REGIONAL WATER SUPPLY STUDY

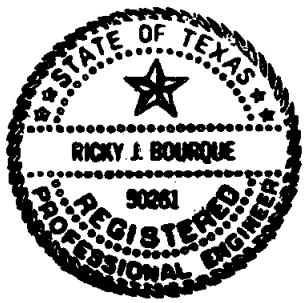
FOR

LOWER NECHES VALLEY AUTHORITY

Prepared by:

Schaumburg & Polk, Inc.
Consulting Engineeers
8865 College Street
Beaumont, Texas 77707

April 1996



Ricky J Bourque
4/23/96

Schaumburg & Polk, Inc.
CONSULTING ENGINEERS

8865 College St., Suite 100
Beaumont, Texas 77707
Phone: (409) 866-0341
FAX: (409) 866-0337

April 23, 1996

Mr. Tommy Hebert
Lower Neches Valley Authority
PO Box 3464
Beaumont, Texas 77704

Re: Regional Water Supply Study
LNVA Regional Planning Contract No. 94-483-036

Dear Mr. Hebert,

Enclosed is the final report of the "Regional Water Supply Study" and "Water Conservation Plan". These documents include revisions which resulted from the public meeting held on April 18, 1996. We are forwarding twelve copies of the report to the Texas Water Development Board and one copy to each of the participating entities.

We appreciate the opportunity to be of service on this project.

Sincerely,

Gary G. Graham, P.E.
Vice President

Ricky J. Bourque, P.E.
Project Manager

cc: Mr. Dennis Crowley, P.E./Texas Water Development Board

TABLE OF CONTENTS

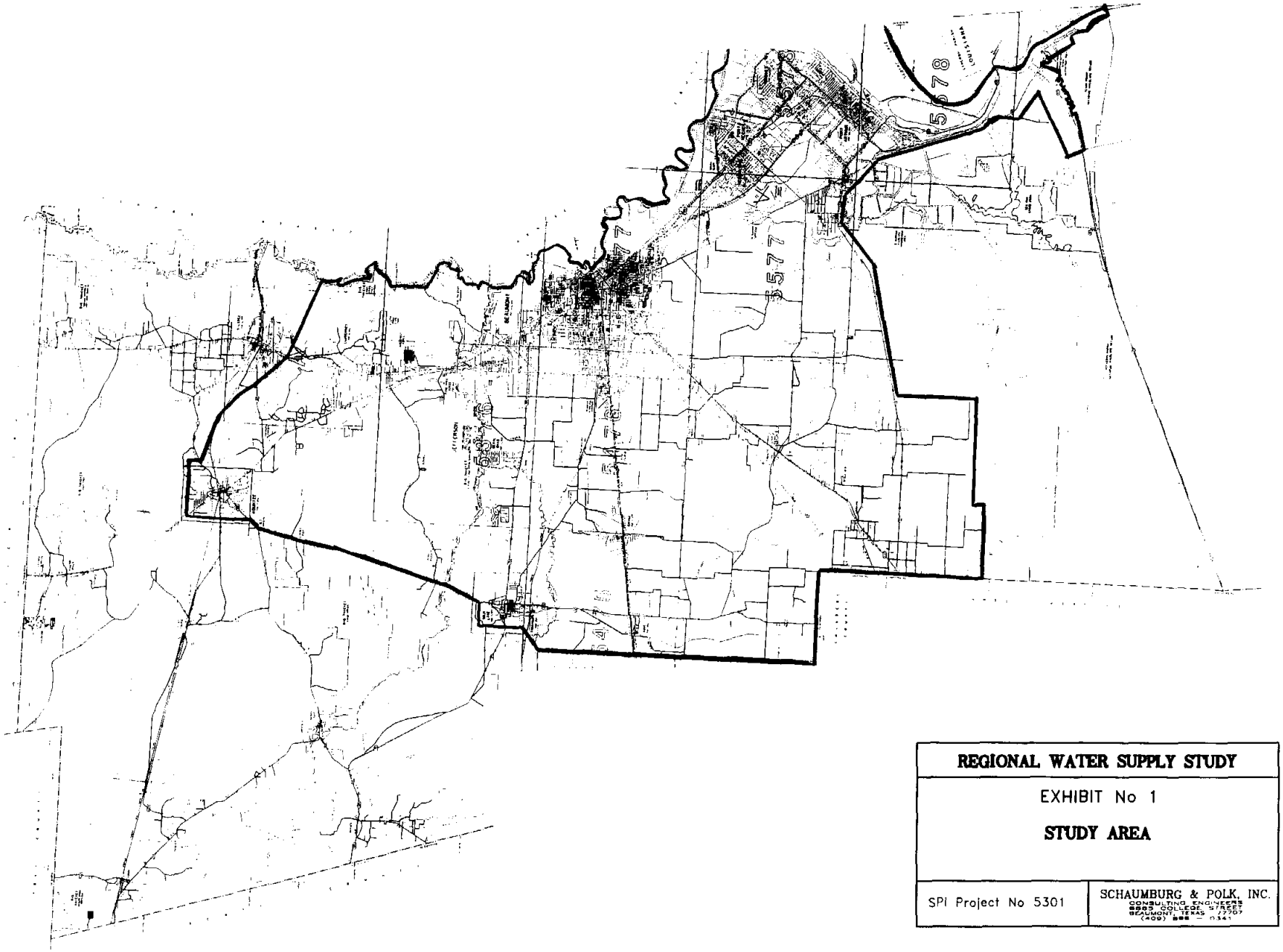
INTRODUCTION

The purpose of this study was to inventory the condition of the surface and ground water supply systems for each participating entity, evaluate the future demands for water, and evaluate alternatives for providing surface water supplies to thos areas not presently served by surface water. The area included in this study includes all of Jefferson County (excluding the sparsely inhabitated southern third) and the southeastern portion of Hardin County. The boundary of the study area is shown in Exhibit 1. The study evaluated water supply demands for the present and 25 and 50 years in the future

This study was provided in cooperation with the Lower Neches Valley Authority and the following municipalities and water districts:

Municipalities	Water District
Beaumont	Lumberton MUD
China	Bevil Oaks MUD
Groves	West Jefferson County MWD
Kountze	
Nederland	
Port Neches	
Port Arthur	
Sour Lake	

Other water supply entities which are in the study area but were did not participate in the study are Pinewood (Hardin County WCID No. 1), Meeker WSC and Jefferson County WCID No. 10



REGIONAL WATER SUPPLY STUDY	
EXHIBIT No 1 **STUDY AREA**	
SPI Project No 5301	SCHAUMBURG & POLK, INC. CONSULTING ENGINEERS 8905 COLLEGE STREET BEAUMONT, TEXAS 77707 (409) 866 — 0341

EXECUTIVE SUMMARY

A summary of the most cost effective plan to provide surface water supply to serve the future needs of the study area is provided in this section. Discussion of all alternatives considered is provided in later sections of this report. It should be understood that the selected plan includes an assumption that ground water supplies will not be available beyond the 50 year design period. An evaluation of the validity of this assumption is beyond the scope of this study and can only be substantiated by a detailed study of the ground water aquifers servicing the study area.

Selected Plan

The plan developed for providing surface water to the entities located within the study area requires the construction of three surface water treatment plants with associated transmission facilities. The phasing of these improvements would depend on both meeting growth demands and the availability of ground water. The general locations of the water plants are shown on Exhibit 2. The following provides a description of each plant including its proposed service area, transmission facilities required, and phasing of the improvements based on certain assumptions.

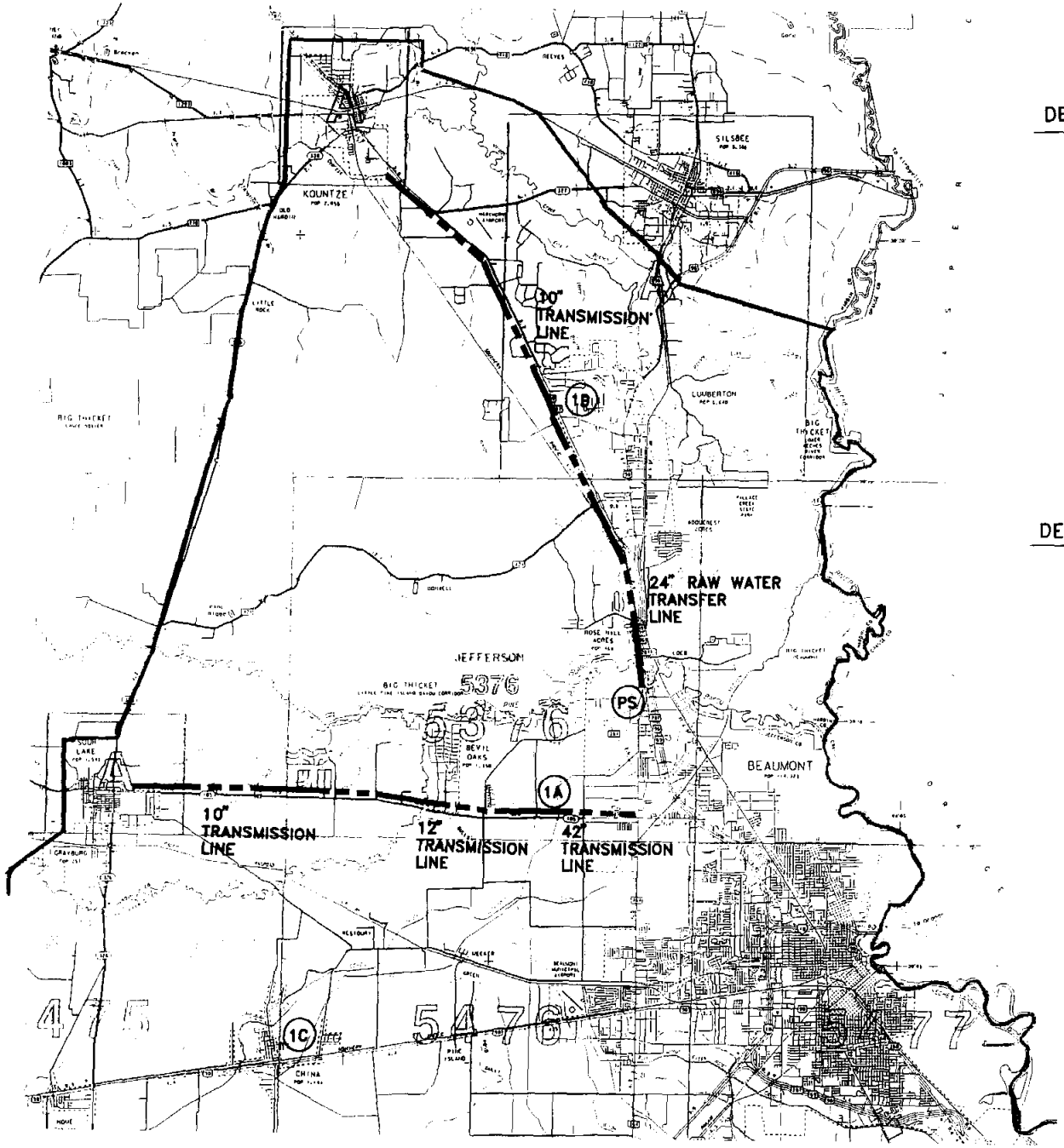
Regional Plant No. 1

A water treatment plant site would be located in the area near the intersection of State Highway 105 and the LNVA canal just outside of the Beaumont City limits. This plant would serve Beaumont (west end), Bevil Oaks MUD and Sour Lake. These communities are currently served by ground water supplies. Based on a review of future water demands and assuming that groundwater supplies are adequate until the year 2045, this plant would not require construction until the year 2025. If groundwater supplies remain adequate, this plant would not require construction. It is possible that groundwater supplies for Bevil Oaks MUD and Sour Lake may deteriorate prior to the wells which supply Beaumont. If this does occur these communities would need to evaluate the cost of new wells versus the cost of supplying surface water.

Transmission facilities to the three entities would require the construction of pump stations at the proposed plant and associated transmission lines. The required pumping capacity would be 21.76 mgd for Beaumont, 0.60 mgd for Bevil Oaks MUD and 0.77 mgd for Sour Lake. A 42-inch transmission line would be constructed to Beaumont and could be connected into the existing 30-inch water line located on the west side of Beaumont. Transmission lines to Bevil Oaks and Sour Lake would be 12-inches to Bevil Oaks MUD with a 10-inch line extending to Sour Lake.

Regional Plant No. 2

This plant would be constructed to serve the communities of Lumberton and Kountze. These communities are currently served by ground water. We would anticipate these entities to continue to utilize ground water supplies for as long as possible. For the purpose of this study, we have assumed that conversion from ground water to surface water will be required for the year 2045. The plan developed by this study includes the construction of a treatment plant in the area of West Chance Cutoff and Highway 69. A raw water pump station would be constructed near the existing



DESCRIPTION OF PROPOSED TREATMENT PLANTS

(1A) **REGIONAL PLANT NO. 1**

23.13 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE BEAUMONT, BEVIL OAKS, AND SOUR LAKE.

(1B) **REGIONAL PLANT NO. 2**

9.42 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE KOUNTZE AND LUMBERTON.

(1C) **REGIONAL PLANT NO. 3**

0.51 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE CHINA.

DESCRIPTION OF PROPOSED PUMPING FACILITIES

(PS) 9.42 MILLION GALLON PER DAY RAW WATER PUMPING FACILITY TO SERVICE KOUNTZE AND LUMBERTON

REGIONAL WATER SUPPLY STUDY

EXHIBIT No 2

SELECTED PLAN

SPI Project No 5301

SCHAUMBURG & POLK, INC.
CONSULTING ENGINEERS
8888 COLLEGE
BEAUMONT, TEXAS 77707
(409) 898-

LNVA canal pump station located at Highway 69,96, 287 and carried by a 24-inch line. After treatment at the new plant, treated water would be transmitted to Kountze by a 10-inch waterline.

Regional Plant No. 3

China will need to consider conversion from ground water to surface water within the 25 year design period. Because of an existing freshwater canal which runs through China, construction of a single plant to serve China is the most effective cost measure for this community.

The above plan was selected as it was shown to be the most cost-effective and groups together those cities which have common problems. The cost for implementation of such a plan is presented below.

Costs

The 1995 capital and operation and maintenance costs for the selected plan is provided in Table 1. The amortized captial costs is based on repayment at 8% interest for a 20 year period. Operation costs is based on $0.60 per thousand gallon of treated water, except for China where cost were increased due to small size of the plant. This table also projects the estimated monthly water rate required per connection and cost per thousand gallons produced for an average month to pay for debt service and operation and maintenance for the facilities. The actual rate increase would be unique to each entity depending upon current debt service and existing operation and maintenance cost which would eliminated by the proposed construction.

The above selected plan involves cooperation between entities with the exception of China. It would be anticipated that the treatment operations would be constructed and operated under the directions of the Lower Neches Valley Authority or a newly created regional water district. The transmission and distribution of the water would be the responsibility of the entity which receives the water.

TABLE 1
1995 CAPITAL COSTS
SELECTED PLAN

ENTITY	CONNECTIONS	TOTAL COSTS (Present Value)	ANNUAL AMORTIZED COSTS	ANNUAL O & M COSTS (Present Value)	TOTAL ANNUAL COSTS	MONTHLY COSTS PER CONNECTION	MONTHLY COSTS PER 1000 GALLON
BEAUMONT	48500	$35,399,875	$3,605,555	$2,326,014	$5,931,570	$10	$0.65
BEVIL OAKS MUD	570	$1,213,940	$123,642	$37,828	$161,470	$24	$2.60
CHINA	514	$1,589,578	$161,902	$90,598	$252,500	$41	$3.78
KOUNTZE	1099	$3,877,455	$394,927	$97,499	$492,426	$37	$3.07
LMUD	7404	$18,441,055	$1,878,262	$595,680	$2,473,942	$28	$2.53
SOUR LAKE	869	$2,062,755	$210,096	$63,072	$273,168	$26	$2.63

EXISTING TREATMENT AND DISTRIBUTION SYSTEMS

An inventory of water supply and distribution systems for participating entities located in the study area was made. A copy of the inventory questionnaire sent to each of the participant is enclosed in Appendix A. This section provides a summary of both surface water supply, ground water supply, and distribution system inventories.

Surface Water Supply

The LNVA maintains and operates a series of pump stations and canals to provide surface water supplies to Jefferson County. The existing LNVA distribution network has two main canals which feed all other supply canals. One main canal takes water from the Neches River in the Big Thicket area and the other main canal takes water from Pine Island Bayou near U.S. Highway 69. The design capacity of the LNVA pump stations is 420,000 gallons per minute. These structures are approximately 30 years old.

The LNVA service area lies generally to the south of the above stated withdrawal points. Most of Jefferson County is adequately served by the present LNVA system. However, areas in Hardin County, which are north of the current LNVA service area, are not presently served by the LNVA. The water is utilized for agricultural, municipal and industrial uses.

The survey forms which were sent to each municipal, agricultural and industrial user solicited input on any problems or inadequacies which are being experienced with the distribution system. With the exception of some comments regarding vegetation growth and some debris in the canals by various agricultural users, the distribution system appears to be in good shape. There was one farmer who remarked that service to one of his fields was not adequate. However, this accounted for less than 1000 acres of the total service area. An official from one entity commented on the turbidity level in the raw water which is taken from Pine Island Bayou. He suggested an advance notification system be implemented which would advise end users prior to using Pine Island Bayou water. This would allow the treatment plants the opportunity to prepare for adjustment in chemical dosages in advance of receiving Pine Island Bayou water.

The cities currently served by surface water and their corresponding surface water treatment capabilities are given in Table 2.

