per year. The groundwater pumping includes 5 percent system losses.

Total Cost: The total cost is the sum of the debt service and O&M costs.

Unit Cost per 1000 Gallons: The total cost divided by the annual supply to customers.

Present Worth of Unit Cost: This is the unit cost per 1000 gallons discounted 4 percent per year.

Table E-1
Life Cycle Costs for Richland-Chambers System
Maximum Participation Scenario

	Annual Supply	Cost of Supply from Regional System								
		Capital Cost of Regional System (1997 Prices)						$23,525,000		
		Cost of System after Inflation (1998 Prices)						$24,466,000		
Year	Regional System (MG)	Debt Service	Raw Water Purchase*	WTP O&M Cost	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996										
1997										
1998										
1999	595	$1,777,428	$392,416	$392,263	$223,276	$52,003	$54,080	$2,891,466	$4.857	$4.491
2000	657	$1,777,428	$427,834	$415,306	$255,530	$54,083	$56,243	$2,986,424	$4.542	$4.038
2001	659	$1,777,428	$426,773	$432,098	$267,907	$56,247	$58,493	$3,018,946	$4.582	$3.917
2002	660	$1,777,428	$419,642	$449,569	$279,745	$58,497	$60,833	$3,045,713	$4.612	$3.791
2003	662	$1,777,428	$438,900	$467,746	$293,268	$60,837	$63,266	$3,101,444	$4.686	$3.703
2004	663	$1,777,428	$453,065	$486,658	$307,424	$63,270	$65,797	$3,153,641	$4.755	$3.613
2005	665	$1,777,428	$467,685	$506,335	$322,243	$65,801	$68,428	$3,207,920	$4.826	$3.526
2006	682	$1,777,428	$494,420	$529,215	$343,658	$68,433	$71,166	$3,284,319	$4.814	$3.382
2007	700	$1,777,428	$522,338	$553,116	$367,636	$71,170	$74,012	$3,365,700	$4.809	$3.249
2008	717	$1,777,428	$551,486	$578,081	$392,273	$74,017	$76,973	$3,450,259	$4.810	$3.124
2009	735	$1,777,428	$581,914	$604,159	$419,028	$76,978	$80,052	$3,539,558	$4.816	$3.008
2010	752	$1,777,428	$613,670	$631,399	$447,299	$80,057	$83,254	$3,633,106	$4.829	$2.900
2011	755	$1,777,428	$634,535	$657,187	$468,381	$83,259	$86,584	$3,707,374	$4.908	$2.834
2012	758	$1,777,428	$656,099	$684,028	$491,267	$86,589	$90,047	$3,785,460	$4.992	$2.772
2013	761	$1,777,428	$678,386	$711,966	$515,234	$90,053	$93,649	$3,866,716	$5.080	$2.712
2014	764	$1,777,428	$701,420	$741,043	$539,431	$93,655	$97,395	$3,950,373	$5.170	$2.654
2015	767	$1,777,428	$725,226	$771,308	$565,678	$97,401	$101,291	$4,038,332	$5.265	$2.599
2016	770	$1,777,428	$749,828	$802,809	$593,158	$101,297	$105,342	$4,129,862	$5.364	$2.546
2017	773	$1,777,428	$775,254	$835,595	$620,922	$105,349	$109,556	$4,224,104	$5.465	$2.494
2018	776	$1,777,428	$801,530	$869,720	$653,111	$109,563	$113,938	$4,325,291	$5.575	$2.446
2019	779	$1,777,428	$828,686	$905,237	$684,694	$113,946	$118,496	$4,428,487	$5.687	$2.400
2020	782	$1,777,428	$856,749	$942,205	$717,761	$118,504	$123,236	$4,535,883	$5.803	$2.354
2021	782	$1,777,428	$882,452	$979,893	$746,471	$123,244	$128,165	$4,637,653	$5.933	$2.315
2022	782	$1,777,428	$908,925	$1,019,089	$776,330	$128,173	$133,292	$4,743,238	$6.068	$2.276
2023	782	$1,777,428	$936,193	$1,059,852	$807,384	$133,300	$138,623	$4,852,781	$6.209	$2.240
2024	782	$1,777,428	$964,279	$1,102,247	$839,679	$138,632	$144,168	$4,966,433	$6.354	$2.204
2025	782	$1,777,428	$993,207	$1,146,336	$873,266	$144,178	$149,935	$5,084,351	$6.505	$2.169
2026	782	$1,777,428	$1,023,003	$1,192,190	$908,197	$149,945	$155,933	$5,206,695	$6.661	$2.136
2027	782	$1,777,428	$1,053,694	$1,239,877	$944,525	$155,943	$162,170	$5,333,636	$6.824	$2.104
2028	782	$1,777,428	$1,085,304	$1,289,473	$982,306	$162,180	$168,657	$5,465,347	$6.992	$2.073
Totals	22,087	$53,322,840	$21,044,914	$22,996,002	$16,647,081	$2,916,603	$3,033,073	$119,960,513		
Averages	**736**	**$1,777,428**	**$701,497**	**$766,533**	**$554,903**	**$97,220**	**$101,102**	**$3,998,684**	**$5.393**	**$2.869**

* Allowing for 5% loss in transmission & distribution system

Table E-2
Life Cycle Costs for Richland-Chambers System
Lesser Participation Scenario