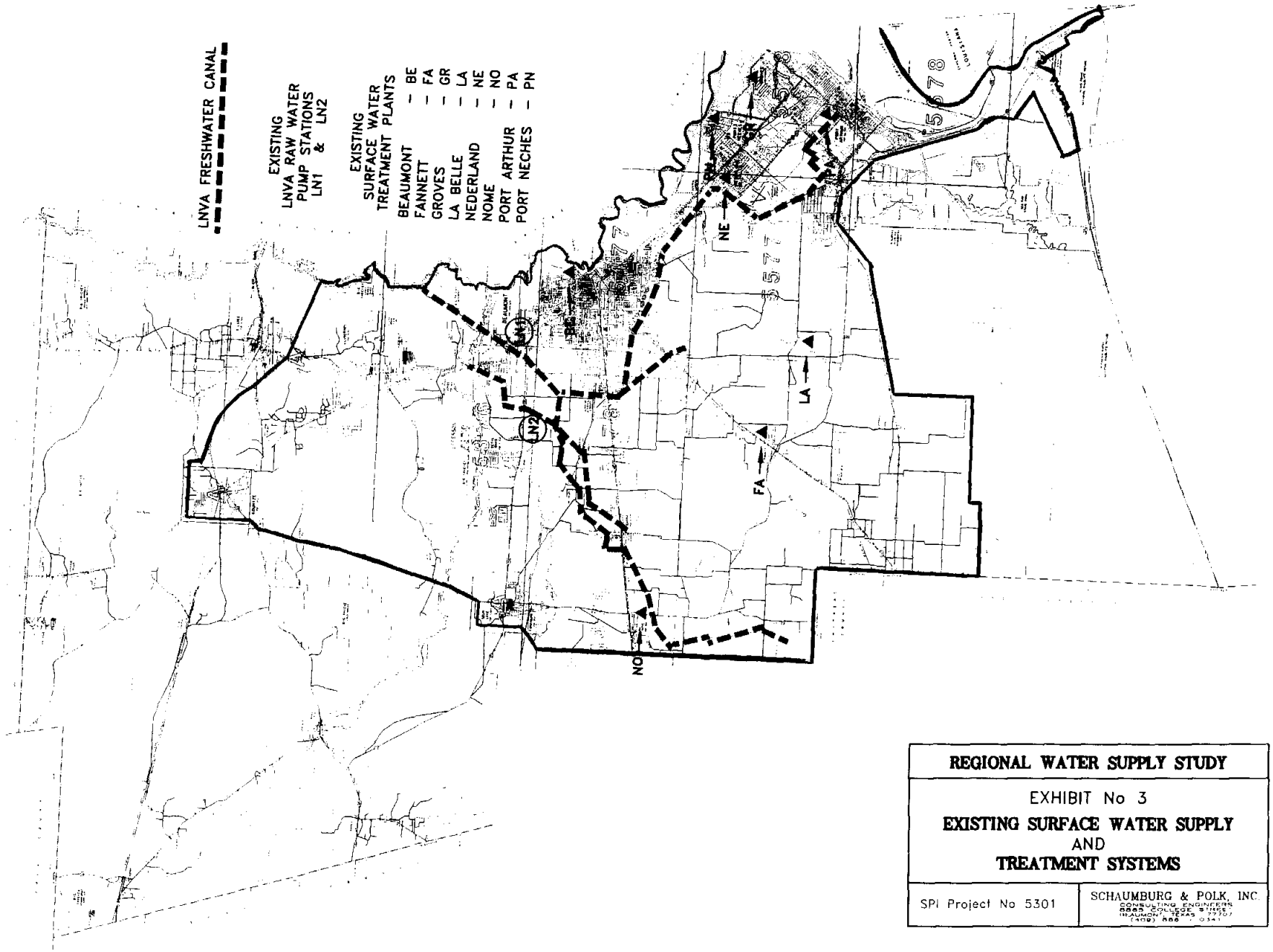
Exhibit 3 provides an overview of the LNVA system and surface water treatment plants in the study area.

Ground Water Supplies

The LNVA does not currently provide services related to ground water supply. However, several municipalities in the study area utilize ground water. The ability of the ground water aquifers to provide both the required quantity and quality of water will be crucial in the planning for future

TABLE 2
EXISTING INDIVIDUAL SURFACE WATER TREATMENT SYSTEMS

ENTITY	CAPACITY (mgd)	DATE OF CONSTRUCTION	UPGRADE	QUALITY
BEAUMONT	30.00	1948	1982	Good
GROVES	5.50			
PLANT 1	2.50	1962	1995	Good
PLANT 2	3.00	1982		Good
NEDERLAND	6.00	1995		Good
NOME	0.25	1975	1983	Good
PORT ARTHUR	26.00	1997		Good
PORT NECHES	4.00	1962	1994	Good
W. JEFFERSON CO. MWD	1.05			
LABELLE PLANT	0.60	1979	1994	Good
FANNETT PLANT	0.45	1969	1985	Good



REGIONAL WATER SUPPLY STUDY	
EXHIBIT No 3 **EXISTING SURFACE WATER SUPPLY** AND **TREATMENT SYSTEMS**	
SPI Project No 5301	SCHAUMBURG & POLK, INC. CONSULTING ENGINEERS 8885 COLLEGE STREET BEAUMONT, TEXAS 77707 (409) 866 - 0141

water surface supply needs. A number of ground water supply studies have been performed and were reviewed. A list of these studies are referenced in Appendix B. These studies were utilized to better understand existing ground water supplies and to evaluate the future ground water usage.

Existing Ground Water Supplies

The ground water utilized in the service area is taken from both the Chicot and Evangeline Aquifers (also collectively known as the Gulf Coast Aquifer). Appendix C provides a review of the classification of the aquifers in the study area which have been developed. Previous studies have evaluated the quality of ground water in these aquifers. These studies typically utilize total dissolved solids and chlorides as the two constituents controlling the acceptability of groundwater. TNRCC guidelines have established the maximum limits for total dissolved solids and chlorides to be 1000 mg/l and 300 mg/l, respectively. A 1989 study compiled by the Ground Water Protection Unit Staff of the Texas Water Commission delineated the concentrations of these constituents. A 1973 study by J.B. Wesselman and a 1979 study by E.T. Baker Jr. both indicated high levels of total dissolved solids in the ground water to a point near the Jefferson/Hardin County line. Results from these studies generally indicate that these aquifers do not provide drinking quality water for wells located in Jefferson County. Results from these studies, in exhibit form, are included in Appendix D.

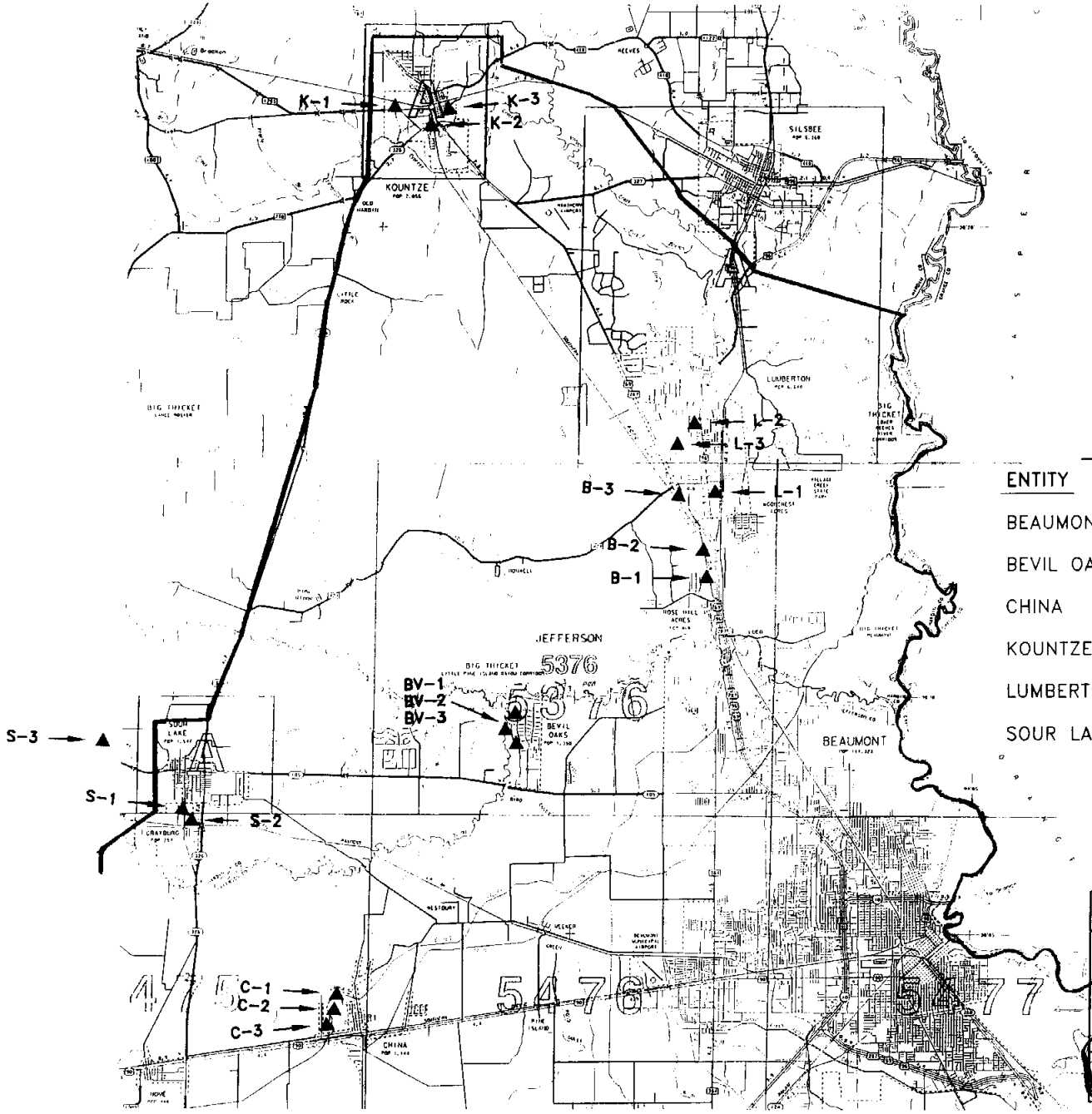
Another constituent which was not noted in a 1989 ground water study is radioactivity. The above referenced 1989 report provided a review of potential areas of radioactive ground water in Texas. Appendix D contains an exhibit from this report showing the location of these potential areas.

The survey of participating entities seemed to confirm the information contained in these studies. Table 3 is a summary of water wells in use by the participating entities and describes noted problems. Exhibit 4 provides an overview of public water supply well locations.

TABLE 3
EXISTING GROUND WATER SYSTEMS

ENTITY	CAPACITY (mgd)	WELL #1		WELL #2		WELL #3		QUALITY
		YEAR BUILT	DEPTH (ft)	YEAR BUILT	DEPTH (ft)	YEAR BUILT	DEPTH (ft)	
BEAUMONT	13.50	1956	802	1962	798	1979	780	Good
BEVIL OAKS MUD	0.58	1975	550	1963	450	1991	572	Good
CHINA	0.46	1950	210	1962	210	1962	210	Poor - Problems with high Chlorides and Total Dissolved Solids.
KOUNTZE	1.44	1951*	484	1958	496	1994	702	Poor - Well #1 has radiation problems and Well #3 is to be upgraded due to sand.
LMUD	4.80	1977	448	1977	463	1983	796	Good
SOUR LAKE	1.12	1964	246	1950*	224	1995	950	Poor - salt water and high Chlorides in Well #2.

*Well to be abandoned.



EXISTING WELLS

ENTITY	WELL NUMBERS
BEAUMONT	B-1, B-2, B-3
BEVIL OAKS MUD	BV-1, BV-2, BV-3
CHINA	C-1, C-2, C-3
KOUNTZE	K-1, K-2, K-3
LUMBERTON MUD	L-1, L-2, L-3
SOUR LAKE	S-1, S-2, S-3

REGIONAL WATER SUPPLY STUDY

EXHIBIT No 4

EXISTING PUBLIC WATER SUPPLY WELLS

SPI Project No 5301

SCHAUMBURG & POLK, INC.
CONSULTING ENGINEERS
8505 COLLEGE STREET
BEAUMONT, TEXAS 77707
(409) 866 - 0341

PROJECTED WATER SUPPLY AND SYSTEM CAPACITIES

A projection of both the supply of raw water and the capacity to treat and distribute potable water is needed to evaluate future improvements. Raw water supply is based on a total annual usage of water. Treatment and distribution system capacities are based on guidelines developed by the TNRCC to meet peak hour demands.

Raw Water Supply

A review was made of records for governmental water supply agencies, agricultural businesses and industry to arrive at raw water supply (both surface and groundwater) used during 1994. Projection for each of these three types of users are unique. Projections for governmental water supply agencies can be analyzed by arriving at a gallon per capita per day usage rate and correlating the data to future population projections. Projections for agricultural and industrial use are based on business conditions and the potential for future growth in the study area.

Governmental water supply agencies include municipalities and utility districts which provide treated water to the general public. These agencies also provide water for both commercial and industrial uses. A summary of the data used in developing the projections are included on Table 4. Projections were derived by first defining the current gallon per capita per day usage for residential uses, commercial uses and industrial uses. Current data would indicate that the per capita usage for residential occupation and commercial services are higher in the larger cities as compared to the smaller communities. Therefore, future projections need to account for the type of development which may occur in a community as well as accounting for increase in annual usage due to drought conditions. A summary of the type of development expected to occur in certain communities is noted on Table 4 as justification for future per capita usages. Industrial use of water supplied by the governmental agencies was assumed to increase in proportion to population projections. The current per capita usage includes an increase to account for usage during below normal rainfall conditions. An accounting of the decrease in water usage due to water conservation measures was made in the per capita usage for future projections. The TWDB has estimated the gallon per capita per day savings which will be realized by the installation of water conservation plumbing fixtures. The savings by each type of fixture are as follows:

Fixture	Gallon per Capita per Day Reduction
Toilets	14.5 gpcd
Urinals	0.3 gpcd
Showers	4.0 gpcd
Faucets	2.0 gpcd
TOTAL	21.7 gpcd

These figures include not only a comparison of water conserving fixture to older fixtures but also variables such as the number of flushes per day (assumed to be 5), time required for showers and no change in the quantity of water used for such activities as cooking and clothes washing. The TWDB also anticipates complete replacement of all old fixtures with post 1990 fixtures which must meet federal water conservation standards. The projection for future municipal water supply was based

on reducing the current gallon per capita per day usage by 10 in the year 2020 and by 21 in the year 2045. Commercial and industrial gallon per capita per day usage rates were left unchanged since these quantities would most likely include more absolute volume requirements which would not be as greatly impacted by the use of water conserving fixtures.

Agricultural usage projections were also based on the 1996 Consensus Water Plan assuming that there will be no change in water efficient irrigation technology and no reductions in the Federal Farm Program. The agricultural base used for the projections was the agricultural consumption usage observed in 1994 as reported by LNVA records. These records do not account for agricultural usage in the study area within Hardin County. The one exception taken to the 1996 Consensus Water Plan is the projection from the year 1990 to 2000. While the Consensus Water Plan shows a reduction of 34% from the year 1990 to 2000 actual records indicate that agricultural is on a slight rise from 1990, after a low in the usage which occurred in 1987. This trend is most likely attributable to the introduction of crayfish farming. Therefore, this report holds the current usage constant until the year 2000 and follows the 1996 Consensus Water Plan after that date.

The projected industrial demands were determined by using the present day usage obtained from the completed survey forms and the LNVA records and making future projections in proportion to the growth of the area population. Industry consumption is not dependent on weather conditions and therefore the average annual consumption was not adjusted for weather conditions. Projected industrial demands are shown on Table 6.

It is recommended that each entity participating in this study continue to track water usage trends. For municipal water systems, continuing to monitor per capita or per connection usage will be useful in evaluating whether the water conservation assumptions used in this report are valid. Consideration should also be given to water meter replacement programs where unaccounted water percentages remain high. Agricultural usage has consistently comprised 50% to 60% of the LNVA raw surface water usage. Trends which develop in this sector of the local economy will greatly impact the need for water and the reasons for changes in trends (farm program payments, irrigation technology, crop types, weather) should be analyzed. The trends in the municipal, agricultural and industrial sectors should continued to be compared and coordinated with TWDB projections. The information obtained from this effort will be critical in planning for future water resources for the study area.

Water Treatment and Distribution Capacities

The design flow rates used in evaluating the capacities of each municipal system were determined using the Texas Natural Resource Conservation Commission (TNRCC) criteria. Population projection information was obtained from the Texas Water Development Board, in accordance with the requirements of this study. Using TAC 31 Chapter 290 of the TNRCC design criteria and population and service connection information provided by each entity, a figure of three (3) persons per connection was used to estimate the number of service connections for each entity. From the same guidelines, TAC 31 Chapter 290 of the TNRCC's criteria, a flow rate of 0.6 gallons per minute per connection was used to estimate the residential demand. Commercial and industrial usages were

also estimated using information obtained from each entity. The residential, commercial and industrial demands were used in determining the present and future design flow rates for each entity.

The design period selected for this study is 25 years and 50 years. These correspond to design years 2020 and 2045. However, any improvements to a system should take place at least 20 years prior to the design year in order to allow for a sufficient system life. An analysis of the supply capacities of each entity was made for the purpose of identifying those entities likely to have a need for a new or alternative water supply in the future. Most of the entities included in this study and which currently use surface water for their water needs have adequate treatment capacities through the year 2020. Many do not, however, have the capacity in their existing system to meet the demands of the design year 2045.

The municipal facility projections shown on Table 7 are based on peak day demands. These projections were made for the purpose of evaluating required treatment plant capacity.

TABLE 4
MUNICIPAL RAW WATER SUPPLY PROJECTION

Existing per capita usage

Entity	Population Projection			Usage				Current Per Capita Usage(1)		
	1995	2020	2045	Raw Water (mgd)	Residential (mgd)	Commercial (mgd)	Industrial (mgd)	Residential (gpcd)	Commercial (gpcd)	Industrial (gpcd)
BEAUMONT	117,952	137902	161225	18.98	12.13	6.21	0.64	114	56	5
BEVIL OAKS MUD	1404	1710	2082	0.12	0.12	0	0	94	0	0
CHINA	1190	1452	1771	0.13	0.13	0	0	135	0	0
GROVES	16950	19314	22007	1.62	1.62	0	0	103	0	0
PT NECHES	13285	14953	16831	1.71	1.54	0.17	0	126	13	0
NEDERLAND	16401	17489	18649	2.62	2.34	0.28	0	161	18	0
W JEFF CO MWD	7094	7584	8107	0.65	0.54	0.11	0	84	16	0
NOME	742	793	848	0.1	0.1	0	0	167	0	0
PT ARTHUR	60110	64548	75905	11.78	8.03	2.68	1.07	156	49	18
LMUD	11967	21971	28343	1.16	1.06	0.1	0	111	9	0
KOUNTZE	2439	3580	4391	0.26	0.26	0	0	127	0	0
SOUR LAKE	1691	2179	2673	0.19	0.19	0	0	140	0	0

Projected Water Usage Based on Installation of 100% Water Conserving Fixtures Resulting in 21 GPCD Usage

Entity	2020 Future Per Capita Usage			2045 Future Per Capita Usage			Future Water Usage		Note
	Residential (gpcd)	Commercial (gpcd)	Industrial (gpcd)	Residential (gpcd)	Commercial (gpcd)	Industrial (gpcd)	2020 (mgd)	2045 (mgd)	
BEAUMONT	104	58	5	93	58	5	23.03	25.15	(2)
BEVIL OAKS MUD	84	0	0	73	0	0	0.14	0.15	
CHINA	125	0	0	114	0	0	0.18	0.20	
GROVES	93	0	0	82	0	0	1.80	1.80	
PT NECHES	116	13	0	105	13	0	1.93	1.99	
NEDERLAND	151	18	0	141	18	0	2.96	2.97	
W JEFF CO MWD	74	16	0	63	16	0	0.68	0.64	
NOME	155	0	0	156	0	0	0.12	0.13	
PT ARTHUR	146	49	18	135	49	18	13.75	15.33	
LMUD	101	16	0	90	16	0	2.57	3.00	(3)
KOUNTZE	117	0	0	106	0	0	0.42	0.47	
SOUR LAKE	130	0	0	119	0	0	0.28	0.32	

NOTES

(1) Current per Capita Usage based on 1994/95 usage with an increase for below normal rainfall (drought) conditions for the year 2000 as developed by the Texas Water Development Board for the 1996 Water Conservation Plan.

(2) Increase of 3% included to account for recent commericial and hospital growth.

(3) Potential exists to expand commercial consumption to same level as Groves, Nederland, and Port Neches

TABLE 5
AGRICULTURAL USAGE PROJECTIONS

County	1994	PROJECTED ANNUAL USAGE 2020	2045
Jefferson	226,425 ac - ft	188,192 ac - ft	176,845 ac - ft

TABLE 6
INDUSTRIAL USAGE PROJECTIONS (1)

INDUSTRY	1994	PROJECTED ANNUAL USAGE 2020	2045
Air Liquid America	85 mgal	101 mgal	117 mgal
Mobil Oil (Chemical) PE Plant	356 mgal	423 mgal	489 mgal
Sandoz Agro, Inc.	300 mgal	356 mgal	412 mgal
Olin Corporation	180 mgal	214 mgal	247 mgal
Huntsman Corporation	5,960 mgal	7,080 mgal	8,185 mgal
Sun Marine Terminals, Inc	0	mgal	mgal
Star Enterprises	6,137 mgal	7,291 mgal	8,428 mgal
Winnie Pipeline Co. (Centana)	1,577 mgal	1,873 mgal	2,165 mgal
J.T.Thorp Company	1 mgal	2 mgal	2 mgal
Fina Oil & Chemical Co.	1,604 mgal	1,906 mgal	2,203 mgal
Chevron Pipe Line (Clark)	6 mgal	8 mgal	9 mgal
Goodyear Tire & Rubber Co.	1,100 mgal	1,307 mgal	1,511 mgal
Al Cook Nursery	5 mgal	6 mgal	6 mgal
Gulf Coast Marine & Supply	1 mgal	1 mgal	1 mgal
E.I.Dupont de Nemours & Co.	4,653 mgal	5,527 mgal	6,390 mgal
Jones Boys, Inc.	2 mgal	2 mgal	3 mgal
Mobil Chemical - O/A PLant	2,593 mgal	3,080 mgal	3,561 mgal
PD Glycol	789 mgal	937 mgal	1,084 mgal
Mobil Oil Corporation	6,656 mgal	7,907 mgal	9,141 mgal
Chevron (Clark)	6,192 mgal	7,356 mgal	8,504 mgal
Quantum	471 mgal	560 mgal	647 mgal
Total Required Usages	38,668 mgal 106 mgd	45,937 mgal 126 mgd	53,104 mgal 145 mgd

(1) Assumes growth at projected population growth for same period.

TABLE 7
MUNICIPAL FACILITY PROJECTIONS

ENTITY	POPULATION			RESIDENTIAL SUPPLY REQUIREMENT (based on 0.6 gpm per connection)			COMM / IND USAGES (based on population growth)			REQ'D. TREATMENT CAPACITY			CURRENT CAPACITY
	1995 (persons)	2020 (persons)	2045 (persons)	1995 (mgd)	2020 (mgd)	2045 (mgd)	1995 (mgd)	2020 (mgd)	2045 (mgd)	1995 (mgd)	2020 (mgd)	2045 (mgd)	(mgd)
BEAUMONT	117,952	137,902	161,225	33.97	39.72	46.43	4.68	4.99	5.33	38.65	44.71	51.76	43.50
BEVIL OAKS MUD	1,404	1,710	2,082	0.40	0.49	0.60	0.00	0.00	0.00	0.40	0.49	0.60	0.58
CHINA	1,190	1,452	1,771	0.34	0.42	0.51	0.00	0.00	0.00	0.34	0.42	0.51	0.46
GROVES	16,950	19,314	22,007	4.88	5.56	6.34	0.00	0.00	0.00	4.88	5.56	6.34	5.50
PT NECHES	13,285	14,953	16,831	3.83	4.31	4.85	0.12	0.13	0.14	3.95	4.43	4.98	6.00
NEDERLAND	16,401	17,489	18,649	4.72	5.04	5.37	0.28	0.30	0.32	5.00	5.34	5.69	6.00
W JEFF CO MWD	7,094	7,584	8,107	2.04	2.18	2.33	0.11	0.12	0.13	2.15	2.30	2.46	1.05
NOME	742	793	848	0.21	0.23	0.24	0.00	0.00	0.00	0.21	0.23	0.24	0.25
PT ARTHUR	60,110	67,548	75,905	17.31	19.45	21.86	1.25	1.33	1.42	18.56	20.79	23.28	26.00
LMUD	11,967	21,971	28,343	3.45	6.33	8.16	0.00	0.00	0.00	3.45	6.33	8.16	4.80
KOUNTZE	2,439	3,580	4,391	0.70	1.03	1.26	0.00	0.00	0.00	0.70	1.03	1.26	1.44
SOUR LAKE	1,691	2,179	2,673	0.49	0.63	0.77	0.00	0.00	0.00	0.49	0.63	0.77	1.12

FUTURE REQUIREMENTS

The information on the existing water supply systems and projected water requirements were used to evaluate future improvements needed to meet water supply requirements for each participating entity. A critical issue which will drive the implementation of these improvements is the projection of continued groundwater usage in the study area. Since one of the purposes of this study is to evaluate future surface water supply requirements, conservative assumptions on the continued use of groundwater had to be made. The assumption used in this report is that China will require conversion to surface water supply immediately with the remainder of the entities currently served by groundwater being converted to surface water supply by 2045. The following discusses the future requirements for both groundwater and surface water systems for each of the participating entities and also a summary of future raw water supply.

Ground Water

Studies which projected the future of groundwater supplies specifically for the study area could not be found. However, a 1979 study by Muller and Price did provide estimates of groundwater availability for the various aquifers in the various river basins in the state. The 1979 study projected the availability for the Gulf Coast Aquifer, which includes both the Chicot and Evangeline aquifers, in the Neches River Basin to be 101,000 acre-feet per year. This availability is dependent on recharge to maintain annual supplies. An excerpt of figures and exhibits from the report showing the study area and availability are included in Appendix E. In addition, a 1985 study by Carr, Meyer, Sandeen and McLane estimated withdrawals from the Evangeline and Chicot Aquifers for the years 1971-75. Based on the 1985 study it is estimated that the 1975 withdrawal rates in the Chicot and Evangeline aquifer within the Neches River Basin would be on the order of 30 million gallons per day (33,600 acre-feet per year). This equivocates to approximately 33% of the amount available estimated in the 1979 report.

In addition to the quantity of ground water available, the quality of ground water must also be considered. As stated earlier in this report, several reports investigated the quality of groundwater in the study area. This information is contained in Appendix D. This information indicates that fresh ground water supplies within the study area are sufficiently available north of the Pine Island Bayou. Fresh ground water south of the Pine Island Bayou is limited to relatively shallow depths (200 feet or less). Also, the availability of fresh ground water can be affected by local geological features, such as salt domes, as reported in a 1992 study prepared for the City of Sour lake by William F. Guyton Associates, Inc.

Additional studies of groundwater supplies, providing more current trends, will need to be made to be conclusive about any projections for future groundwater availability. However, for the purpose of this study we have made assumptions based on the studies and questionnaires which were part of this study. These assumptions are listed below.

o Fresh ground water is most likely to be limited in the area of China based on results from a 1973 study (see Figure 25 contained in Appendix D). Analysis of one well in 1990 showed elevated levels of total dissolved solids and chlorides which would indicate a deterioration of water quality in this

area. Based on this information it was assumed that there is an immediate need for China to convert from ground water to surface water.

It was assumed that the remaining municipalities would require conversion to surface water before the end of the 50 year study, year 2045. Construction of these plants would occur in the year 2025. This assumption is based on the following facts:

o The major aquifers supplying ground water are dependent on recharge. As development continues, demand will increase and recharge may decrease, thereby reducing the availability of groundwater.

o The salt water intrusion into the ground water supplies have been documented to be as far reaching as the Jefferson/Hardin County limits.

o The affects of continued increases in the removal of ground water are not precisely known. However, studies indicate the potentiometric surfaces in this area decrease with increase in removal of ground water.

The projected flow rates were compared to each entity's capacity. Deficiencies were determined when the projected required flow rates exceeded the current capacity of each individual system. Recommendations for upgrades will be made in the following sections.

Beaumont

Beaumont currently receives approximately 13.5 mgd capacity from three wells located north of Pine Island Bayou. A review current well data does not indicate any significant changes in the static water level. The last well was constructed in 1980 and was moved approximately 1 mile north of the existing wells. An additional 8.26 mgd capacity will have to be added to the current ground water and surface water supplies to meet design year 2045 design capacity. For the purpose of this study we have assumed that ground water will no longer be available in the design year 2045.

Lumberton MUD

The Lumberton Municipal Utility District (LMUD) is the largest strictly groundwater user participating in this study. The LMUD has experienced substantial growth recently and continues to grow. That growth will obviously result in higher water demands. Using the previously described method, the projected required design flow rates were determined. The LMUD's current capacity is 4.8 mgd while its required capacity in the design year 2020 is 6.33 mgd and 8.16 mgd in the design year 2045. Therefore, the District will require some type of improvement to its existing system in order to meet the requirements of the next 50 years. We have assumed that ground water will be available to meet the needs until the year 2025. We have assumed that to meet the design year 2045 demands the use of surface water will be needed to satisfy the District's needs. In addition to its inadequate supply capacity, the District is also lacking in its future total storage capacity for the design year 2045, according to the TNRCC's design criteria. The elevated storage capacity of the District, however, meets TNRCC's design criteria.

Bevil Oaks MUD

Bevil Oaks MUD currently has a capacity of 0.58 mgd while its projected required capacity in the design year 2045 is 0.6 mgd. This deficiency is only marginal and does not merit an upgrade. However, this should be noted when considering any requirements past the design period. In line with the parameters of this report, an alternative source of water for Bevil Oaks MUD will be considered for the design year 2045.

China

The City of China currently has a capacity of 0.46 mgd and its projected required capacity in the design year 2045 is 0.51 mgd. Again, this deficiency is only marginal. However, the City of China is also experiencing water quality problems in its wells, which has been noted in the section covering water well information. Only one groundwater test could be obtained for the City's wells. Additional groundwater tests should be performed on the City of China's wells to obtain a better evaluation of the quality of the groundwater in the China area. Due to present ground water quality problems in the City of China's vicinity it was assumed that a surface water supply source would be needed for the design year 2020.

Kountze

The City of Kountze is presently removing from normal service one well that has shown low levels of radiation near the existing guidelines. Another well has sand in the water which is retrieved. This well will be redeveloped.

Sour Lake

A 1992 study by William F. Guyton Associates for the City of Sour Lake indicates increasing mineralization of the water. The study indicates this increase may be attributable to the location of the existing wells relative to the Sour Lake salt dome. The study did identify potential fresh ground water supplies to the north and west of the City. A new well is currently being constructed west of the City. Continued observations of this well will assist in evaluating if a decrease in the water quality is due to the salt dome or is due to a more regional problem, such as salt water intrusion.

Treated Surface Water

City of Beaumont

The City of Beaumont, the largest, participant in this study, currently gets is water from two sources, the Neches River (30 mgd capacity surface water treatment plant) and three wells (13.5 mgd capacity) located to the north near the City of Lumberton. The City of Beaumont draws approximately 31% of its water from these wells. Even with the three wells in service for the next 50 years, the City of Beaumont's current capacity is not adequate to serve the projected demands in the design year 2045. The City's current capacity is also inadequate to serve the projected demands

of the design year 2020, though only by a small margin. Should the City lose the use of its wells, its capacity to produce potable water would be severely inadequate and an additional source of water would be needed immediately. Therefore, the City of Beaumont will need to increase its capacity by the year 2025 for the design year 2045. The main supply canals for the LNVA (see Exhibit 5) run through Beaumont's North and West sides, being an obvious potential source for additional water.

Groves

The City of Groves, who also draws its water from the LNVA, currently has a capacity of 5.5 mgd. Its projected required capacity is 5.56 mgd for the design year 2020 and 6.34 mgd for the design year 2045. The slight deficiency for the design year 2020 is negligent and should be ignored in lieu of the deficiency for the design year 2045. Any improvements should be toward the end of the design period.

Nederland

The City of Nederland's existing water plant was constructed in 1950's with an upgrade performed in 1963. The City is currently constructing a new water plant with a capacity of 6.0 mgd and is projected for completion in 1995. This plant will treat water from the LNVA system and will be adequate to meet the future needs.

Nome

The City of Nome, which also draws water from the LNVA, has the capacity to serve itself through the design year 2045. However, the City's capacity is 0.25 mgd while the projected required flows for the design year 2045 is 0.24 mgd. Their current capacity leaves little room for growth or fluctuation beyond the design year 2045. The City of Nome does not necessarily need upgrades to its current system. However, its ability to meet excess demands beyond the projected required peak demands is in question.

Port Neches

The City of Port Neches is currently upgrading its plant. The plant was originally constructed in 1962 with an upgrade performed in 1994. The plant capacity was reported as 4 mgd. This is less than the projected design capacity of 4.98 mgd for the year 2045. It is assumed that increase in demand will continue to be serviced by upgrade to the existing plant.

Port Arthur

The City of Port Arthur's current capacity is inadequate for meeting its design flows for the present and for the design years of 2020 and 2045. However, the City is in the process of building a new surface water treatment plant with a capacity of 26.0 mgd. This is more than sufficient to handle the design flows for the next 50 years.

West Jefferson County MWD

West Jefferson County MWD

The West Jefferson County MWD currently purchases raw water from the LNVA for its two plants which serve the communities of Cheek, Fanette and Labelle. The combined capacity of these two plants is 1.05 mgd. However, the District's required capacity for the design year 2020 is 2.30 mgd and for the design year 2045 it is 2.46 mgd. These required capacities are more than twice the District's current capacity for both design years 2020 and 2045. In addition, the District's present required capacity based on the TNRCC design criteria and the commercial and industrial usages is 2.15 mgd. This is also more than twice the District's current capacity. Therefore, consideration should be given to upgrades to the existing system to increase capacity because the need for additional capacity is pressing. An in depth study for the West Jefferson County MWD should be undertaken to determine the most efficient means by which to increase the capacity of the District's system. This would give the District a better idea of which plant site would best serve the community with an upgrade in capacity or if a new plant would be the best alternative.

Raw Surface Water

The LNVA supplies surface water to agricultural, industrial and municipal users. The previous section of this report discussed the development of projections for future water supply. Given the previous projections and the assumptions made for future requirements Table 8 provides a time line for possible future demands on the LNVA supply system. The table includes projections based on both anticipated local conditions and the 1996 Consensus Water Plan.

An evaluation of the LNVA system to supply water on demand will require more detailed evaluation as to the size of peak demands (especially for agricultural users) and the capacity of individual supply canals. A study to evaluate the system is currently underway. However, a comparison can be made to the design pumping capacity of the two combined lift stations (820,000 gpm) and the total flow for the year 2045. The demand for the year 2045 is equivalent to 250,000 gpm which is 30% of the design rated capacity of the two existing lift stations.

TABLE 8
ANNUAL CONSUMPTION (ACRE-FEET)

Usage	Present	Projections	
		2020	2045
Agricultural	226425	188192	176845
Industrial	118676	140985	162981
Municipal			
(Surface)			
Groves	1815	2016	2016
Port Neches	1916	2162	2229
Nederland	2935	3315	3326
W. Jeff. Co. MWD	728	761	717
Nome	112	134	146
Port Arthur	13196	15400	17170
(Ground)			
Bevil Oaks MUD			168
China	146	202	224
Lumberton MUD			3360
Kountze			526
Sour Lake			358
(Beaumont)			28168
(Others)	437	605	773
TOTAL	366386	353772	399007

REGIONAL ALTERNATIVES TO MEET FUTURE WATER DEMANDS

The previous section of this report discussed the future needs for each participating entity. These needs were evaluated from a regional basis to develop cost-effective alternatives to meet future water demands. In the course of developing regional facility alternatives it was found that regional facility alternatives would probably not be cost effective where:

o the local entity has surface water treatment and distribution facilities which will meet, or almost meet, its demands for the fifty year study period (Groves, Nederland, Port Neches, Port Arthur), and

o a close supply of raw surface water is currenlty available to the local entity wherein only the cost of treatment facility is required and transportation of raw or treated surface water over a long distance to the distribution system is not necessary (China, Nome, West Jefferson County MWD).

Taking into account the above observations a total of three alternatives were developed. The three alternatives are based on the assumption that at some point in the future, the need to provide surface water to each entity will be necessary. The ultimate time frame chosen for this change is the design year 2045. The importance of analyzing this possibility lies in the need for having sufficient sources of surface water available to serve the planning area in the event that, for one reason or another, groundwater supplies are no longer a viable option for water supplies. In this event, several entities would have no alternative water source as many do not currently have a suitable nearby surface water source. Therefore, these alternatives explore the possibility of a semi-regional water treatment/distribution system to provide water to those entities who do not have access to a surface water supply. These systems could be operated by the individual entities or a combination of entities or a regional institution. These alternatives are separated by the design period in which they are needed.

Alternative one will look at a set of three semi-regional water treatment plants and transmission facilities.

- Regional Plant One would be located near State Highway 105 and the LNVA canal just outside of Beaumont. This plant would serve the City of Beaumont, Bevil Oaks MUD, and the City of Sour Lake.

- Regional Plant Two would be located in the City of Lumberton near the intersection of West Chance Cutoff and US Highway 69. This plant would serve the LMUD and the City of Kountze.

- Regional Plant Three would be located in the City of China near the LNVA canal and would serve the City of China.