	Annual Supply		Cost of Supply from Regional System								Cost of Supply from Groundwater				Regional System & Groundwater		
			Capital Cost of Regional System (1997 Prices)						$16,677,000		Capital Cost of New Well (1997 Prices)			$750,000			
			Cost of System after Inflation (1998 Prices)						$17,344,000								
Year	Regional System (MG)	Ground-water (MG)	Debt Service	Raw Water Purchase*	WTP O&M Cost	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Capital Expenditure (New Wells)	Debt Service	O&M Cost	Total Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996																	
1997																	
1998																	
1999	489	106	$1,260,023	$322,313	$271,994	$115,625	$35,217	$35,693	$2,040,864	$4.173		$0	$46,015	$46,015	$2,086,879	$3.505	$3.241
2000	539	118	$1,260,023	$350,753	$288,794	$138,218	$36,626	$37,121	$2,111,534	$3.917		$0	$53,296	$53,296	$2,164,830	$3.293	$2.927
2001	540	119	$1,260,023	$349,755	$300,469	$145,183	$38,091	$38,605	$2,132,126	$3.946		$0	$55,644	$55,644	$2,187,770	$3.320	$2.838
2002	541	119	$1,260,023	$343,786	$312,616	$151,739	$39,614	$40,150	$2,147,927	$3.967		$0	$58,094	$58,094	$2,206,021	$3.341	$2.746
2003	543	119	$1,260,023	$360,095	$325,387	$157,808	$41,199	$41,756	$2,186,267	$4.029		$0	$60,145	$60,145	$2,246,412	$3.394	$2.683
2004	544	119	$1,260,023	$371,581	$338,541	$165,738	$42,847	$43,426	$2,222,155	$4.086		$0	$62,793	$62,793	$2,284,948	$3.445	$2.618
2005	545	120	$1,260,023	$383,432	$352,226	$173,208	$44,561	$45,163	$2,258,612	$4.145		$0	$65,557	$65,557	$2,324,169	$3.496	$2.555
2006	559	123	$1,260,023	$405,080	$368,413	$187,132	$46,343	$46,969	$2,313,960	$4.139		$0	$70,190	$70,190	$2,384,150	$3.494	$2.455
2007	573	127	$1,260,023	$427,682	$385,331	$201,892	$48,197	$48,848	$2,371,972	$4.137		$0	$75,089	$75,089	$2,447,061	$3.497	$2.362
2008	587	130	$1,260,023	$451,275	$403,013	$218,480	$50,125	$50,802	$2,433,717	$4.143	$1,154,591	$83,880	$80,268	$164,148	$2,597,865	$3.621	$2.352
2009	602	133	$1,260,023	$476,691	$421,661	$236,073	$52,130	$52,834	$2,499,411	$4.154		$83,880	$85,100	$168,980	$2,668,391	$3.631	$2.268
2010	616	136	$1,260,023	$502,410	$440,982	$254,723	$54,215	$54,947	$2,567,300	$4.169		$83,880	$90,856	$174,736	$2,742,036	$3.644	$2.189
2011	618	137	$1,260,023	$519,162	$458,985	$267,040	$56,383	$57,145	$2,618,739	$4.235		$83,880	$95,129	$179,009	$2,797,748	$3.704	$2.139
2012	621	137	$1,260,023	$537,333	$477,914	$279,933	$58,639	$59,431	$2,673,273	$4.306		$83,880	$98,878	$182,758	$2,856,031	$3.767	$2.091