In addition, alternative one looks at required upgrades for the West Jefferson County MWD and the

City of Groves system in order to meet projected design flows.

Exhibit 5 provides a schematic of this alternative. A summary of the probable present value costs shown in Table 9.

Alternative two deals with providing only raw water to each entity who does not currently have a nearby raw water source. Individual water treatment plants would be the responsibility of each entity. Raw water would be pumped to LMUD and to the City of Kountze via a common transmission system. In addition, a pumping system with a pump station and a transmission line would be constructed to serve Bevil Oaks MUD and the City of Sour Lake. The City of Beaumont and the City of China would be excluded from this alternative because those entities have direct access to an LNVA canal.

Exhibit 6 shows the location of transmission facilities considered in this alternative. Table 10 provides a summary of the probable costs.

Alternative three looks at one regional plant to serve all entities involved who would need a water source other than groundwater.

Design Year 2020

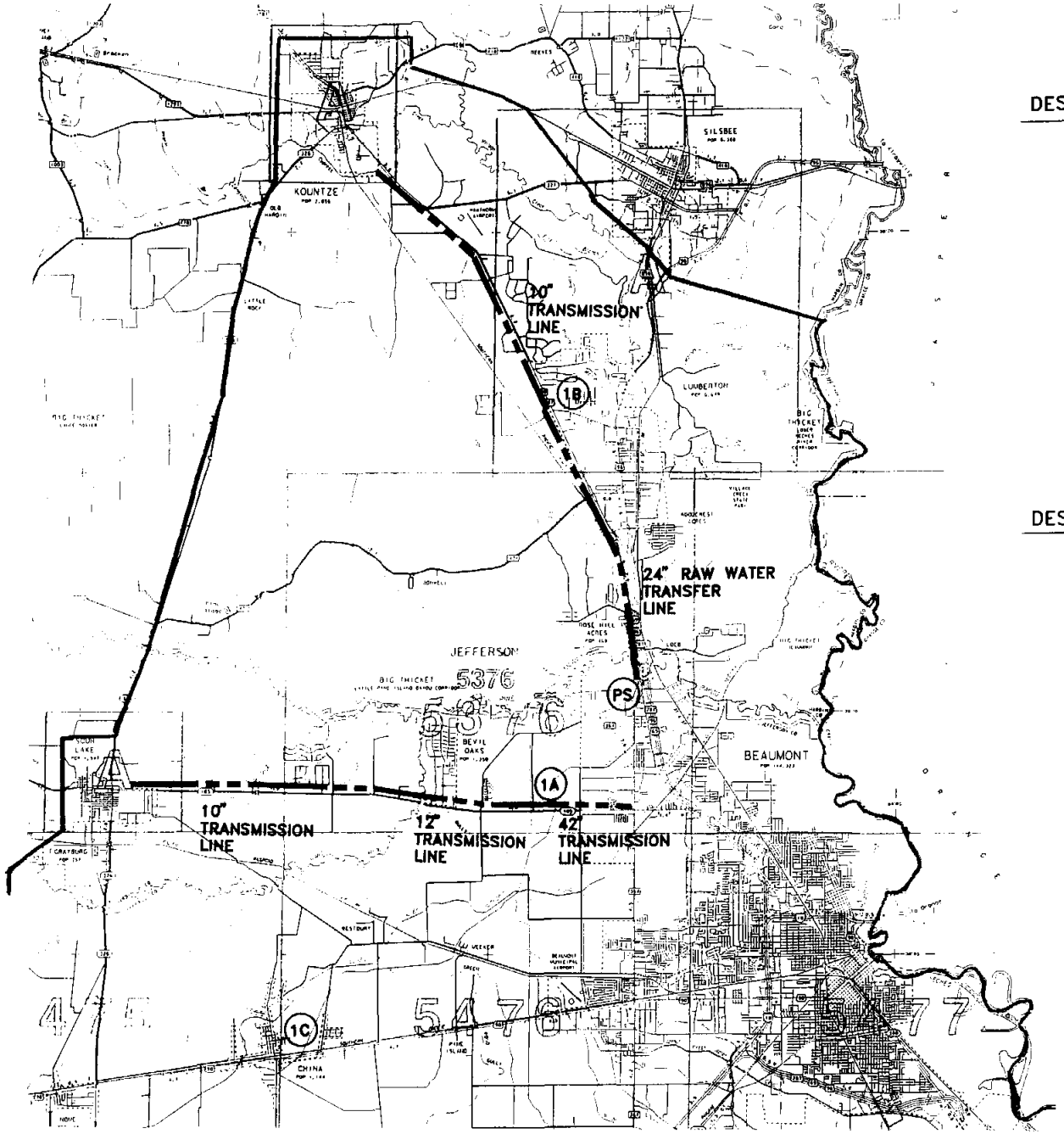
This time period includes those entities whose water supply systems do not meet their individual projected required design capacities for the design year 2020. These entities include the City of China, the West Jefferson County MWD, and the City of Groves. Any requirements for the design year 2020 would need to constructed by the year 2000 in order to provide a design life of 20 years. It should be noted that these recommendations should, at a minimum, be implemented using the peak flows for the design year 2020. However, in many instances, it is more practical to design for the year 2045 to avoid increased future unit costs. Since the added capacity is usually not very much more and would be worth the extra design life.

Alternative One

Water Treatment Plants One and Two do not apply to the design year 2020 but, rather, to the design year 2045. Recommendations for these facilities can be found in the later sections.

Water Treatment Plant Three would be constructed to serve the City of China which is experiencing problems with water quality in its wells. Otherwise, it would not require additional capacity until the design year 2045. Any design for the City of China should utilize the demands of the design year 2045 because the difference between the projected design capacities for the years 2020 and 2045 is only 0.09 mgd. Therefore, a surface water treatment plant should be constructed in the year 2000, or before, to serve the City of China through the year 2045.

The West Jefferson County MWD currently uses the LNVA surface water supply system. Their supply capacity is 1.05 mgd. However, their projected required design capacity for the design year



DESCRIPTION OF PROPOSED TREATMENT PLANTS

(1A) REGIONAL PLANT NO. 1

23.13 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE BEAUMONT, BEVIL OAKS, AND SOUR LAKE.

(1B) REGIONAL PLANT NO. 2

9.42 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE KOUNTZE AND LUMBERTON.

(1C) REGIONAL PLANT NO. 3

0.51 MILLION GALLON PER DAY TREATMENT PLANT AND PUMPING FACILITIES TO SERVICE CHINA.

DESCRIPTION OF PROPOSED PUMPING FACILITIES

(PS) 9.42 MILLION GALLON PER DAY RAW WATER PUMPING FACILITY TO SERVICE KOUNTZE AND LUMBERTON

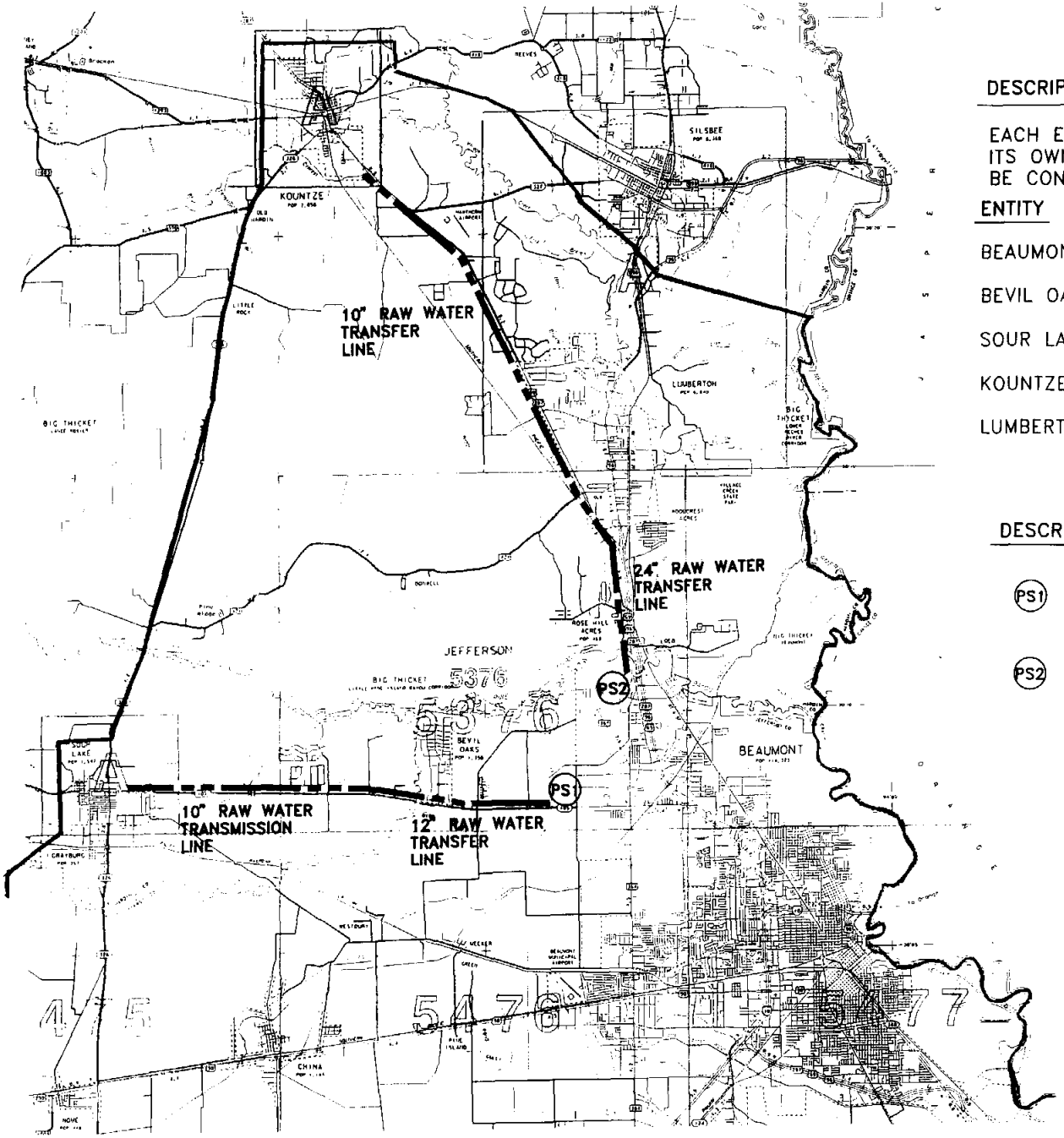
REGIONAL WATER SUPPLY STUDY	
EXHIBIT No 5 **ALTERNATE ONE**	
SPI Project No 5301	SCHAUMBURG & POLK, INC. CONSULTING ENGINEERS 8833 COLLEGE STREET BEAUMONT, TEXAS 77707 (409) 866 - 0341

TABLE 9
ALTERNATIVE ONE SUMMARY OF COSTS BY ENTITY

Regional Water Plant No. One			
	Beaumont	Bevil Oaks	Sour Lake
Item of Construction			
23.13 MGD Regional Treatment Plant	$24,000,000	$660,000	$770,000
Pump Station	$400,000	$40,000	$60,000
42" Transmission Line	$850,000		
12" Transmission Line		$90,000	$120,000
10" Transmission Line			$430,000
On-site Storage to Receive Treated Water		$70,000	$90,000
Probable Cost of Construction	$25,250,000	$860,000	$1,470,000
Land Acquisition	$230,000	$15,000	$15,000
Engineering Fees	$3,535,000	$120,400	$205,800
Legal, Fiscal	$757,500	$25,800	$44,100
Adminsitration	$1,010,000	$34,400	$58,800
Contingencies	$4,617,375	$158,340	$269,055
OPINION OF TOTAL PROBABLE PROJECT COST	$35,399,875	$1,213,940	$2,062,755

Regional Water Plant No. Two			
	LMUD	Kountze	
9.42 MGD Regional Treatment Plant	$11,260,000	$1,750,000	
Raw Water Pump Station	$170,000	$30,000	
Raw Water Transfer Line	$1,430,000	$230,000	
Treated Water Pump Station	$160,000	$160,000	
10" Transmission Line		$500,000	
On-site Storage to Receive Treated Water	$150,000	$100,000	
Probable Cost of Construction	$13,170,000	$2,770,000	
Land Acquisition	$100,000	$20,000	
Engineering Fees	$1,843,800	$387,800	
Legal, Fiscal	$395,100	$83,100	
Adminsitration	$526,800	$110,800	
Contingencies	$2,405,355	$505,755	
OPINION OF TOTAL PROBABLE PROJECT COST	$18,441,055	$3,877,455	

Regional Water Plant No. Three			
	China		
Item of Construction			
0.51 MGD WATER TREATMENT PLANT	$1,000,000		
Pump Station	$20,000		
Transmission Line	$10,000		
On-site Storage to Receive Treated Water	$60,000		
Probable Cost of Construction	$1,090,000		
Land Acquisition	$20,000		
Engineering Fees	$196,200		
Legal, Fiscal	$32,700		
Adminsitration	$43,600		
Contingencies	$207,375		
OPINION OF TOTAL PROBABLE PROJECT COST	$1,589,875		



DESCRIPTION OF PROPOSED TREATMENT PLANTS

EACH ENTITY WOULD CONSTRUCT AND OPERATE ITS OWN TREATMENT FACILITIES. PLANTS TO BE CONSTRUCTED ARE DESCRIBED BELOW:

ENTITY	PLANT CAPACITY (MGD)
BEAUMONT	21.76
BEVIL OAKS MUD	0.60
SOUR LAKE	0.77
KOUNTZE	1.26
LUMBERTON MUD	8.16

DESCRIPTION OF PROPOSED PUMPING FACILITIES

(PS1) 1.37 MILLION GALLON PER DAY TO SERVICE BEVIL OAKS AND SOUR LAKE

(PS2) 9.42 MILLION GALLON PER DAY TO SERVICE KOUNTZE AND LUMBERTON

REGIONAL WATER SUPPLY STUDY

EXHIBIT No 6

ALTERNATE TWO

SPI Project No 5301

SCHAUMBURG & POLK, INC.
CONSULTING ENGINEERS
885 COLLEGE STREET
BEAUMONT, TEXAS 77701
(409) 866 0341

TABLE 10
ALTERNATIVE TWO

Each Entity Construct Separate Facility	Item of Construction					
	Beaumont	Bevil Oaks	Sour Lake	Lumberton	Kountze	China
Individual Treatment Plant	$24,000,000	$1,200,000	$1,500,000	$11,600,000	$2,500,000	$1,000,000
Pump Station	$400,000	$40,000	$60,000	$170,000	$200,000	$20,000
42" Transmission Line	$850,000					
12" Transmission Line		$90,000	$120,000			
10" Transmission Line			$430,000		$500,000	$10,000
24" Transmission Line				$1,400,000	$200,000	
On-site Storage to Receive Treated Water		$70,000	$90,000	$150,000	$100,000	$60,000
Probable Cost of Construction	$25,250,000	$1,400,000	$2,200,000	$13,320,000	$3,500,000	$1,090,000
Land Acquisition	$230,000	$15,000	$15,000	$20,000	$15,000	$20,000
Engineering Fees	$3,535,000	$196,000	$308,000	$1,864,800	$490,000	$196,200
Legal, Fiscal	$757,500	$42,000	$66,000	$399,600	$105,000	$32,700
Adminsitration	$1,010,000	$56,000	$88,000	$532,800	$140,000	$43,600
Contingencies	$4,617,375	$256,350	$401,550	$2,420,580	$637,500	$207,375
OPINION OF TOTAL PROBABLE PROJECT COST	$35,399,875	$1,965,350	$3,078,550	$18,557,780	$4,887,500	$1,589,875

2020 is 2.30 mgd and 2.46 mgd for the design year 2045. At a minimum, improvements to one of the District's two treatment plants or a third separate water treatment plant should be constructed in the near future for the design year 2020. As mentioned previously, recommendation is made to conduct a study to analyze the District's demand requirements in order to formulate the optimum solution to its water needs. Because the difference in the required flows for the two design years are negligible, any design should include the design year 2045 flows to avoid increased future unit costs.

The City of Groves is expected to experience deficiencies in its system within the design periods. The City currently draws raw water from the LNVA. Because the City currently draws raw water from the LNVA, it is not recommended for participation in a regional facility. For all practical purposes, the existing water supply system has the capacity to meet the expected design period demand. The City, whose current capacity is 5.5 mgd, will require 5.56 mgd for the design year 2020 and 6.34 mgd for the design year 2045. Though the City's deficiency is slight, consideration should be given for additional capacity either toward the end of the design period or for a design year beyond the scope of this study.

Alternative Two

There are no applications for this alternative for the design year 2020. If this alternative were to be chosen, the most economical application in all cases would be to apply this alternative in the year 2045.

Design Year 2045

This time period includes not only those entities whose current supply capacities exceed the projected capacities for the design year 2020 but also those entities currently using groundwater. These entities include the City of Beaumont, the City of Sour Lake, the City of Kountze, and Bevil Oaks MUD. Of these, the City of Sour Lake, Bevil Oaks MUD, and the City of Kountze are included because they currently rely solely on groundwater for their supply. LMUD is included in this design period because upgrades based on the design year 2020 are not practical given the small difference between the required flows for the design years 2020 and 2045. For all entities, improvements required in the 2045 design year should be in use by the year 2025 in order to have at least a 20 year design life.

As noted earlier, some recommendations were made for improvements in the design year 2020 but were not necessarily required until the design year 2045. This was an attempt to avoid increased future unit costs when the added capacity was not substantial.

Alternative One

The City of Beaumont will require additional capacity in order to meet its projected required design flows for the design year 2045. The City currently has a 30 mgd surface water treatment plant and three (3) wells with a combined capacity of 13.5 mgd. In the design year 2020, the City's current capacity with the wells in service will be slightly deficient. However, the deficiency is small and does not necessitate an upgrade. However, compared to the design flows for the year 2045, the

system's inadequacies become greater. In line with the parameter set forth in this report, being that an alternative source of water to groundwater should be explored, the system's deficiencies are even greater without the capacity of the wells. Therefore, the City of Beaumont would have a supply capacity of 30 mgd compared to a required capacity of 51.76 mgd for the design year 2045. Therefore, the City would require an additional 21.76 mgd in order to adequately serve itself for the design year 2045.

Water Treatment Plant One would be located in the vicinity of State Highway 105 and the LNVA just west of the City of Beaumont. It should be designed to serve the City of Beaumont, Bevil Oaks MUD, and the City of Sour Lake. Both the City of Sour Lake and Bevil Oaks MUD currently use groundwater for their water supply. Therefore, in line with the parameters of this report, it will be assumed that these entities will need surface water by the design year 2045. A total of 1.37 mgd would be required in the design year 2045 for the combination of the City of Sour Lake and Bevil Oaks. With the additional capacity required by the City of Beaumont, the plant would have a capacity of 23.13 mgd. This plant should be located as close to the existing LNVA canal as possible. In addition, treated water transmission facilities will be required for the City of Beaumont and for the combination of Bevil Oaks and the City of Sour Lake. A facility for the City of Beaumont would include a pump station with a 42" transmission line tied directly to the City's distribution system. For Bevil Oaks and the City of Sour Lake, a pump station along with a combination 10"/12" transmission line would be required.

Water Treatment Plant Two would serve both the LMUD and the City of Kountze. The plant site would be located in the City of Lumberton near the West Chance Cutoff and Highway 69. LMUD will require additional capacity in order to meet its projected demands for the design year 2020. The projected required flows are 6.33 mgd for the design year 2020 and 8.16 for the design year 2045. The difference between the required flows for the design year 2020 and the design year 2045 is small. Therefore, any design should consider the design year 2045 flows. This plant would also be sized to handle the projected demands for the City of Kountze for the design year 2045. The required capacity for the City of Kountze is only 1.26 mgd. Therefore, a total capacity of 9.42 mgd would be required in order to serve both the City of Kountze and the LMUD.

This alternative will also require transmission facilities. Raw water must be supplied to the plant from the LNVA at Pine Island Bayou and US Highway 69 near the City of Beaumont. This would entail a pumping station and a 24" transmission line to the plant site. Estimates for a 24" transmission line are included in the cost for this study. However, the City of Beaumont currently has in service a 24-inch line from its well at FM 421 in Hardin County to just south of Pine Island Bayou. Reuse of this line may be feasible. A transfer facility has not been included for the LMUD because the proposed plant site would be located within the District's boundaries. A transfer facility would be required to pump the treated water from the regional water plant to the City of Kountze. These facilities would consist of a pump station in series with a booster pump station and a 10" transmission line.

Water Treatment Plant Three would be built around the year 2000 for the design year 2045 and, therefore, requires no additional explanation here. Recommendations for this facility can be found under the Design Year 2020 section.

Alternative Two

Alternative two consists of providing raw water to each entity who does not currently have access to an LNVA canal. Responsibility for water treatment would be left to each individual entity in this alternative. Entities being considered in this alternative include the LMUD, the City of Kountze, the City of Sour Lake, and Bevil Oaks MUD.

The LMUD could use an alternate raw water source in the design year 2020 due to its existing system's inability to meet projected design flows. However, flows from the design year 2045 were used in determining the magnitude of an alternative water system in order to extend the design life of the LMUD system. The system would consist of a pump station at the LNVA canal at Pine Island Bayou and a 24-inch transmission line to a site near West Chance Cutoff and US Highway 69 in the City of Lumberton. This system should be large enough to provide enough raw water for both the LMUD and the City of Kountze in the design year 2045. Additional transmission facilities would be required to provide the City of Kountze with raw water. This system would be an extension of the system serving LMUD with raw water and would include a pump station, an in line booster station, and a 10" transmission line. This system would supply the City of Kountze with an adequate amount of raw water through the design year 2045.

The City of Sour Lake and the Bevil Oaks MUD would also require a surface water source by the design year 2045. Initially, a raw water canal was examined for providing surface water to these entities. However, after investigation, it was found that the costs of a raw water canal compared to the cost of a pumping station was excessive. Therefore, a raw water pumping station in series with a booster station and a combination 10"/12" transmission line would be required. This system would serve both the City of Sour Lake and the Bevil Oaks MUD well into the design period.

Alternative Three

Alternative three consisted of a single regional plant to serve the entities which do not have access to a surface water source. The City of Sour Lake was determined to be the best location for the regional plant. Transmission facilities would be required for each entity including the City of Sour Lake, the City of China, Bevil Oaks, LMUD, and the City of Kountze. This alternative would also require a raw water supply to be transmitted to the regional facility as, currently, there is not an LNVA canal near the City of Sour Lake. The required pumping facilities were analyzed for pump station sizing and line length. In order to serve the City of Kountze and LMUD, a series of pump stations and booster stations would be required as the pumping distance to each entity is approximately 17 miles. Due to costs of supplying raw water, plant construction, and pumping facilities, this alternative is not a viable solution to the region's water needs for the future. Also, the fact that some entities will require additional water in the design year 2020 while others will not require additional water until the design year 2045 would tend to cause problems in design, financing, and construction.

The City of Beaumont was not included in the regional plant alternative because there would be no benefit to the City by participating in a regional facility. This is due to the high demand expected for the City. A single regional plant would not be cost effective for the City of Beaumont because

the City can treat its water cheaper than it could by being involved in a regional facility and paying for high transmission costs.

Other Considerations

During evaluation of the alternatives other considerations were developed but were not included for the purpose of clarity. These considerations may impact both the scheduling and financing of the projects. Theses considerations are briefly discussed.

Communities which have public wells along State Highway 105 and west of Beaumont (Bevil Oaks MUD, Pinewood and Meeker) may require conversion to surface water prior to Sour Lake or Beaumont. The location of new wells for these communities is limited. Further data is required from these communities to evaluate when that need may arise. Surface water supplies for these communities could best be served by Water Treatment Plant No. One mentioned earlier in this report. This location is optimal since distribution lines from the Meeker supply wells are located in an area west of Bevil Oaks and north of State Highway 105.

The other consideration is to evaluate the system to supply raw water to the west Hardin County area if required in the future. If the cities in this area (Lumberton, Kountze and Silsbee) require surface water supply in the future, then a gravity system (either pipe or canal) could should be considered from the Neches River to an area between Lumberton and Silsbee. A central treatment plant and transmission facilities could be constructed to serve these communities.

PROJECT FINANCING

A summary of the captial costs to construct the selected alternative and annual operation and maintenance cost is presented in Table 11. The impact of financing the selected alternative was evaluated. The annual amortized costs and estimated operation and maintenance cost were projected. These costs were used to calculate a monthly rate based on the projected number of connections. Table 11 provides a summary of the anticipated rates created by the proposed facilities. The actual rate increase would be unique to each entity depending upon current debt service and existing operation and maintenance cost which would be eliminated by the proposed construction.

The financing for construction and funds for operation could be implemented under the direction of the LNVA or under a new regional water district created under the Texas Water Code, Chapter 50. Funding could be obtained through the Texas Water Development Board. The financial assistance programs which are under the jurisdiction of the Texas Water Devlopment Board are regulated by the Texas Adminsitrative Code Chapter 363. Two funding options are currently available, the Texas Water Development Fund and Water Assistance Fund. These funds are generally available in the form of loans. However, the TWDB can provide grants for projects which include supplying water to areas in which the water supply services from a community do not provide drinking water of a quality that meets the standards set forth by the Commission in 30 TAC Section 290.01-290.26, 30 TAC Sections 290.38 - 290.51 and any applicable standards of any governmental unit with jurisdiction over the area or where financial resources are inadequate to meet the above referenced standards and requirements. Loans from the Texas Water Development Fund have interest rate varying with market condition and are generally set at 0.5% above the TWDB borrowing cost with repayment periods of 20 to 25 years. The Water Assistance Fund is funded through appropriations made by the State Legislature. The subfunds provide grants and loans at an interest set by the TWDB.

TABLE 11
1995 CAPITAL COSTS
SELECTED PLAN

ENTITY	CONNECTIONS	TOTAL COSTS (Present Value)	ANNUAL AMORTIZED COSTS	ANNUAL O & M COSTS (Present Value)	TOTAL ANNUAL COSTS	MONTHLY COSTS PER CONNECTION	MONTHLY COSTS PER 1000 GALLON
BEAUMONT	48500	$35,399,875	$3,605,555	$2,326,014	$5,931,570	$10	$0.65
BEVIL OAKS MUD	570	$1,213,940	$123,642	$37,828	$161,470	$24	$2.60
CHINA	514	$1,589,578	$161,902	$90,598	$252,500	$41	$3.78
KOUNTZE	1099	$3,877,455	$394,927	$97,499	$492,426	$37	$3.07
LMUD	7404	$18,441,055	$1,878,262	$595,680	$2,473,942	$28	$2.53
SOUR LAKE	869	$2,062,755	$210,096	$63,072	$273,168	$26	$2.63

ENVIRONMENTAL ASSESSMENT

DESCRIPTION OF STUDY AREA

The planning area for the regional water planning study covers portions of Jefferson and Hardin Counties in Southeast Texas. The area consists of all of Jefferson County *(excluding the sparsely inhabited southern third)* and the southeastern portion of Hardin County. The largest cities within the area are Beaumont, Port Arthur, Nederland, Port Neches, and Groves, all in Jefferson County. Other cities and communities within the area include Central Gardens, Beauxart Gardens, Hamshire, Fannett, China, Nome, and Bevil Oaks in Jefferson County; and Sour Lake, Pinewood, Rose Hill Acres, Lumberton, and Kountze in Hardin County.

The 1995 population of the planning area is estimated at 251,230 including 235,130 in Jefferson County and 16,100 in Hardin County. The largest city is Beaumont (1995 population 117,952), followed by Port Arthur (1995 population 60,110). Other portions of the planning area range from vast unpopulated rural areas to cities in the 10,000 to 20,000 range.

The entire area lies in the Beaumont-Port Arthur-Orange metropolitan area.

CURRENTLY EXISTING ENVIRONMENT WITHOUT THE PROPOSED PROJECT

Geological Elements

A. Topography. The planning area overlaps two vegetational areas -- the Gulf Prairies and Marshes, and the Piney Woods region. The area is bounded on most of its east side by the Neches River and extends as a narrow strip to the Gulf of Mexico.

The topography of the planning area varies from flat to moderately hilly. Jefferson County is mainly flat, with elevations from 0 to 49 feet. Most of Hardin County within the area is flat or nearly so, but there is sharp relief (up to 50 feet) along portions of Village Creek and its tributaries. Elevations within the Hardin County portion of the area vary from 4 to 100 feet.

The planning area in Hardin County, as well as narrow strips of Jefferson County, lies within the Neches River Basin. Most of the remainder of the planning area in Jefferson County drains through Taylor Bayou to the Intracoastal Canal in the Neches-Trinity Coastal Basin. Other small areas drain to the Intracoastal Canal through other routes, to Sabine Lake, or to the Sabine-Neches Channel.

B. Soil Types

1. Associations.

a. Jefferson County. A 1965 USDA soil survey shows seven soil associations covering the land areas of the county, all falling within the planning area.

The most prevalent association in the area is the **Beaumont-Morey**. This association is interspersed with areas of the **Morey-Crowley-Hockley** and to a lesser extent, the **Garner-Byars-Acadia**. Other associations are the **Harris-Made land, Salt water marsh-Tidal marsh, Bibb-Alluvial land**, and **Sabine-Coastal land**.

Soil associations at the proposed and alternative surface water treatment sites in Jefferson County include Beaumont-Morey at Regional Plant No. 1 for Beaumont, Bevil Oaks, and Sour Lake; Beaumont-Morey at the alternate plant location at Meeker; and Morey-Crowley-Hockley at the Regional Plant No. 3 for China.

b. Hardin County. A USDA soil map (revised 1991) shows eight soil units covering the portion of the county within the planning area.

Bottom land units along major streams include the **Mantachie-Owentown** and the **Estes**. Immediately upland are various other units in different portions of the planning area: **Waller-Kirbyville, Otanya-Kirbyville, Aris-Aldine-Anahuac**, and **Bienville-Besner-Mollville**. Even farther upland are two other associations, **Otanya-Kirbyville-Evadale** and **Vamont-Beaumont**.

The proposed Regional Plant No. 2 for Lumberton and Kountze falls in the Waller-Kirbyville unit. The alternative plant at Sour Lake falls into the Vamont-Beaumont unit.

2. General Characteristics. Most soils in the planning area in Jefferson County and in parts of Hardin County are clay, acid soils with poor internal drainage. The Bibb-Alluvial and Morey-Crowley-Hockley soils are loamy and silty soils. Some soils along the river downstream from Beaumont are saline. Other bottomland soils are clay or loam. Most Hardin County upland soils are loamy, except for clay at Sour Lake. Many areas parallel to the Neches River and Village Creek are sandy.

Most soils in Jefferson County and in large areas of Hardin County are relatively impermeable, with the surface layers more permeable than the subsurface. More permeable soils include the Salt water marsh; certain soils in the Sabine Pass, Neches River, and upland areas; and swamp land along the Neches River and several bayous.

Soils in Hardin County within the planning area for the most part range from very slowly permeable to moderately permeable. Portions of the Bienville-Besner-Mollville unit, however, range up to moderately rapid permeability.

Because of the flat topography in Jefferson County, erosion is not a major problem. Most of Hardin County, especially the part in the study area, is also flat or gently sloping and is thus not subject to erosion problems. Some areas along Village Creek and its tributaries, however, are steeply sloped.

Soils with a high shrink-swell potential can also present potential erosion problems on steep slopes, as on the sides of ditches and embankments. Soils of this type are found in Jefferson County in various surface and subsurface layers. In Hardin County, soils of this type are found in several areas including Sour Lake.

Prime agricultural land, as defined by the USDA, is limited to suitable soils within nonurbanized areas. Within Jefferson County, only two soil types *(mapping units)* are prime in their natural state, with nine other types prime if drained. Much of rural Jefferson County falls in the prime-if-drained category. The proposed Regional Plant No. 1 and the alternative Meeker plant fall into prime-if-drained areas. The proposed China Regional Plant No. 3, depending on its exact location, may or may not fall into prime areas.

The Hardin County soil map does not discuss prime agricultural land, but it appears unlikely that much of this type land occurs in the county in light of the small amount of farming in the county. The sites for Regional Plant No. 2 and for the alternate Sour Lake plant do not appear on visual inspection to be prime farmland.

C. Geologic Structures. The soils in the Gulf Coast Region are underlain by sedimentary material for several thousand feet. The sedimentary formations are divided into three major groups according to deposition dates: Pleistocene, Holocene, and Modern.

Pleistocene deposits underlie almost all of Jefferson County and most of southern Hardin County. Where rivers cut through these deposits during times of lowered sea level, the eroded Pleistocene deposits have been replaced by Holocene and Modern deposits from these rivers. The Pleistocene formations generally underlie the soils of the coastal prairie, with Holocene and Modern formations occurring in floodplains and coastal strips.

The formations crop out in belts parallel to the coast and dip toward the Gulf at angles steeper than the surface. The formations thicken downdip, so older formations dip more steeply. Of the aquifers under the Gulf Coast Region, the most important in Jefferson County is the Chicot. In Hardin County, both the Chicot and the underlying Evangeline *(sometimes referred to collectively as the Gulf Coast aquifer)* are major water sources.

Hardin County and much of Jefferson County contain alluvial sediments with strata varying from fine at the surface to coarse at the bottom. Along the Neches River, the Recent alluvium contains two sequences of sediments with combined depth ranging from 120 feet near the mouth of the river to 40 feet upstream. Hardin County can be divided into three land surfaces – Recent alluvial floodplains along the Neches River and major tributaries; and two plains north and south of a line through the U. S. 69-96 wye in Lumberton, representing the outcrops of the Lissie Formation and the Beaumont clay .

Natural processes presently operating in the coastal regions include erosion, deposition, compaction, and subsidence. Measurable amounts of subsidence and sedimentation have occurred in the Jefferson County area in recent years, although the rate of subsidence is relatively minor. In Hardin County, subsidence occurs primarily because of oil and gas

removal, particularly in salt dome areas such as Sour Lake. In 1929, a sink hole 1500 feet in diameter formed in that area after years of heavy oil pumping, leaving a large pond within the sink. Natural subsidence has also been noted in that area.

Cumulative subsidence in the planning area varies from 0 to 1 foot.

Hydrological Elements

A. Streams

1. Neches River and Tributaries. All of the planning area in Hardin County and along north and east Jefferson County drains into the Neches River, draining 10,100 square miles. Stream segments within the planning area *(defined by the TNRCC for water quality purposes)* are 601 (Neches River Tidal), 602 (Neches River Below B. A. Steinhagen Lake), 607 (Pine Island Bayou), and 608 (Village Creek).

   The Neches River *(which flows into Sabine Lake, thence to the Gulf of Mexico)* forms the eastern boundary of the planning area from the northeast corner of the area to its mouth. Pine Island Bayou forms the Hardin/Jefferson County line. Village Creek passes through the Hardin County portion of the area.

   Existing major improvements to the Neches River include dredging of a ship channel to central Beaumont. A permanent salt water barrier just north of Interstate 10 is proposed to replace the existing seasonal barrier near Pine Island Bayou.

   The Neches River and, to a lesser extent, Pine Island Bayou, are presently sources of large amounts of surface water used for municipal, industrial, and industrial purposes. Most such usage occurs in Jefferson County, although some of the Neches River intake points are located several miles north of the county.

   The Neches River receives many domestic discharges throughout its basin plus a number of industrial discharges, particularly in or near Segment 601. Nonpoint source pollution from various sources occurs throughout the basin. Nonpoint pollution is especially marked for the sluggish, lowland Pine Island Bayou, which is of a much lower quality than Village Creek, which drains hilly land to the north.

   Desirable uses for Segment 601 are listed by the TNRCC as contact recreation and intermediate quality aquatic habitat. Other existing uses include industrial cooling water and navigation.

   Major surface water withdrawals include intakes for the City of Beaumont and for the Lower Neches Valley Authority (LNVA) canal system. The canals, covering a large portion of Jefferson County, supply water for irrigation and for domestic and industrial water supply for much of the planning area. The intakes are located upstream from local industrial waste discharge points.

The TNRCC lists Segments 602, 607, and 608 as having three desirable uses--contact recreation, high quality aquatic habitat, and domestic water supply. The LNVA has an intake on Pine Island Bayou near its crossing with Highway 69, 96 and 287.

2. Taylor Bayou and Tributaries. Most of Jefferson County within the planning area drains to the Intracoastal Canal through Taylor Bayou. This stream originally flowed into Sabine Lake just south of Port Arthur, but was diverted in the 1970's into the Intracoastal Canal several miles west of Port Arthur.

   The Taylor Bayou system is fan-shaped, including North and South Forks of Taylor Bayou as well as various tributaries. Stream segments *(defined by TNRCC for water quality)* are 701 (Taylor Bayou Above Tidal) and 704 (Hillebrandt Bayou).

   Hillebrandt Bayou drains most of Beaumont. A system of drainage ditches in and north of the Port Arthur area drains most of Port Arthur, Groves, Port Neches, and Nederland to the tidal portion of Taylor Bayou through a pump station.