2013	623	138	$1,260,023	$555,236	$497,424	$293,434	$60,984	$61,808	$2,728,909	$4.378		$83,880	$103,524	$187,404	$2,916,313	$3.831	$2.046
2014	626	138	$1,260,023	$574,646	$517,936	$306,367	$63,424	$64,281	$2,786,678	$4.453		$83,880	$107,604	$191,484	$2,978,162	$3.898	$2.001
2015	628	139	$1,260,023	$593,777	$539,080	$319,868	$65,961	$66,852	$2,845,560	$4.529		$83,880	$112,656	$196,536	$3,042,096	$3.966	$1.958
2016	631	139	$1,260,023	$614,512	$561,309	$336,543	$68,599	$69,526	$2,910,512	$4.615		$83,880	$117,096	$200,976	$3,111,488	$4.041	$1.918
2017	633	140	$1,260,023	$634,953	$584,223	$352,698	$71,343	$72,307	$2,975,547	$4.699		$83,880	$122,588	$206,468	$3,182,015	$4.117	$1.879
2018	636	140	$1,260,023	$657,101	$608,311	$368,205	$74,197	$75,199	$3,043,037	$4.787	$1,709,076	$208,043	$127,421	$335,464	$3,378,501	$4.355	$1.911
2019	638	141	$1,260,023	$678,943	$633,143	$387,303	$77,165	$78,207	$3,114,783	$4.881		$208,043	$133,391	$341,434	$3,456,217	$4.438	$1.873
2020	641	141	$1,260,023	$702,599	$659,247	$404,308	$80,251	$81,336	$3,187,764	$4.976		$208,043	$138,650	$346,693	$3,534,457	$4.522	$1.835
2021	641	141	$1,260,023	$723,677	$685,616	$420,481	$83,461	$84,589	$3,257,848	$5.085		$208,043	$144,196	$352,239	$3,610,087	$4.619	$1.802
2022	641	141	$1,260,023	$745,388	$713,041	$437,300	$86,800	$87,973	$3,330,524	$5.199		$208,043	$149,964	$358,007	$3,688,531	$4.719	$1.770
2023	641	141	$1,260,023	$767,749	$741,563	$454,792	$90,272	$91,492	$3,405,890	$5.316		$208,043	$155,963	$364,006	$3,769,896	$4.823	$1.740
2024	641	141	$1,260,023	$790,782	$771,225	$472,984	$93,882	$95,151	$3,484,047	$5.438		$208,043	$162,201	$370,244	$3,854,291	$4.931	$1.710
2025	641	141	$1,260,023	$814,505	$802,074	$491,903	$97,638	$98,957	$3,565,100	$5.565		$208,043	$168,689	$376,732	$3,941,832	$5.043	$1.682
2026	641	141	$1,260,023	$838,940	$834,157	$511,579	$101,543	$102,915	$3,649,159	$5.696		$208,043	$175,437	$383,480	$4,032,639	$5.159	$1.654
2027	641	141	$1,260,023	$864,109	$867,523	$532,042	$105,605	$107,032	$3,736,335	$5.832		$208,043	$182,454	$390,497	$4,126,832	$5.280	$1.628
2028	641	141	$1,260,023	$890,032	$902,224	$553,324	$109,829	$111,313	$3,826,746	$5.973	$2,529,850	$391,834	$189,752	$581,586	$4,408,332	$5.640	$1.672
Totals	18,101	3,986	$37,800,690	$17,248,296	$16,064,423	$9,335,922	$1,975,137	$2,001,828	$84,426,297		$5,393,517	$3,311,064	$3,288,640	$6,599,704	$91,026,001		
Averages	**603**	**133**	**$1,260,023**	**$574,943**	**$535,481**	**$311,197**	**$65,838**	**$66,728**	**$2,814,210**	**$4.632**	**$179,784**	**$110,369**	**$109,621**	**$219,990**	**$3,034,200**	**$4.084**	**$2.151**

* Allowing for 5% loss in transmission & distribution system

Table E-3
Life Cycle Costs for Corsicana Navarro Mills System
Maximum Participation Scenario

	Annual Supply	Cost of Supply from Regional System							
		Capital Cost of Regional System (1997 Prices)					$19,883,000		
		Cost of System after Inflation (1998 Prices)					$20,678,000		
Year	Regional System (MG)	Debt Service	Treated Water Purchase*	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996									
1997									
1998									
1999	595	$1,502,234	$1,238,805	$205,333	$52,696	$10,816	$3,009,884	$5.056	$4.67
2000	657	$1,502,234	$1,394,548	$238,426	$54,803	$11,249	$3,201,260	$4.869	$4.33
2001	659	$1,502,234	$1,439,552	$250,657	$56,996	$11,699	$3,261,138	$4.949	$4.23
2002	660	$1,502,234	$1,486,002	$262,927	$59,275	$12,167	$3,322,605	$5.031	$4.14
2003	662	$1,502,234	$1,533,943	$275,192	$61,646	$12,653	$3,385,669	$5.116	$4.04
2004	663	$1,502,234	$1,583,423	$289,232	$64,112	$13,159	$3,452,161	$5.205	$3.96
2005	665	$1,502,234	$1,634,491	$302,694	$66,677	$13,686	$3,519,781	$5.295	$3.87
2006	682	$1,502,234	$1,727,598	$324,640	$69,344	$14,233	$3,638,049	$5.332	$3.75
2007	700	$1,502,234	$1,824,820	$348,539	$72,118	$14,802	$3,762,513	$5.376	$3.63
2008	717	$1,502,234	$1,926,320	$373,830	$75,002	$15,395	$3,892,781	$5.427	$3.53
2009	735	$1,502,234	$2,032,268	$401,323	$78,002	$16,010	$4,029,838	$5.484	$3.43
2010	752	$1,502,234	$2,142,840	$429,652	$81,122	$16,651	$4,172,499	$5.545	$3.33
2011	755	$1,502,234	$2,215,640	$450,828	$84,367	$17,317	$4,270,386	$5.654	$3.27
2012	758	$1,502,234	$2,290,880	$473,840	$87,742	$18,009	$4,372,705	$5.767	$3.20
2013	761	$1,502,234	$2,368,640	$497,109	$91,252	$18,730	$4,477,965	$5.883	$3.14
2014	764	$1,502,234	$2,449,004	$521,480	$94,902	$19,479	$4,587,099	$6.003	$3.08
2015	767	$1,502,234	$2,532,058	$547,007	$98,698	$20,258	$4,700,255	$6.128	$3.02
2016	770	$1,502,234	$2,617,892	$574,711	$102,646	$21,068	$4,818,551	$6.258	$2.97
2017	773	$1,502,234	$2,706,596	$603,759	$106,752	$21,911	$4,941,252	$6.393	$2.92
2018	776	$1,502,234	$2,798,266	$635,260	$111,022	$22,788	$5,069,569	$6.535	$2.87
2019	779	$1,502,234	$2,893,001	$667,224	$115,462	$23,699	$5,201,621	$6.680	$2.82
2020	782	$1,502,234	$2,990,902	$699,589	$120,081	$24,647	$5,337,453	$6.829	$2.77
2021	782	$1,502,234	$3,080,629	$727,573	$124,884	$25,633	$5,460,953	$6.987	$2.73
2022	782	$1,502,234	$3,173,048	$756,676	$129,880	$26,658	$5,588,496	$7.150	$2.68
2023	782	$1,502,234	$3,268,239	$786,943	$135,075	$27,725	$5,720,216	$7.318	$2.64
2024	782	$1,502,234	$3,366,286	$818,421	$140,478	$28,834	$5,856,252	$7.492	$2.60
2025	782	$1,502,234	$3,467,275	$851,158	$146,097	$29,987	$5,996,750	$7.672	$2.56
2026	782	$1,502,234	$3,571,293	$885,204	$151,941	$31,187	$6,141,858	$7.858	$2.52
2027	782	$1,502,234	$3,678,432	$920,612	$158,018	$32,434	$6,291,730	$8.049	$2.48
2028	782	$1,502,234	$3,788,785	$957,437	$164,339	$33,731	$6,446,526	$8.247	$2.44
Totals	22,087	$45,067,020	$73,221,476	$16,077,276	$2,955,427	$606,615	$137,927,814		
Averages	**736**	**$1,502,234**	**$2,440,716**	**$535,909**	**$98,514**	**$20,220**	**$4,597,594**	**$6.19**	**$3.25**