   In normal weather, most of the flow in the Taylor Bayou system consists of return flows of surface water originally taken from the Neches River and Pine Island Bayou. Much of these flows are made of municipal wastewater discharges. However, Nederland, Port Neches, and Groves have participated in a regional wastewater study which may result in future diversion of flows to the Neches River in response to upgraded stream standards for existing receiving streams.

   Large volumes of industrial wastewater are also discharged into the system, mainly from the Star Enterprise refinery at Port Arthur. Finally, rice farmers throughout much of Jefferson County return large volumes of irrigation water seasonally.

   Desirable uses for Segments 701 and 704 are listed by the TNRCC as contact recreation and intermediate quality aquatic habitat.

   Taylor Bayou drains only Jefferson County and small areas in Chambers and Liberty Counties. The drainage area is flat, with less than a foot of drop per mile for Taylor Bayou. Even during heavy storms the streams are relatively slow flowing. Apart from storm events and flows diverted from the Neches basin, the entire Taylor Bayou system is very sluggish with little or no visible flow.

   In addition to the diversion into the Intracoastal Canal, major improvements to the Taylor Bayou system include a salt water barrier north of the canal and various channel improvements.

   Taylor and Hillebrandt Bayous and several tributaries have been straightened and widened by the Corps of Engineers several times, including a major improvement program in the early 1990's. Outside the Corps projects, many drainage ditches have been constructed or improved by local drainage districts.

Because of poor water quality, the Taylor Bayou system is not used for municipal water supply, although some water is used for irrigation and industrial cooling.. Surface water rights total approximately 270,000 acre-ft./year. Other uses include boating and fishing.

3. Other. A small area of western Jefferson County, adjacent to Chambers and Liberty Counties, drains through Spindletop Bayou to the Intracoastal Canal. Small portions of the planning area south of Highway 73 drain to the Intracoastal Canal through small local streams. Finally, a small area near Sabine Pass drains west to the Intracoastal Canal through Salt Bayou.

B. Canals and Bodies of Water

The planning area extends to the Gulf of Mexico as a narrow strip near Sabine Pass, parallelling the Sabine Pass channel.. Other than the Gulf, the only significant body of water is Sabine Lake. The lake, covering almost 100 square miles, is seven miles inland from the Gulf and receives flows from the Sabine and Neches Rivers, draining to the Gulf through Sabine Pass. Sabine Lake reportedly contained fresh water in its natural state before the late 19th century, but became saline after ship channel dredging. The lake and adjacent canals, as well as downstream portions of tributary streams, are tidally affected.

The Sabine-Neches Canal, an improved ship channel, was formed along the northern/western edge of the lake. The dredged material from the channel was placed in the lake beside the channel to form Pleasure Island. The canal connects both the Sabine and Neches Rivers to the Gulf for shipping.

The Intracoastal Canal, paralleling the Gulf Coast, is a barge route sheltered from the storms and wave action of the open Gulf. The canal runs approximately 3½ miles inland west of the planning area, turning farther inland to intersect the Sabine-Neches Canal near Port Arthur. The canal follows the Sabine-Neches Canal route to a point near Orange, then continues east through Louisiana. To the west, the canal inters East Bay (a branch of Galveston Bay). The canal intercepts several coastal streams, including Taylor Bayou.

The Lower Neches Valley Authority operates a canal system throughout most of the north two thirds of Jefferson County to supply irrigation, domestic, and industrial water. The intakes are located on the Neches River and on Pine Island Bayou north of Beaumont.

There is little or no need for irrigation water in the area from Beaumont to Port Arthur, but the canal system in this area supplies large amounts of domestic and industrial water. Major customers include the cities of Port Arthur, Groves, Port Neches, and Nederland; Jefferson County WCID No. 10 (Central Gardens); and a number of industries including duPont, several chemical plants, and the Fina, Star Enterprise, and Chevron refineries.

One portion of the LNVA canal system extends across the southeastern corner of Hardin County from the intake on the Neches River to Pine Island Bayou. The system extends into eastern Liberty and Chambers Counties and totals several hundred miles in length.

A number of brackish lakes are located in southern Jefferson County to the south of the planning area and west of Sabine Pass. A number of salt water ponds, resulting from oil field activity earlier in the century, are located in the Sour Lake area.

C. Aquifers. Several aquifers underlie the Gulf Coast area and supply it with fresh water. In order from the oldest to the youngest, they are the Oakville Sandstone, sands in the Lagarto Clay, the Goliad Sand, the Willis Sand, the Lissie Formation and sands, and sands and gravels in the Recent alluvium.

The principal aquifer in the Jefferson County area is the Chicot aquifer, including the Lissie and Willis formations. Although this aquifer supplies large quantities of water in Hardin County (particularly for the three large Loeb wells serving the City of Beaumont), only small to moderate fresh water supplies can be obtained in Jefferson County. Some industries in eastern Jefferson County reportedly use partially saline well water for cooling and firefighting purposes. However, all of the cities and all or most industries in the area south of Beaumont take their water supply from the LNVA canal system.

Productive aquifers in Hardin County are in most areas hydrologically connected and are often referred to collectively as the Gulf Coast aquifer. The largest wells are the Loeb wells in the southern Lumberton area, drawing from the Chicot and supplying approximately 45% of the water for Beaumont. Farther north are three wells supplying the Lumberton Municipal Utility District. Two of the Lumberton wells draw from the Chicot; the newer well draws from the deeper Evangeline *(including the Goliad Sand)*.

Kountze is in the process of replacing its older wells with a new and deeper well. Information on varying depths and thicknesses of individual aquifers throughout the county is very inexact in available TWDB materials. Consequently, it is difficult to correlate the Kountze wells to specific units. However, the older wells appear to draw from the Chicot, and the new well from the lower Goliad Sand or the upper Lagarto Clay.

Sour Lake, like Kountze, is in the process of replacing its water supply. The existing wells reportedly draw water from the Chicot sediments with different degrees of mineralization. One of these wells will be taken out of service and the other maintained as a partial source of supply. The new well, located on the west edge of the salt dome area, will draw from the Evangeline aquifer.

Pinewood apparently draws water from the Chicot, as do various communities in northwestern Jefferson County including Bevil Oaks, Meeker, and China.

A 1971 TWDB report indicated that ground water in Jefferson County was fairly well developed, implying little potential for additional water wells without creating problems.

Existing TWDB reports, as well as hydrological reports for the Loeb wells, implied an adequate supply of ground water in southern Hardin County for many years. A 1989 TWC

report shows the entire Southeast Texas area to have less than 20 feet of decline in ground water levels from 1975 to 1985. The report designated some areas, including Orange and eastern Jefferson Counties but not Hardin County, for further study.

D. Interbasin Transfer of Water. All water in the LNVA canal system comes from the Neches River basin. That portion of the water supplying Beaumont, Central Gardens, Nederland, Port Neches, and portions of Port Arthur and Groves is presently being returned to the Taylor Bayou drainage area *(in the Neches-Trinity Coastal Basin)*. The flow from some plants in Groves and Port Arthur enters the Sabine-Neches Canal, also included in the Neches-Trinity Coastal Basin.

The interbasin transfer through the Beaumont and Central Gardens plants, as well as some of the Port Arthur plants, will continue and will increase slightly with future population growth. The future of the various Midcounty plants has been the subject of a regional study partially funded by the TWDB.

The water supply project could impact the amount of interbasin transfer in two ways. First, the project could increase the transfer through substitution of surface water for those communities now using ground water, particularly Beaumont. Second, the water conservation programs which would be implemented in the event of TWDB funding for the project may reduce total water consumption slightly and thus reduce interbasin transfer. However, of the communities involved, Beaumont and Lumberton have already implemented programs, requiring new programs only for the smaller communities..

No agreement is needed to continue, discontinue, or modify interbasin transfer, since the LNVA has jurisdiction over both the Neches-Trinity Coastal Basin and the lower Neches.

Floodplains and Wetlands

Flood hazards within the planning area result from two sources--excessive rainfall and potential hurricane surges from the Gulf. Although the storm surge area covers a significant portion of south Jefferson County as well as the Neches River downstream from Beaumont, hurricanes pose much less danger to populated areas than conventional rainfall flooding.

The floodplain follows the Neches River in a wide band narrowing in the Port Neches and downtown Beaumont areas. Wide areas along Pine Island Bayou, Village Creek, and their main tributaries are also flood prone, with narrow floodplains along several minor streams. Outside the Neches basin, floodplain areas follow Taylor Bayou and its various branches, again occurring in wide bands in many cases *(including most of Fannett.)*

Flooding from the Gulf *(from hurricanes)* is a hazard for almost all of Jefferson County south of Highway 73, including the extreme southwest and southeast portions of the planning area. The Sabine Pass area is included in this flooding zone. The 100 year flood elevation is 22 feet along the coast line, dropping to the 12 foot range near Highway 73. Coastal flooding occurs in some floodplain areas along the Neches River and in the Taylor Bayou basin.

Many local floodplain areas are undeveloped or sparsely developed, especially along the Neches River. However, many communities in the planning area received severe flood damage in the 1979 floods and more recently in the October 1994 floods. Along Pine Island and Little Pine Island Bayous, various communities suffered from severe residential flooding in 1994. Several portions of Beaumont along the Neches River, as well as areas along Village Creek in Hardin County, suffered similar flooding, as did communities in the Taylor Bayou watershed. Some areas which escaped flooding were isolated for one or more days.

The 1994 flooding along Pine Island Bayou reached levels several feet above previously calculated 100 year flood levels.

The developed portions of Nederland, Port Neches, Groves, and Port Arthur are above flooding or are protected by a flood levee encompassing the urbanized area from Nederland through Port Arthur. All rainfall and effluent flows in this area are drained through storm sewers and/or ditches to Jefferson County DD7 pump stations along the levee.

All proposed and alternate plant locations in both counties are outside floodplains.

Wetland maps for Beaumont, Port Arthur, and surrounding areas shows wetland areas to occur predominantly in floodplain areas along the Neches River, Pine Island Bayou, and major branches of the Taylor Bayou system. Wetlands are also scattered throughout undeveloped areas to the south and west of Beaumont, as well as narrow strips along minor streams. Most urbanized areas lack wetlands other than in floodplains and along streams.

USGS quadrangle maps for other portions of Jefferson County show similar wetland patterns north of Highway 73 and in some portions of the area to the south. Most of the county south of Highway 73 is covered with coastal marshes.

Quadrangle maps for the planning area in Hardin County do not show marshy areas outside the Neches River floodplain. It appears that wetland patterns for this area are similar to those in north Jefferson County, but with fewer isolated wetlands within upland areas.

The area south of Sabine Pass consists of tidal salt water marshes. The Neches River marshes are predominantly salt and brackish up to a point downstream from Beaumont where fresh water marshes begin. North of the downstream edge of Beaumont, the marshes are forested. Some portions of the marshland have reportedly been covered with spoil material and thus removed from wetland status.

Climatic Elements

A. General. The climate of the study area is semitropical, with a mixture of tropical and temperate conditions. Sea breezes usually prevent extremely high summer temperatures. The area lies far enough south so that cold air masses of winter are moderate in severity, but still provide seasonal change. The Gulf of Mexico dominates the climate of the region, causing high humidity and high average rainfall. Mean annual relative humidity is approximately 83%, with average annual temperature at Port Arthur of about 69° F.

The average rainfall is 60.0 inches according to 1962-1987 National Weather Service records. The prevailing wind is south-southeasterly, averaging 11 mph. Except during tropical disturbances and severe thunderstorms, the wind seldom exceeds 45 mph. The area enjoys approximately 308 clear or partly cloudy days each year.

Winter temperatures are exceptionally mild. In January, mean temperature is 53.3° F, dropping to 32° F only four-five times in the month. Daily maximum temperatures in winter average 64.3° F. Approximate dates of first and last killing frosts are December 2 and March 2. Prevailing winds from September through January are northerly.

Summers are warm and humid, with a growing season averaging 250 days. The month of July has a mean temperature of 84°F. Daytime maximum temperatures are moderated by the prevailing off-shore winds, which are southerly from February to August.

Rainfall is abundant during the summer months; the excessive amounts of rain will occur over short periods of time. Thunderstorms are most frequent during July and August.

B. Air Quality. The Jefferson-Orange County area was classified as a nonattainment area for not meeting the EPA standards for ozone concentration in the atmosphere. Consequently, the area faces possible sanctions from the EPA if it cannot attain compliance by 1999. As part of a plan for bringing local air quality to EPA standards, the state legislature imposed a requirement for vehicle emissions testing beginning in 1995. However, the program has been suspended in anticipation of favorable results of ongoing studies.

Much of Jefferson County has noticeable odors from various refineries, chemical plants, and rubber industries.

Hardin County, having fewer air quality problems than Jefferson County, was not covered by emission testing requirements. Air quality in the county is generally good, but odors from a paper mill just to the east are often noticeable in southeastern Hardin County.

Biological Elements

A. Plant Communities

1. General. The planning area overlaps two vegetational areas -- the Gulf Prairies and Marshes, and the Piney Woods region. Most of the area in Hardin County, as well as the northern edge of Jefferson County, is forested *(mainly with second growth pines)*. Hardin County lies in the southern edge of the Big Thicket as it originally existed.

   Most of Jefferson County is open land, but with large forested areas southwest of Beaumont and along Pine Island Bayou . Most residential areas from Beaumont to Port Arthur appear to have been open land before trees were planted around homes. In Groves, pecan orchards were planted and later developed into residential lots.

Some areas of Jefferson County are open marshland, much of which is covered with salt tolerant vegetation. These areas include most areas along the west side of the Neches River downstream from Beaumont, as well as a coastal area extending several miles west from the mouth of Sabine Pass.

2. Big Thicket. The Big Thicket, nationally known for a wide variety of plant and animal life, extends through Hardin County to the north edge of Jefferson County. The Big Thicket was originally a vast wilderness extending from the Sabine River *(north of the Beaumont-Port Arthur-Orange area)* westward beyond the Conroe and Huntsville areas. Over the years, timber cutting and advancing civilization transformed most of the Thicket to second growth timber and, in some areas, farm and pasture land. Today, the residual Big Thicket areas can be found mainly in portions of Hardin, Tyler, and Polk Counties, interspersed with other vegetative communities.

   The Thicket is typified by swampy hardwood areas. In addition to pine and hardwood, the area contains many varieties of smaller plants and contains at least seven major plant associations.

3. Sabine-Neches Estuary. The Sabine-Neches Estuary extends from the Gulf to the salt water barrier on the Neches River adjacent to the planning area and is recognized as a sensitive and unique ecosystem. The principal ecological areas are downstream from Beaumont, especially near the Highway 87 bridges over the Neches River.

   Plant life along the estuary includes marsh grasses, tallow and willow trees, sedge, bulrush, and marshay millet.

B. Animal Communities

1. General. Animal life in open areas of Jefferson County includes ducks, quail, doves, geese, prairie chickens, raccoons, mink, squirrels, nutria, muskrats, and deer.4 Aquatic animal life in inland areas includes turtles, moccasins, frogs, and alligators.

   Mammals and birdlife known to occur in Hardin County or in the Big Thicket are listed in Table E-2. Several types of poisonous snakes can be found in the county, including copperheads and cottonmouth moccasins.

2. Sabine-Neches Estuary. Aquatic life in the estuary includes gar, mullet, crabs, blue catfish, saltwater catfish, shrimp, croakers, common water snakes, and Rangia cuneata (a brackish clam). Land animals include nutria, muskrats, raccoons, opossums, rats, mice, beavers, skunks, and moccasins. The estuary contains over 200 species of birds, over half of which are aquatic species.

C. Endangered Species. Correspondence with state and federal wildlife agencies in 1988-90 for a Beaumont wastewater project identified several endangered or candidate species in Jefferson County -- bald eagle, paddlefish, and a wetland plant, Amsonia glaberrima.

Agency correspondence in 1992 for a Lumberton project showed several species listed for Hardin County -- Texas trailing phlox; bald eagle; red-cockaded woodpecker. Additionally, candidate species included six plant species, two reptiles, two birds, and three mammals. Also, the correspondence for the Beaumont project noted two rare or candidate species in southern Hardin County -- Amsonia glaberrima and giant palmetto.

Cultural Resources.

The TWDB, in a previous reconnaissance report for a Beaumont project, indicated that cultural remains (from Indian villages) could be expected mainly along major watercourses. In the planning area, the Neches River appears to be the most likely location for such resources, followed by medium sized streams. It should be noted, however, that many cultural remains along the lower course of the river may have been disturbed over the years in the course of repeated channel dredging and other activities.

The Spindletop Oil Field and nearby Lucas Gusher, south of Beaumont, has been proposed as a National Historic Landmark. This oil field and gusher ushered in the petroleum age at the beginning of the century.

One state historical park is located in Jefferson County. The Sabine Pass Battleground State Historical Park, located south of Sabine Pass, commemorates a Civil War battle near that site. Other historical sites or museums include the French home *(a 19th century pioneer home)*, the Tyrrell Library, and the Spindletop Monument in Beaumont; museums in Nederland, Port Neches, and Port Arthur; and the Kirby-Hill house in Kountze.

The Sour Lake area was the location of major oil field activity early in the century and the birthplace of several major oil corporations. The Beaumont and Port Arthur areas contain several refineries constructed during the first oil boom *(although subsequently modified)*.

In addition to the historical park noted above, the area contains portions of the Big Thicket National Preserve along the Neches River and Pine Island Bayou. Southern Jefferson County contains several parks or wildlife refuges just west of the planning area near Sabine Pass.

A number of golf courses are located in or near the area. Many hunting, fishing, and boating opportunities are within easy driving distance.

Economic Conditions.

Jefferson County is part of the Golden Triangle which encompasses Beaumont and Port Arthur in Jefferson County and Orange in Orange County. Together with Hardin County, these counties make up the Beaumont-Port Arthur-Orange metropolitan area.

The side of the Triangle from Beaumont to Port Arthur, including Nederland, Port Neches, and Groves, is a highly industrialized area extending the length of eastern Jefferson County in a broad strip parallel to the Neches River. Dominant industries in the area include petroleum refining and

chemical and plastics industries, with two large paper mills a short distance north of the Triangle. Shipyards and a steel mill are also located in the Triangle.

In recent years, Jefferson County south of Beaumont has become the home of various state, federal, and county correctional facilities. Upon completion of all currently proposed units, the area will house approximately 12,000 inmates.

Hardin County, especially within the planning area, contains a large proportion of commuters working in Jefferson and Orange Counties or at an Evadale paper mill. The dominant industries are timber industries at Silsbee and Kountze, although some fabricating and septic tank industries can be found in the area. Oilfield drilling and production is still significant in the county, and two small refineries are located in the county north of the planning area.

Jefferson County agriculture consists mainly of rice and soybeans. Timber is the main Hardin County crop, along with Christmas trees, beef cattle, and related feed crops. Truck farming is also common north of Silsbee, outside the planning area.

Jefferson County per capita income for 1989 was $16,375. Average weekly wage rate was $446.53 in 1990, with retail sales over $1.8 billion and tax value over $10 billion. For Hardin County, corresponding figures were $12,691, $308.62, $357 million, and $1.37 billion

The petroleum industry was born in Jefferson County at the beginning of the century. Over the years the area became highly dependent on oil and related industries, including refining, chemical/plastics manufacturing, and fabrication of oil field equipment. The local economic growth peaked in the early 1980's during a period of high demand for oil and refined products.

However, because of high oil prices, motors were made more efficient, reducing worldwide fuel demand. Refineries cancelled expansion plans and laid off thousands of workers. Shipyards declined, and oil prices fell in 1986 on the collapse of OPEC price controls.

At the same time, the major timber industries in Silsbee were sold and remained closed for a period of time. Employment in southern Hardin County reached approximately 20% for some time. One of the refineries in that area was also closed for several years.

Local employment has improved since then, despite additional plant closings and cutbacks. Factors contributing to improved conditions include diversification efforts, the growth of service industries, tax abatements, plant construction for environmental purposes, and the selection of Jefferson County for state and federal prison facilities. However, some plant closings continue to occur, and some plants remaining in service are cutting back on staffing.

The Jefferson County Airport at Nederland serves the Southeast Texas area with several airlines, with smaller airports at Beaumont and Kountze. Highways in the area include an interstate, three federal and nine state highways, and a number of farm roads and spurs. Several branches of four major railroads pass through the area. Local ship channels include the Neches River and connecting

channels to the Gulf. Ports include industrial ports in Port Arthur and Port Neches, as well as the Ports of Port Arthur and Beaumont. The Intracoastal Waterway, passing the southeast edge of Port Arthur, carries barge traffic.

Education through high school is provided by several school districts in each county, as well as by various parochial schools. Higher education is available at Lamar University at Beaumont, Port Arthur, and Orange.

General hospitals within or adjacent to the planning area are located in Beaumont, Nederland, Groves, Port Arthur, and Silsbee, with various specialized hospitals in Jefferson County.

The 1995 populations of the main cities are estimated at 117,952 for Beaumont, 16,401 for Nederland, 13,285 for Port Neches, 16,950 for Groves, and 60,110 for Port Arthur. For the entire planning area, the 1995 population is estimated at 251,230 (235,130 in Jefferson County, 16,100 in Hardin County. Projected populations in 25 and 50 years are as follows:

Year	Jefferson	Hardin	Total
2020	268,750	27,730	296,480
2045	307,430	35,410	342,840

Land Use

A Jefferson County. Existing and potential land use covers a broad spectrum.

Beaumont, Nederland, Port Neches, Groves, and Port Arthur all have zoning. Each city contains large residential areas as well as varying amounts of commercial, public, and public areas. Large industrial areas are also located within or adjacent to each city.

Beaumont and Port Arthur also contain large areas of vacant land, both developable and undevelopable. Port Neches contains large undevelopable areas, but little developable area. Nederland and Groves contain little developable land, but Nederland has a potential to annex a considerable adjoining area.

Various other residential communities in Jefferson County include Central Gardens, Beauxart Gardens, Fannett, Hamshire, China, Nome, Northwest Forest, and Bevil Oaks.

An area west of Nederland and south of Beaumont is becoming the home of various existing and proposed correctional facilities on the federal, state, and county levels.

In contrast with the urban areas which are mainly concentrated along the east side of the county, vast areas are used for farming, pasture, and timber. Also, oil and gas wells are scattered throughout the county.

B. Hardin County. Hardin County, although much less urbanized than Jefferson County, includes several residential communities. Cities within the planning area are Kountze,

Lumberton, Sour Lake, Rose Hill Acres, and Grayburg. Also within the area is Pinewood (unincorporated).

The cities contain a mixture of solid residential areas, residential and commercial strip development along highways, vacant land, and *(in the cases of Kountze and Lumberton)* small industries.

Most of the area in Hardin County is covered with timber, much of it in floodplains. Limited areas are used for farming and pasture. Some timber land, mainly in corridors along major streams, is included in the Big Thicket National Preserve or in Village Creek State Park in the Lumberton area.

Other Programs

A. Economic Development. A number of programs were developed in Southeast Texas in the late 1980's for the purpose of attracting new industries. The immediate goal was to replace the thousands of jobs lost during that decade from plant closings and production cutbacks. Some programs included a low interest loan program in which local citizens accepted a low rate of interest on savings; City revolving loan funds (in Beaumont and Port Arthur) for small businesses; several job training programs; and agencies providing various information to new or expanding businesses, including export assistance.

Local governments in the area also offered tax abatements for new industrial facilities or for expansion of existing facilities.

Jefferson County and several local governments submitted a proposal several years ago for a state prison location on a site between Beaumont and Port Arthur. The site was selected by the state government, and a number of state units are in service, under construction, or scheduled within the next few years. Similar proposals to the federal government resulted in a federal prison under construction west of the state facilities.

Other recent programs for economic development include establishment of foreign trade zones, enterprise zones, and economic redevelopment zones. Hardin County has applied for and received several grants which directly or indirectly aid in providing utility service to a plant under construction between Silsbee and Evadale just outside the planning area.

The immediate goal of most of these programs was to provide employment for local residents who lost their previous jobs or who were entering the job market. Beyond that goal, additional net job creation could induce the Southeast Texas area to grow beyond the peak population reached in the 1980's.

The economical development programs have been relatively successful in the last several years, although some plant closings have continued to occur. As a result, the TWDB increased its population projections for Jefferson County and for cities within the county.

Increased population and industrial growth in the area will be a major factor in the need for this planning study. The growth over the next several decades may place a strain on available ground water resources. However, it must be noted that several other factors can lead to the need for increased surface water usage, including potential restrictions on ground water usage by state or federal agencies.

B. Drainage. Most of Jefferson County suffers from poor natural drainage because of flat topography and low elevation. Drainage for the Midcounty cities, as well as the Port Arthur area, is enhanced by Jefferson County Drainage District No. 7. The District operates a network of improved drainage ditches, many of which are concrete lined.

Surrounding the urbanized area on three sides is a storm levee constructed by the Corps of Engineers, designed to protect against tidal surges during hurricanes. The drainage system takes local storm water to various points just inside the levee and pumps it to the opposite side of the levee with storm water pump stations. Some pumps must operate daily because of large volumes of domestic and industrial treatment plant effluent.

Drainage from most cities in that area reaches the Main Outfall Ditch and is pumped by the Alligator pump station. The intermittent operation of existing pumps results in cyclic high levels in the lateral ditch which receives effluent from two wastewater plants in Port Neches and Groves. The high stream levels create hydraulic problems in the Port Neches plant, thus reducing effective flow capacity for wastewater effluent.. The District has been seeking funding to upgrade its pumping facilities to eliminate this problem.

Drainage in most of north Jefferson County, including Beaumont, is assisted by drainage ditch improvements by Jefferson County Drainage District No. 7. Many drainage ditches feed into segments of the Taylor Bayou system improved by the Corps of Engineers.

Some areas of Hardin County require drainage improvements. Near Lumberton and Sour Lake, some ditches are maintained by the county or by the City of Lumberton.

C. Miscellaneous Programs. Several highway improvements within the planning area are under construction, including several projects in Beaumont.. For the Midcounty area, a master plan for future westward highway loop extensions has been prepared for linking the Midcounty area with Interstate 10 to Houston. Ongoing widening of State Highway 73 west of Port Arthur will also improve access to the area. In coming years, Interstate 10 from Beaumont southwest is expected to be widened from four to six lanes.

The Hardin County portion of the planning area will benefit within a few years from a relocation of U. S. 69 to an abandoned railroad right-of-way extending from Lumberton to Lufkin and recently purchased by the Texas Department of Transportation.

Other programs which contribute to the quality of life in Jefferson County include low rent housing programs; mosquito control by a county agency; and the higher education provided at Beaumont and Port Arthur by Lamar University. Hardin County also has low rent housing in some portions of the planning area.

PRIMARY IMPACTS OF VARIOUS ALTERNATIVES

Short Term Impacts

A. Alterations to Land Forms, Streams, Drainage Patterns

1. Intake and Transmission Lines. Any linework *(except boring, tunnelling, and above-grade crossings)* will temporarily alter the ground surface and any streams crossed. Local drainage patterns will often be disturbed, including temporary impediments to small ditches and streams. However, contractors will normally be required to restore existing conditions.

   Stream crossings will be designed to have little or no permanent effect on stream flow. Pipe supports will be located outside the streams or located/designed to minimize erosion and flow impediment.

2. Water Treatment Plant Construction. Treatment units may require small amounts of sitework including plant access roads. Other permanent alterations in land forms *(other than in cases of raw water or sludge reservoirs)* should be minor. Trenching operations for yard piping will cause only temporary alterations. Any drainage pattern alterations will be minor.

   The need for sitework should be minimized since all proposed or alternate plant sites lie in flat areas.

   Any sludge storage ponds or raw water reservoirs will involve some levee work and probably several feet of excavation over the pond areas. Also, if the in situ soil fails to meet impermeability requirements *(as is likely for the Regional Plant No. 2)*, undercut and replacement with a clay or synthetic liner will also be needed. A clay liner may require moderate amounts of borrow excavation from offsite.

   Drainage patterns should not be impacted noticeably from treatment unit or pond construction because of the relatively small areas involved.

3. Intake Stations. Raw water intake stations would be a part of the plant sites for Regional Plant No.1 and 3. Offsite stations would be required for Regional Plant No. 2. Site work would be similar to that for plant sites, except that it would cover less land, would not involve reservoir construction, and may require a longer access road with more grading required.

B. Siltation and Sedimentation. Siltation and sedimentation could occur temporarily and locally in the drainage patterns of the project areas pending revegetation.

Control measures for treatment plant construction should be covered to a large extent by a required Pollution Prevention Plan, at least in the case of the regional plant in Jefferson County. Such measures may include silt curtains, hay bales, salvaging/ replacing topsoil,

reseeding, and scheduling operations for favorable weather. All potential plant sites lie in flat areas, thus minimizing the risk of erosion.

Measures for linework and offsite intake stations will be similar. Additionally, ditch crossings for linework will be sodded and/or covered with riprap as necessary. Headwalls will be placed around intake lines if necessary.

C. Effects of Construction on Area Watercourses. The linework, as well as yard piping in plants, will require large amounts of trenching throughout the construction period. Some temporary and minor siltation of watercourses is expected. Any stream crossing requiring pipe supports in an unlined stream will involve some siltation.

Some boring and/or tunnelling is anticipated for the linework, but it should not affect watercourses unless soil from the bore pits washes into ditches or streams.

Mitigative measures, in addition to those discussed in subsection b above, may include scheduling for dry weather and low stream flow; possible isolation of the crossing area by sandbags; and location of equipment outside the stream.

Offsite intake stations, because of their location near streams, pose a risk of soil being knocked into the streams accidentally or washed into the streams. Protective measures will be included in construction specifications as appropriate.

Intake lines will be designed so as to have minimum impact on the canals or streams in which they are located.

D. Injury to Cover Vegetation. Vegetation must be removed from construction areas, but the areas will be restored to the extent that they are not covered by reservoirs, treatment units, etc. Care will be taken to minimize destruction to adjacent tree roots.

Vegetation from any reservoirs will be disposed of.

Any rare or endangered species found in a construction area will be considered for preservation by transplanting or design modifications.

E. Herbicides, Defoliants, Cutting, Burning. Clearing will not involve herbicides or defoliants. Large amounts of cutting are not expected for the Regional Plant No. 1 or for the alternate Meeker plant because of the open nature of the area. Regional Plant No. 3, even should it be located in a timbered area, would not involve much cutting because of its limited size. Regional Plant No. 2 may involve several acres of clearing, but it is likely that the plant would be located in an area of light timber which has grown up since clear cutting several years ago.

Small amounts of cutting would be required for offsite intake stations and their access roads. Intake and transmission lines would in most cases involve little clearing since the lines would

be small enough to be located in existing highway and road ROW or, in the case of the transmission line to Beaumont, pass through open land.

The intake for Regional Plant No. 2 is likely to require at least a mile of clearing from Pine Island Bayou to the intersection of the abandoned Southern Pacific railroad ROW with U. S. 69, since most of the water line corridor is already taken. From that point to a point near the plant, the line could parallel the abandoned railroad ROW. Even so, the line would require clearing if it is constructed before the proposed highway along the route, or if it is found necessary to take a new easement outside the ROW. The southmost 1½ miles of ROW is likely not to be used for a highway route, so clearing will probably required for that distance.

The transmission line to Kountze will probably require clearing for at least part of the distance unless it follows the Southern Pacific ROW and is constructed after the route has been cleared for highway construction.

Burning, if applicable, will be conducted according to TNRCC regulations for areas within and outside cities.

F. Disposal of Soil and Vegetative Spoil. Any excess linework excavation which cannot be spread along the route must be removed, but can probably be placed on nearby vacant land or construction sites. Excess soil from plant construction (including reservoirs) can probably be placed within the site.

Vegetative spoil, if not placed within unused portions of plant sites, can be disposed of in a commercial landfill south of Beaumont.

G. Land Acquisition.

1. Amount to be Acquired. Acreages required for plant sites include 14 acres for the Regional Plant No. 1, 1 acre for Regional Plant No. 3, and 8 acres for Regional Plant No. 2, exclusive of reservoirs. Requirements for offsite intake stations are less than one acre for the Plant No. 2.

   Regional Plants No. 1 and 3 would not require easements for intake lines because of their location adjacent to the canals supplying their raw water. Regional Plant No. 2 is expected to require between one and six miles of easements for its intake line, depending on how much the abandoned Southern Pacific ROW *(recently purchased by the Texas Department of Transportation for highway ROW)* can be used for the water line.

   The transmission line to Beaumont is expected to require at least ¾ mile of easement parallel to Highway 105 to reach the existing City water system. Up to 1.8 miles of additional easement may be required if the City water mains at the city limits are inadequate at the time the new plant is constructed. Several miles of easements may be required for the transmission line to Kountze if the route follows the Southern Pacific ROW and if that ROW is not available for a water line route at the time of water line

construction. Alternately, if the line follows existing U. S. 69, easements would be required for part of the distance within Lumberton to avoid conflict with existing Lumberton water lines.

2. Method of Acquisition. The plant sites, offsite intake station sites, and linework easements will be acquired according to the Uniform Relocation and Assistance Act of 1970. Eminent domain will be exercised only if necessary. Existing improvements along line routes will remain undisturbed as much as practical.

3. Effects on Adjacent Land Values. Little effect on land values adjacent to plant sites or offsite intake stations is expected. The same is true for land along line routes except that some land values along treated water transmission could improve if the owner of the line allows connections along the way.

H. Abandonment of Facilities. Some existing water wells for the communities involved could be abandoned or their use reduced after the new plants are in service. Associated facilities such as storage tanks, booster pumps, and transmission lines could also be abandoned with the wells.

However, the project would not be the true cause of the abandonments. The project, or selected elements of it, would be constructed only in response to actual or imminent problems with existing water supplies. Such problems could be impaired quantity or quality of ground water, increased operating costs, or possible future regulatory requirements. The project would afford an alternate or replacement supply which would allow the communities to reduce their dependency on ground water.

I. Discharge of Water Treatment Wastes. It is probable that all wastes such as filter backwash will routed into existing sewer systems instead of being discharged directly into surface drainage. These wastes are not expected to have any significant impact on the wastewater collection or treatment facilities.

J. Construction in Waterways. The Corps of Engineers will be contacted regarding the possible need for Section 10 or 404 permits for construction in waterways. Such contact will be made whenever any portion of the project potentially requiring a Corps permit is to be implemented. It is presently anticipated that permits may be required only for offsite intake facilities and for linework crossing streams or wetland areas. Primary candidate locations include the stream crossings between the Regional Plant No. 1 and Sour Lake *(Pine Island Bayou, possibly Coon Marsh Gully, and/or Goleman Gully, and/or Clemmons Gully)*; the Pine Island Bayou intake for the Regional Plant No. 2; and the Cypress Creek crossing between that plant and Kountze. It is probable that most if not all of these locations would be covered under a nationwide permit rather than requiring individual permits.

K. Dust Control. Dust problems are unlikely for any project elements. If necessary, construction areas can be watered in dry weather.

l. Noise. Normal construction noise will be a short term nuisance in the immediate vicinity. Noise will occur in residential and commercial areas, along highways, and also in remote areas. OSHA requirements, including mufflers, should protect residents and wildlife.

M. Blasting. No blasting should be required.

N. Safety Provisions. Construction within plant sites will not interfere with vehicular or pedestrian traffic. If heavy construction traffic causes problems on roads leading to the sites, or in cases of linework along travelled roads, standard safety precautions will be taken such as barricades, warning signs, etc. Parking of construction vehicles will be kept away from heavy traffic or sensitive areas as much as possible.

Open trenches will be closed as soon as possible or barricaded to prevent accidental entry. If necessary, pedestrian walkways will be provided.

Measures such as warning signs, fences, and locked gates will be used as needed to keep the public out of plant sites. Similar measures will be used for the offsite intake station, in addition to its relatively isolated location.

O. Night Work. Night work will occur only in special cases such as when construction of a project element is needed urgently to replace a failing existing source of water. Effects of the resulting noise will be minimized by noise control measures or remote locations as appropriate.

P. Effects on Existing Utilities. Owners of all pipelines and utilities crossing linework routes will be notified well in advance of construction. Owners will be contacted to determine facility depths, avert damage, and arrange for any necessary adjustments.

Long Term Impacts

A. Land Affected, Beneficial Uses. Away from construction sites, land uses may be affected by slight improvement in developability as a result of adequate water availability. This future development is not expected to affect wetlands or prime agricultural land, or floodplains other than through infilling.

B. Scenic Views. No scenic views should be affected. No landscaping, other than restoring existing surface conditions, is needed for any alternative.

C. Wind Patterns. Prevailing winds are described as being from the south-southeast, although the wind rose shows several prevalent directions.

No odor problems are expected to result from the water treatment plants or from intake facilities.

No incineration is proposed in any sludge disposal methods.