* Allowing for 5% loss in transmission & distribution system

Table E-4
Life Cycle Costs for Corsicana Navarro Mills System
Lesser Participation Scenario

	Annual Supply		Cost of Supply from Regional System							Cost of Supply from Groundwater				Regional System & Groundwater		
			Capital Cost of Regional System (1997 Prices)						$14,558,000	Capital Cost of New Well (1997 Prices)			$750,000			
			Cost of System after Inflation (1998 Prices)						$15,140,000							
Year	Regional System (MG)	Ground-water (MG)	Debt Service	Treated Water Purchase*	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Capital Expenditure (New Wells)	Debt Service	O&M Cost	Total Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996																
1997																
1998																
1999	489	106	$1,099,905	$1,019,373	$144,863	$41,317	$5,408	$2,310,866	$4.726		$0	$46,015	$46,015	$2,356,880	$3.959	$3.660
2000	539	118	$1,099,905	$1,145,179	$187,977	$42,970	$5,624	$2,481,655	$4.604		$0	$53,296	$53,296	$2,534,951	$3.856	$3.428
2001	540	119	$1,099,905	$1,181,703	$196,932	$44,689	$5,849	$2,529,078	$4.683		$0	$55,644	$55,644	$2,584,722	$3.923	$3.353
2002	541	119	$1,099,905	$1,219,388	$207,053	$46,476	$6,083	$2,578,905	$4.767		$0	$58,094	$58,094	$2,636,999	$3.993	$3.282
2003	543	119	$1,099,905	$1,260,570	$216,112	$48,335	$6,327	$2,631,249	$4.846		$0	$60,145	$60,145	$2,691,394	$4.067	$3.214
2004	544	119	$1,099,905	$1,300,757	$226,374	$50,269	$6,580	$2,683,884	$4.934		$0	$62,793	$62,793	$2,746,677	$4.141	$3.147
2005	545	120	$1,099,905	$1,342,220	$237,951	$52,279	$6,843	$2,739,198	$5.026		$0	$65,557	$65,557	$2,804,755	$4.219	$3.083
2006	559	123	$1,099,905	$1,417,680	$262,335	$54,371	$7,117	$2,841,406	$5.083		$0	$70,190	$70,190	$2,911,597	$4.267	$2.998
2007	573	127	$1,099,905	$1,496,459	$289,197	$56,545	$7,401	$2,949,508	$5.147		$0	$75,089	$75,089	$3,024,597	$4.322	$2.920
2008	587	130	$1,099,905	$1,578,689	$318,736	$58,807	$7,697	$3,063,835	$5.219	$1,154,591	$83,880	$80,268	$164,148	$3,227,982	$4.500	$2.923
2009	602	133	$1,099,905	$1,667,253	$351,160	$61,159	$8,005	$3,187,482	$5.295		$83,880	$85,100	$168,980	$3,356,462	$4.567	$2.853
2010	616	136	$1,099,905	$1,756,881	$386,688	$63,606	$8,325	$3,315,405	$5.382		$83,880	$90,856	$174,736	$3,490,142	$4.639	$2.786
2011	618	137	$1,099,905	$1,815,416	$405,347	$66,150	$8,658	$3,395,476	$5.494		$83,880	$95,129	$179,009	$3,574,486	$4.732	$2.733
2012	621	137	$1,099,905	$1,878,883	$425,987	$68,796	$9,005	$3,482,576	$5.608		$83,880	$98,878	$182,758	$3,665,334	$4.834	$2.684
2013	623	138	$1,099,905	$1,941,433	$446,477	$71,548	$9,365	$3,568,728	$5.728		$83,880	$103,524	$187,404	$3,756,132	$4.935	$2.635
2014	626	138	$1,099,905	$2,009,229	$469,125	$74,410	$9,740	$3,662,409	$5.850		$83,880	$107,604	$191,484	$3,853,893	$5.044	$2.589
2015	628	139	$1,099,905	$2,076,066	$492,866	$77,386	$10,129	$3,756,352	$5.981		$83,880	$112,656	$196,536	$3,952,888	$5.154	$2.544
2016	631	139	$1,099,905	$2,148,483	$516,465	$80,482	$10,534	$3,855,869	$6.111		$83,880	$117,096	$200,976	$4,056,845	$5.269	$2.501
2017	633	140	$1,099,905	$2,219,897	$542,508	$83,701	$10,956	$3,956,966	$6.251		$83,880	$122,588	$206,468	$4,163,434	$5.387	$2.459
2018	636	140	$1,099,905	$2,297,246	$571,210	$87,049	$11,394	$4,066,803	$6.394	$1,709,076	$208,043	$127,421	$335,464	$4,402,267	$5.675	$2.490
2019	638	141	$1,099,905	$2,373,546	$599,881	$90,531	$11,850	$4,175,713	$6.545		$208,043	$133,391	$341,434	$4,517,147	$5.801	$2.448
2020	641	141	$1,099,905	$2,456,160	$628,421	$94,152	$12,324	$4,290,961	$6.694		$208,043	$138,650	$346,693	$4,637,654	$5.933	$2.407
2021	641	141	$1,099,905	$2,529,845	$653,558	$97,918	$12,817	$4,394,042	$6.855		$208,043	$144,196	$352,239	$4,746,281	$6.072	$2.369
2022	641	141	$1,099,905	$2,605,740	$679,700	$101,835	$13,329	$4,500,509	$7.021		$208,043	$149,964	$358,007	$4,858,516	$6.216	$2.332
2023	641	141	$1,099,905	$2,683,912	$706,888	$105,908	$13,862	$4,610,476	$7.193		$208,043	$155,963	$364,006	$4,974,481	$6.364	$2.295
2024	641	141	$1,099,905	$2,764,429	$735,163	$110,145	$14,417	$4,724,059	$7.370		$208,043	$162,201	$370,244	$5,094,303	$6.517	$2.260
2025	641	141	$1,099,905	$2,847,362	$764,570	$114,550	$14,994	$4,841,381	$7.553		$208,043	$168,689	$376,732	$5,218,113	$6.676	$2.226
2026	641	141	$1,099,905	$2,932,783	$795,153	$119,132	$15,593	$4,962,567	$7.742		$208,043	$175,437	$383,480	$5,346,046	$6.840	$2.193
2027	641	141	$1,099,905	$3,020,767	$826,959	$123,898	$16,217	$5,087,745	$7.937		$208,043	$182,454	$390,497	$5,478,242	$7.009	$2.161
2028	641	141	$1,099,905	$3,111,390	$860,037	$128,854	$16,866	$5,217,051	$8.139	$2,529,850	$391,834	$189,752	$581,586	$5,798,638	$7.419	$2.199
Totals	18,101	3,986	$32,997,150	$60,098,738	$14,145,692	$2,317,268	$303,307	$109,862,155		$5,393,517	$3,311,064	$3,288,640	$6,599,704	$116,461,859		
Averages	603	133	$1,099,905	$2,003,291	$471,523	$77,242	$10,110	$3,662,072	$6.006	$179,784	$110,369	$109,621	$219,990	$3,882,062	$5.211	$2.706

* Allowing for 5% loss in transmission & distribution system

Table E-5
Life Cycle Costs for Corsicana Airport System
Maximum Participation Scenario

	Annual Supply	Cost of Supply from Regional System							
		Capital Cost of Regional System (1997 Prices)					$17,013,000		
		Cost of System after Inflation (1998 Prices)					$17,694,000		
Year	Regional System (MG)	Debt Service	Treated Water Purchase*	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996									
1997									
1998									
1999	595	$1,285,450	$1,238,805	$202,343	$50,359	$10,816	$2,787,773	$4.683	$4.330
2000	657	$1,285,450	$1,394,548	$236,353	$52,374	$11,249	$2,979,973	$4.533	$4.030
2001	659	$1,285,450	$1,439,552	$247,963	$54,469	$11,699	$3,039,132	$4.612	$3.942
2002	660	$1,285,450	$1,486,002	$260,124	$56,647	$12,167	$3,100,389	$4.695	$3.859
2003	662	$1,285,450	$1,533,943	$272,861	$58,913	$12,653	$3,163,820	$4.780	$3.778
2004	663	$1,285,450	$1,583,423	$286,807	$61,270	$13,159	$3,230,109	$4.870	$3.701
2005	665	$1,285,450	$1,634,491	$300,802	$63,721	$13,686	$3,298,149	$4.961	$3.625
2006	682	$1,285,450	$1,727,598	$322,672	$66,269	$14,233	$3,416,222	$5.007	$3.518
2007	700	$1,285,450	$1,824,820	$347,175	$68,920	$14,802	$3,541,167	$5.060	$3.418
2008	717	$1,285,450	$1,926,320	$372,411	$71,677	$15,395	$3,671,252	$5.118	$3.325
2009	735	$1,285,450	$2,032,268	$400,586	$74,544	$16,010	$3,808,859	$5.183	$3.237
2010	752	$1,285,450	$2,142,840	$429,652	$77,526	$16,651	$3,952,118	$5.253	$3.155
2011	755	$1,285,450	$2,215,640	$450,828	$80,627	$17,317	$4,049,862	$5.362	$3.096
2012	758	$1,285,450	$2,290,880	$473,840	$83,852	$18,009	$4,152,031	$5.476	$3.041
2013	761	$1,285,450	$2,368,640	$497,108	$87,206	$18,730	$4,257,134	$5.593	$2.986
2014	764	$1,285,450	$2,449,004	$522,378	$90,694	$19,479	$4,367,006	$5.715	$2.934
2015	767	$1,285,450	$2,532,058	$548,874	$94,322	$20,258	$4,480,962	$5.842	$2.884
2016	770	$1,285,450	$2,617,892	$575,683	$98,095	$21,068	$4,598,188	$5.972	$2.835
2017	773	$1,285,450	$2,706,596	$604,769	$102,019	$21,911	$4,720,745	$6.108	$2.788
2018	776	$1,285,450	$2,798,266	$636,311	$106,099	$22,788	$4,848,914	$6.250	$2.743
2019	779	$1,285,450	$2,893,001	$668,315	$110,343	$23,699	$4,980,808	$6.396	$2.699
2020	782	$1,285,450	$2,990,902	$702,997	$114,757	$24,647	$5,118,753	$6.549	$2.657
2021	782	$1,285,450	$3,080,629	$731,117	$119,347	$25,633	$5,242,176	$6.707	$2.617
2022	782	$1,285,450	$3,173,048	$760,362	$124,121	$26,658	$5,369,639	$6.870	$2.577
2023	782	$1,285,450	$3,268,239	$790,776	$129,086	$27,725	$5,501,276	$7.038	$2.539
2024	782	$1,285,450	$3,366,286	$822,407	$134,250	$28,834	$5,637,227	$7.212	$2.501
2025	782	$1,285,450	$3,467,275	$855,304	$139,620	$29,987	$5,777,635	$7.392	$2.465
2026	782	$1,285,450	$3,571,293	$889,516	$145,204	$31,187	$5,922,650	$7.577	$2.430
2027	782	$1,285,450	$3,678,432	$925,096	$151,013	$32,434	$6,072,425	$7.769	$2.395
2028	782	$1,285,450	$3,788,785	$962,100	$157,053	$33,731	$6,227,120	$7.967	$2.362
Totals	22,087	$38,563,500	$73,221,476	$16,097,529	$2,824,398	$606,615	$131,313,518		
Averages	**736**	**$1,285,450**	**$2,440,716**	**$536,584**	**$94,147**	**$20,220**	**$4,377,117**	**$5.885**	**$3.082**

* Allowing for 5% loss in transmission & distribution system

Table E-6
Life Cycle Costs for Corsicana Airport System
Lesser Participation Scenario

	Annual Supply		Cost of Supply from Regional System							Cost of Supply from Groundwater				Regional System & Groundwater		
			Capital Cost of Regional System (1997 Prices)						$12,491,000	Capital Cost of New Well (1997 Prices)			$750,000			
			Cost of System after Inflation (1998 Prices)						$12,991,000							
Year	Regional System (MG)	Ground-water (MG)	Debt Service	Treated Water Purchase*	Electricity for Pumping	Other O&M	Adminis-tration Cost	Total Cost	Unit Cost per 1000 Gallons	Capital Expenditure (New Wells)	Debt Service	O&M Cost	Total Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996																
1997																
1998																
1999	489	106	$943,782	$1,019,373	$108,315	$37,510	$5,408	$2,114,388	$4.323		$0	$46,015	$46,015	$2,160,402	$3.629	$3.355
2000	539	118	$943,782	$1,145,179	$140,291	$39,010	$5,624	$2,273,887	$4.218		$0	$53,296	$53,296	$2,327,183	$3.540	$3.147
2001	540	119	$943,782	$1,181,703	$146,621	$40,571	$5,849	$2,318,526	$4.291		$0	$55,644	$55,644	$2,374,170	$3.603	$3.080
2002	541	119	$943,782	$1,219,388	$153,982	$42,194	$6,083	$2,365,428	$4.369		$0	$58,094	$58,094	$2,423,522	$3.670	$3.016
2003	543	119	$943,782	$1,260,570	$160,918	$43,881	$6,327	$2,415,478	$4.452		$0	$60,145	$60,145	$2,475,623	$3.741	$2.956
2004	544	119	$943,782	$1,300,757	$168,971	$45,637	$6,580	$2,465,726	$4.534		$0	$62,793	$62,793	$2,528,519	$3.812	$2.897
2005	545	120	$943,782	$1,342,220	$176,571	$47,462	$6,843	$2,516,878	$4.619		$0	$65,557	$65,557	$2,582,435	$3.885	$2.839
2006	559	123	$943,782	$1,417,680	$195,002	$49,360	$7,117	$2,612,941	$4.673		$0	$70,190	$70,190	$2,683,131	$3.933	$2.763
2007	573	127	$943,782	$1,496,459	$214,624	$51,335	$7,401	$2,713,601	$4.733		$0	$75,089	$75,089	$2,788,691	$3.985	$2.692
2008	587	130	$943,782	$1,578,689	$235,504	$53,388	$7,697	$2,819,061	$4.799	$1,154,591	$83,880	$80,268	$164,148	$2,983,209	$4.159	$2.701
2009	602	133	$943,782	$1,667,253	$260,665	$55,524	$8,005	$2,935,229	$4.879		$83,880	$85,100	$168,980	$3,104,209	$4.224	$2.638
2010	616	136	$943,782	$1,756,881	$286,435	$57,745	$8,325	$3,053,168	$4.958		$83,880	$90,856	$174,736	$3,227,904	$4.290	$2.576
2011	618	137	$943,782	$1,815,416	$298,957	$60,055	$8,658	$3,126,868	$5.057		$83,880	$95,129	$179,009	$3,305,877	$4.377	$2.527
2012	621	137	$943,782	$1,878,883	$314,234	$62,457	$9,005	$3,208,361	$5.168		$83,880	$98,878	$182,758	$3,391,119	$4.472	$2.483
2013	623	138	$943,782	$1,941,433	$330,255	$64,955	$9,365	$3,289,790	$5.278		$83,880	$103,524	$187,404	$3,477,194	$4.568	$2.439
2014	626	138	$943,782	$2,009,229	$347,056	$67,553	$9,740	$3,377,359	$5.397		$83,880	$107,604	$191,484	$3,568,844	$4.671	$2.398
2015	628	139	$943,782	$2,076,066	$364,673	$70,255	$10,129	$3,464,905	$5.515		$83,880	$112,656	$196,536	$3,661,441	$4.774	$2.356
2016	631	139	$943,782	$2,148,483	$383,143	$73,066	$10,534	$3,559,007	$5.643		$83,880	$117,096	$200,976	$3,759,983	$4.883	$2.318
2017	633	140	$943,782	$2,219,897	$402,507	$75,988	$10,956	$3,653,129	$5.769		$83,880	$122,588	$206,468	$3,859,597	$4.994	$2.279
2018	636	140	$943,782	$2,297,246	$422,807	$79,028	$11,394	$3,754,256	$5.906	$1,709,076	$208,043	$127,421	$335,464	$4,089,719	$5.272	$2.313
2019	638	141	$943,782	$2,373,546	$442,631	$82,189	$11,850	$3,853,998	$6.039		$208,043	$133,391	$341,434	$4,195,432	$5.388	$2.273
2020	641	141	$943,782	$2,456,160	$464,879	$85,476	$12,324	$3,962,621	$6.185		$208,043	$138,650	$346,693	$4,309,314	$5.513	$2.237
2021	641	141	$943,782	$2,529,845	$483,474	$88,895	$12,817	$4,058,812	$6.335		$208,043	$144,196	$352,239	$4,411,052	$5.643	$2.202
2022	641	141	$943,782	$2,605,740	$502,813	$92,451	$13,329	$4,158,115	$6.490		$208,043	$149,964	$358,007	$4,516,122	$5.778	$2.167
2023	641	141	$943,782	$2,683,912	$522,926	$96,149	$13,862	$4,260,631	$6.650		$208,043	$155,963	$364,006	$4,624,637	$5.917	$2.134
2024	641	141	$943,782	$2,764,429	$543,843	$99,995	$14,417	$4,366,466	$6.816		$208,043	$162,201	$370,244	$4,736,710	$6.060	$2.102
2025	641	141	$943,782	$2,847,362	$565,596	$103,995	$14,994	$4,475,729	$6.986		$208,043	$168,689	$376,732	$4,852,461	$6.208	$2.070
2026	641	141	$943,782	$2,932,783	$588,220	$108,155	$15,593	$4,588,533	$7.162		$208,043	$175,437	$383,480	$4,972,013	$6.361	$2.040
2027	641	141	$943,782	$3,020,767	$611,749	$112,481	$16,217	$4,704,996	$7.344		$208,043	$182,454	$390,497	$5,095,493	$6.519	$2.010
2028	641	141	$943,782	$3,111,390	$636,219	$116,980	$16,866	$4,825,236	$7.532	$2,529,850	$391,834	$189,752	$581,586	$5,406,823	$6.917	$2.051
Totals	18,101	3,986	$28,313,460	$60,098,738	$10,473,879	$2,103,740	$303,307	$101,293,124		$5,393,517	$3,311,064	$3,288,640	$6,599,704	$107,892,829		
Averages	603	133	$943,782	$2,003,291	$349,129	$70,125	$10,110	$3,376,437	$5.537	$179,784	$110,369	$109,621	$219,990	$3,596,428	$4.826	$2.502

* Allowing for 5% loss in transmission & distribution system

Table E-7
Life Cycle Costs for Groundwater Only

	Annual Supply	Capital			Cost of Supply from Groundwater				
Year	Ground-water (MG)	Capital Expenditure	Capital Cost	Capital Cost after Inflation	Debt Service	O&M Cost	Total Cost	Unit Cost per 1000 Gallons	Present Worth of Unit Cost
1996									
1997									
1998									
1999	595				$0	$257,575	$257,575	$0.43	$0.40
2000	657	Wortham Wells & 2 New Wells	$3,500,000	$3,937,000	$286,019	$295,817	$581,836	$0.89	$0.79
2001	659	New Well	$750,000	$877,000	$349,732	$308,333	$658,065	$1.00	$0.85
2002	660	New Well & Replacement Well	$1,500,000	$1,825,000	$482,316	$321,377	$803,693	$1.22	$1.00
2003	662	New Well	$750,000	$949,000	$551,260	$334,972	$886,232	$1.34	$1.06
2004	663	Replacement Well	$750,000	$987,000	$622,964	$349,140	$972,104	$1.47	$1.11
2005	665	New Well	$750,000	$1,026,000	$697,502	$363,905	$1,061,407	$1.60	$1.17
2006	682	Replacement Well	$750,000	$1,067,000	$775,018	$388,443	$1,163,461	$1.71	$1.20
2007	700				$775,018	$414,361	$1,189,379	$1.70	$1.15
2008	717	New Well & Replacement Well	$1,500,000	$2,309,000	$942,764	$441,732	$1,384,496	$1.93	$1.25
2009	735				$942,764	$470,629	$1,413,393	$1.92	$1.20
2010	752	New Well & Replacement Well	$1,500,000	$2,498,000	$1,124,241	$501,131	$1,625,372	$2.16	$1.30
2011	755				$1,124,241	$523,200	$1,647,441	$2.18	$1.26
2012	758	Replacement Well	$750,000	$1,351,000	$1,222,390	$546,233	$1,768,623	$2.33	$1.29
2013	761				$1,222,390	$570,271	$1,792,661	$2.36	$1.26
2014	764	Replacement Well	$750,000	$1,461,000	$1,328,530	$595,359	$1,923,889	$2.52	$1.29
2015	767				$1,328,530	$621,541	$1,950,071	$2.54	$1.25
2016	770	Replacement Well	$750,000	$1,580,000	$1,443,315	$648,865	$2,092,180	$2.72	$1.29
2017	773				$1,443,315	$677,380	$2,120,695	$2.74	$1.25
2018	776	Replacement Well	$750,000	$1,709,000	$1,567,472	$707,139	$2,274,611	$2.93	$1.29
2019	779	New Well	$750,000	$1,777,000	$1,696,569	$738,195	$2,434,764	$3.13	$1.32
2020	782	Replacement Well	$750,000	$1,849,000	$1,830,897	$770,603	$2,601,500	$3.33	$1.35
2021	782				$1,830,897	$801,427	$2,632,324	$3.37	$1.31
2022	782	Replacement Well	$750,000	$1,999,000	$1,976,122	$833,484	$2,809,606	$3.60	$1.35
2023	782				$1,976,122	$866,824	$2,842,946	$3.64	$1.31
2024	782	Replacement Well	$750,000	$2,163,000	$2,133,262	$901,497	$3,034,759	$3.88	$1.35
2025	782				$2,133,262	$937,557	$3,070,819	$3.93	$1.31
2026	782	Replacement Well	$750,000	$2,339,000	$2,303,188	$975,059	$3,278,247	$4.19	$1.34
2027	782				$2,303,188	$1,014,061	$3,317,249	$4.24	$1.31
2028	782	Replacement Well	$750,000	$2,530,000	$2,486,990	$1,054,624	$3,541,614	$4.53	$1.34
Totals	22,087		$19,250,000	$34,233,000	$38,900,278	$18,230,734	$57,131,012		
Averages	**736**		**$641,667**	**$1,141,100**	**$1,296,676**	**$607,691**	**$1,904,367**	**$2.52**	**$1.20**

APPENDIX F
DRAFT REPORT COMMENTS FROM EXECUTIVE ADMINISTRATOR OF TEXAS WATER DEVELOPMENT BOARD

To: Bill Smith
817-465-0976
From: Curtis Johnson

TEXAS WATER DE[VELOPMENT] BOARD

September 9, 1997

Mr. Bill R. Smith
Manager, Development
Northern Region
Trinity River Authority of Texas
P. O. Box 240
Arlington, Texas 76004-0240

Re: Review Comments for Draft Report Submitted by Trinity River Authority of Texas, TWDB Contract No. 96-483-153

Dear Mr. Smith: Bill

Texas Water Development Board staff have completed a review of the draft final report submitted under TWDB Contract No. 96-483-153. As stated in the above referenced contract, the Authority will consider incorporating comments on the draft final report from the TWDB, shown in Attachment 1, and other commentors into a final report. The Authority must include a copy of the TWDB's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. Curtis Johnson, the Board's Contract Manager, at (512) 463-8060, if you have any questions about the Board's comments.

Sincerely,

Tommy

Tommy Knowles
Deputy Executive Administrator
for Planning
Enclosure

cc: Curtis Johnson

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ATTACHMENT 1

TEXAS WATER DEVELOPMENT BOARD
REVIEW COMMENTS FOR TRINITY RIVER AUTHORITY OF TEXAS REGIONAL WATER SUPPLY PLANNING CONTRACT
CONTRACT NO. 96-483-153

1. In Chapter 5, there needs to be a definition of several terms that individuals who are not water professionals probably are not familiar with —— firm capacity —— peak day requirement (or capacity) and any others.

2. There should be a better explanation of why there is so little said about using ground water for a supply as compared to almost the entire report looking at various alternatives for using surface water. Please explain better.

The following text was added in Section 5 in response to TWDB Comment Number 1.

"Several terms used in the following sections may need defining.

- The **average-day** water use is defined as the total year's water used divided by the number of days in the year.

- The **peak-day** water use is the amount of water used during the highest use day of the year. This generally occurs during the summer. According to state standards, any water system must have a water source with the capacity to provide a system's peak-day water need.

- The **firm capacity** of a water system is the highest rate at which that system can pump water to the customers with the largest pump or well out of service. The TNRCC requires that a water system have firm pumping capacity equal to the largest historical peak-day demand or 0.6 gallons per minute per connections, whichever is greater."

The following text was added in the Executive Summary and Section 5 in response to TWDB Comment Number 2.

"This study is a *regional* water planning study, and the main emphasis is placed on water sources that could supply a regional system. Groundwater is not a likely supply source for a regional water system. If groundwater is to remain the source for the participants, each participant should continue to use local groundwater supplies. It would not be necessary or economical to build long distance pipelines connecting the participants when each one has their own source relatively nearby. Therefore, groundwater was given some attention in this study but was not investigated in depth."