D. Land Application. No land application of water treatment wastes, including sludge, is proposed.

E. Effects on Aquatic Life. The effect of increased surface water withdrawal on aquatic life should be considered. The scope of services to make this determination is beyond the scope of this project.

F. Effects on Water Uses. The project should not affect the uses of the streams from which the raw water is drawn.

G. Diversion of Flows. The project would increase the amount of water being diverted from the Neches basin to the Neches-Trinity Coastal basin through the Beaumont wastewater plant, and to a lesser extent through the China plant. Other communities to be served by the project would not be affected in that regard, since they would simply be returning the water to the Neches basin from which they received it.

H. Historical, Cultural, and Archeological Resources. No known historical, cultural, or archeological resources are known to occur in any areas where they would be impacted by the project. However, if any state financing will be involved in the project, the appropriate agencies *(TWDB Archeologist, Texas Historical Commission, and Texas Antiquities Committee)*, will be notified in advance.

If any archeological resources are discovered during construction, work at the immediate site will be suspended pending archeological investigation.

I. Recreational Areas and Preserves. The only recreational area or preserve in which any project elements would fall is the corridor of the Big Thicket National Preserve running along Pine Island Bayou. The raw water intake for Regional Plant No. 2 is to be located in this unit. The project should have negligible effect on this area.

J. Noise Levels. Noise sources will occur in each water treatment plant as well as at the offsite intake station. If necessary, various precautions such as mufflers or motor housing can be used.

K. Access Control. All plant sites as well as the offsite intake station will be surrounded by fences with lockable gates. The isolated locations of the intake station will also discourage trespassing.

L. Insect Nuisance. Insect nuisance is not a significant problem with surface water plants or intake facilities.

M. Floodplains. None of the proposed or alternate plant sites falls within floodplains. However,.the offsite intake station is expected to be in flood zone because of its proximity to the stream supplying the raw water. Linework within the floodplain includes portions of the following lines:

- Transmission line from the Regional Plant No. 1 to Sour Lake: Crossings of Pine Island Bayou, Coon Marsh Gully, Goleman Gully, and Clemmons Gully.

- Intake line to Regional Plant No. 2: Intake @ Pine Island Bayou; crossings of unnamed branches.

- Transmission line to Kountze: Crossing of Cypress Creek.

The intake station is expected to be elevated above flooding.

N. Air Quality. The project should have no effect on air quality.

O. Energy and Chemical Consumption. Energy consumption should be relatively small in the water treatment plants. The main sources of energy consumption would be pumps, mixing units, and clarifier motors. The offsite intake station will also consume a considerable amount of energy, since it will have to pump the raw water for six miles or more to a higher elevation.

P. Coastal Zones. The project should have no impact on coastal zones.

Q. Effects on Wildlife. The project should have no effect on wildlife.

R. Effects on Utilities. The linework will be designed to minimize any problems for existing pipelines and other underground facilities Coordination will be made with pipeline and utility owners during construction.

SECONDARY IMPACTS OF VARIOUS ALTERNATIVES

A. Land Uses. The project can facilitate continued residential growth within the various communities by providing the necessary water supply to supplement or replace existing ground water sources. The project would allow the communities to make efficient use of various other facilities already available or programmed, such as water distribution, wastewater facilities, and highway improvements. Industrial growth could also possibly be stimulated, although any industries using large amounts of water would be more likely to provide their own water treatment.

The amount of residential growth projected by the TWDB for Hardin and Jefferson Counties is relatively moderate even for the next 50 years. Of the communities to served by the project, Beaumont and Lumberton are likely to experience the most growth. This growth will occur in some areas, particularly in western Beaumont and some parts of Lumberton, mainly by developing existing open land. In many parts of Lumberton, however, growth will occur by infilling of existing residential areas. The land where development is likely to occur is predominantly forested in Lumberton and some parts of north Beaumont, but open in western Beaumont. The preference of many homeowners to retain as many trees as possible will ten to reduce the impact of the development on the character of the land.

B. Air Quality. Automobile usage within the planning area should increase somewhat from development. Such increase will be small in relation to existing local and through traffic. Possible requirements for biannual emission testing in Jefferson County should reduce the impact of automobile exhausts. It should be noted that automobile fumes are a relatively small source of air pollution in relation to industrial emissions. Also, much local air quality problems are suspected to result from air currents from the Houston area to the west.

C. Water Quality. Growth in the communities served by the project should have no effect on the quality of the water supply from the Neches River and Pine Island Bayou upstream from the area.

D. Effect on Public Services. Water usage will increase somewhat with growth, but the increase should be offset slightly by water conservation measures. The amount of increased usage should not present a major problem because of the large drainage area of the Neches River and the high rainfall within its basin.

Most of the area to be served is on public sewer systems. The wastewater facilities will require periodic expansion along with growth.

Solid waste management will be a problem in the future with or without population growth. The existing BFI landfill south of Beaumont reports that it has adequate permitted capacity until 2030, considering the communities which it will be serving over the years. It is not known whether additional land would be permitted at that time or whether alternative methods such as incineration would be used. Recycling of as much solid waste as possible can be expected in the future.

With regard to electric power, the Gulf States nuclear plant in Louisiana serving the project area should have adequate power for the area until it reaches the end of its useful life in several decades. By then, alternative energy sources may be developed.

Natural gas service should be adequate for many years to those portions of the project area which are on gas lines. Telephone service can be expanded whenever necessary by adding new area codes and facilities.

E. Economic Impacts. When it becomes necessary to convert from ground to surface water, the capital and operating costs will increase considerably. However, the facilities will be designed so as to minimize the economic impact.

F. Land Use Changes Versus Land Use Plans. Any future development within Beaumont or its ETJ will be in conformance with zoning plans and the City's master plan. Other communities

to be served by the project have little or no zoning, although some subdivisions have restrictions. All new development in the area will be subject to plat approval by county and/or city governments.

G. Impacts of Growth on Sensitive Areas. No growth in floodplains other than infilling is anticipated from the project because of floodplain ordinances. Also, no development of land with significant wetland characteristics is expected, since each plat is scrutinized for any local problems prohibitive to development.

There are no known developable areas within the planning area comprising critical habitats, or environmentally sensitive, other than floodplains and wetlands.

MUNICIPAL SURVEY FORM

REGIONAL WATER SUPPLY PLANNING STUDY

SPONSORED BY

LOWER NECHES VALLEY AUTHORITY

1. Name and address of water purveyor. _____
   _____
   _____
   _____

2. Description of water purveyor.

   City _____

   Water District *(MUD, WCID, etc.; specify)* _____

   Water Supply Corporation _____

   Privately Owned Water Utility Company _____

   Other (specify) _____

3. Service Area *for Water Service*:

   a. Community name and/or description _____
      _____

   b. Current population served _____

   c. Number of service connections _____

   d. General description of customers served -- residential, industrial, agricultural, wholesale, etc. _____
      _____

e. Information on any wholesale customers *(example: a rural water supply corporation receiving its water supply from a city)* or other major customers: name, location, nature of business, population, volume of water usage, etc. Please note if this is an emergency or backup supply only. _____

_____

_____

_____

_____

_____

_____

_____

f. Please mark location of your service area (including any wholesale users) on the enclosed map.

4. Water Production Facilities or Other Sources:

a. Is all or part of your water supply purchased as treated water? If so:

(1) Please indicate supplier and quantity. _____

_____

_____

(2) What is maximum usage rate in your contract with supplier? _____

_____

b. Ground water, surface water, or both? If both, please indicate approximate percentage or volume from each source. Ground _____%

Surface _____%

c. For your own wells:

(1) Please show approximate location(s) on enclosed map.

(2) Capacity(ies): Design capacities and/or actual present capacities.

_____

_____

(3) If one or more wells is inactive or maintained for emergency use only, please explain *(such as mechanical problems, water quality or quantity problems, other supply which is more economical, etc.)* _____

(4) Depths: total, screen intake, etc.; including any information on current water table level. _____

(5) Date of construction or initial service of well(s); also, any information on subsequent reworking or improvements to wells. If wells were purchased from others, please note previous owner and date of purchase. _____

(6) Any available design data: aquifer supplying water; design life of well; design average and peak demand; number/type of pumps *(note if multiple stage)*; horsepower, pump capacity including total dynamic head, etc. **You may wish to lend us a copy of any available design report and/or specification book.**

(7) Treatment provided to well water for use as domestic supply -- chlorination, fluoridation, other chemical treatment, aeration, etc. _____

(8) Please provide copy of latest water quality analysis.

(9) General condition of well(s). Please note specific problems, including lowered water tables or water quality problems, if identified. _____

Municipal Water Supply Survey Form (cont.)

d. For your surface water production:

(1) Please show approximate location(s) of treatment plant(s) and raw water intake(s) on enclosed map. Please note name of stream or canal if known.

_____

(2) Please describe transmission facilities [pipeline(s) including size; your own lateral canal including size; any pumping facilities at intake point or other location, including pumping capacity] required to transmit water from intake source to your plant or reservoir. Please show route of transmission facilities on map, if applicable. _____

_____

_____

_____

_____

_____

(3) Please describe treatment facilities: flocculation, clarification, filters, chemical treatment, etc., including unit sizing and capacities. *Please provide flow diagram if available.* _____

_____

_____

_____

_____

_____

(4) Capacity(ies): Design capacities and/or actual present capacities of surface water treatment plants. _____

_____

_____

_____

_____

(5) Date of construction or initial service of treatment plant(s); also, any information on subsequent expansion, upgrading, rehabilitation, etc. _____

_____

_____

_____

(6) Any available design data: raw water quality; design life of plant(s); design average and peak capacity; etc. **You may wish to lend us a copy of any available design report and/or specification book.**

Municipal Water Supply Survey Form (cont.)

(7) Allowable raw water withdrawal rate *(as specified in water rights permit, contract with LNVA, etc.)* _____

_____

(8) General condition of plants(s) and intake facilities. Please note specific problems, including raw water quality or quantity problems, if identified.

_____

_____

_____

_____

_____

(9) Please provide copies of any TNRCC permits which you may hold in connections with your surface water plant, including rights to withdraw surface water.

5. Other Water Facilities:

a. Storage facilities, including raw water reservoirs, clearwells, other ground storage, elevated storage. Please identify each facility as to type and volume. Please show approximate locations on enclosed map. _____

_____

_____

_____

_____

b. Pressure maintenance facilities, if other than elevated tanks: hydropneumatic tanks, high service pumps, and booster pumps within system. Please identify each facility as to type, number of units, and size *(volume of pressure tanks, gpm of pumps)*. Please show approximate locations on enclosed map. _____

_____

_____

_____

_____

_____

c. Please lend us a water system map if possible, showing distribution system and other facilities *(such as wells, water treatment plants, raw water intakes, transmission line or canal routes, tanks, pumping stations, etc.)*.

6. Water Usage: *Please show for entire system and/or for each source as appropriate your total water production including in-house usage, system losses, water lost in treatment plant backwash, etc.:*

Municipal Water Supply Survey Form (cont.)

a. Current annual average usage. _____

b. Peak historical monthly usage. _____

c. Peak historical daily usage. _____

d. Please provide copies of water production reports for last twelve months.

e. Approximate percentage or quantity of water lost *(leaks, backwash, etc).* _____
_____

7. Information on any known plans for major improvements (ongoing, in near future, or planned for future phase), including actual or projected year of implementation. This includes plans to construct, expand, deactivate, or abandon existing facilities. _____
_____
_____
_____
_____
_____

8. Please provide a copy of your current rate structure.

9. Please show on map your preferred point(s) of delivery for (a) raw surface water and (b) treated water in the event that your system should in the future be supplied with water by a regional system. *In essence, you would be requesting that a pipeline or canal be constructed to that point (if none exists now).*

February __, 1995

[Name, address of water purveyor]

Re: Lower Neches Valley Authority
Regional Water Supply Study
Inventory of Existing Water Supply
Facilities and Users
Information Survey Form

Dear _____:

Schaumburg & Polk, Inc., has been retained to conduct a Regional Water Supply Planning Study for a designated area in Jefferson and Hardin Counties as shown on the attached map. This study is sponsored by the Lower Neches Valley Authority with the assistance of twelve local governments in the two counties. The study is partially funded by the Texas Water Development Board.

The study will identify the region's water supply needs for the next fifty years, and a master plan will be prepared accordingly. Large volumes of water in the planning area are used for domestic, industrial, and agricultural purposes. This water comes from two sources--ground and surface water. The region's ground water supply is gradually becoming less feasible as a major water source because of declining aquifer levels and, in some area, deteriorating water quality. At the same time, surface water is becoming a precious commodity in some regions, and even in Southeast Texas the supply is not unlimited during prolonged droughts.

The study will examine whether continued use of ground water will remain feasible over the long term. If the study should indicate the need for future conversion to surface water, or if a regionalized surface water supply system should prove more feasible than long-term use of local facilities, the most cost effective mode of regional supply will be determined.

The enclosed questionnaire addresses one of the primary tasks of the study, an inventory of existing water treatment/supply facilities within the study area. This questionnaire is designed to provide information on existing water sources, production/treatment facilities, storage facilities, and usage. You will also be asked to designate your preferred point(s) of delivery for raw or treated water, in the event that a regionalized supply should become feasible in the future.

This planning effort is not for the purpose of forcing any individual water supplier to abandon any of its own water facilities in favor of a regional system. However, many communities in the area have already begun to face increased difficulties in producing water and then treating it to acceptable standards. Problems which the Southeast Texas area faces include declining ground water levels, intrusion of salt water into fresh water aquifers, and upgraded standards in the Safe Water Drinking Act. This study is designed to identify feasible methods for each supplier to meet its needs in the event that its existing source of supply becomes unfeasible or uneconomical in the future.

Enclosed is one copy each of the following:

1. Municipal Survey Form.

2. Map showing planning area for LNVA study.

3. Enlarged map of the portion of the planning area in which your facilities are located.

4. Summary page listing items to be supplied and to be marked on map.

We request that the survey form and requested materials be returned to us _____[time frame] _____ as follows:

Carl D. McConnell
Schaumburg & Polk, Inc.
Consulting Engineers
8865 College Street
Beaumont, Texas 77707

Please call me or Gary Graham, P. E. of this office if you have any questions.

Sincerely,
SCHAUMBURG & POLK, INC.

Carl D. McConnell
Project Manager

CDM/DE

encl.

cc: Lower Neches Valley Authority

SUMMARY PAGE

MUNICIPAL SURVEY FORM

Items to be Provided or Shown on Maps

A. Items for Map

1. Service area for water system *(including any wholesale customers)*.
2. Water wells serving system.
3. Surface water treatment plants serving system.
4. Raw water intake points *(on stream or LNVA canal, as applicable)*.
5. Transmission routes from raw water intakes to treatment plants (if applicable).
6. Storage facilities *(raw water reservoirs, clearwells, ground storage, elevated tanks)*.
7. Pressure maintenance facilities.
8. Preferred delivery point(s) for raw or treated water.

B. Supplementary Items

1. Design report, specification book, and/or other design data for wells.
2. Water quality analysis for well(s).
3. Flow diagram for surface water treatment facilities.
4. Design report, specification book, and/or other design data for surface water treatment plants.
5. Any applicable TNRCC permits related to surface water intake and/or treatment plant operation.
6. Water system map.
7. Copies of water production reports for last twelve months.
8. Copy of your current rate structure.

INDUSTRIAL SURVEY FORM

REGIONAL WATER SUPPLY PLANNING STUDY

SPONSORED BY

LOWER NECHES VALLEY AUTHORITY

1. Name and address of industrial water user. _____
   _____
   _____
   _____

2. Description of industrial water user. _____
   _____
   _____
   _____

3. Service Area *for Water Service*:

   a. Please list or describe your facilities served with water *(such as several neighboring industrial plants; marine terminals; plant offices, etc)*. _____
      _____
      _____
      _____

   b. Information on any resale water customers *(example: your facility resells a portion of its water supply to a neighboring facility, subdivision, rural water line customers, etc.)*: name *(if other than individual residences)*, location, nature of business, population, volume of water usage, etc. Please note if this is an emergency or backup supply only.
      _____
      _____
      _____
      _____
      _____
      _____

   c. Any information on special water quality requirements for any portions of your facility or for resale customers, including volume of high quality water required.
      _____
      _____
      _____
      _____
      _____

d. If you or any of your resale customers use large volumes of non-potable water *(or could safely substitute non-potable water)*, please provide information, including volume of such usage. _____

_____

_____

_____

_____

_____

e. If such nonpotable water comes from sources separate from the rest of your usage, please explain. _____

_____

_____

f. Please mark location of your service area (including any resale users) on the enclosed map.

4. Water Production Facilities or Other Sources:

a. Is all or part of your water supply purchased as treated water? If so:

(1) Please indicate supplier and quantity. _____

_____

_____

(2) What is maximum usage rate in your contract with supplier? _____

_____

b. Ground water, surface water, or both? If both, please indicate approximate percentage or volume from each source. Ground _____%

Surface _____%

c. For your own wells:

(1) Please show approximate location(s) on enclosed map.

(2) Capacity(ies): Design capacities and/or actual present capacities.

_____

_____

(3) If one or more wells is inactive or maintained for emergency use only, please explain *(such as mechanical problems, water quality or quantity problems, other supply which is more economical, etc.)* _____

(4) Depths: total, screen intake, etc.; including any information on current water table level. _____

(5) Date of construction or initial service of well(s); also, any information on subsequent reworking or improvements to wells. If wells were purchased from others, please note previous owner and date of purchase. _____

(6) Any available design data: aquifer supplying water; design life of well; design average and peak demand; number/type of pumps *(note if multiple stage)*; horsepower, pump capacity including total dynamic head, etc. **You may wish to lend us a copy of any available design report and/or specification book.**

(7) Treatment provided to well water for use as domestic or industrial supply -- chlorination, fluoridation, other chemical treatment, aeration, etc.

(8) Please provide copy of latest water quality analysis. If inapplicable *(such as well used for nonpotable water only)*, please explain. _____

(9) General condition of well(s). Please note specific problems, including lowered water tables or water quality problems, if identified. _____

_____

_____

_____

_____

d. For your surface water production:

(1) Please show approximate location(s) of treatment plant(s) and raw water intake(s) on enclosed map. Please note name of stream or canal if known.

_____

(2) Please describe transmission facilities [pipeline(s) including size; your own lateral canal including size; any pumping facilities at intake point or other location, including pumping capacity] required to transmit water from intake source to your plant or reservoir. Please show route of transmission facilities on map, if applicable. _____

_____

_____

_____

_____

_____

(3) Please describe treatment facilities: flocculation, clarification, filters, chemical treatment, etc., including unit sizing and capacities. *Please provide flow diagram if available.* _____

_____

_____

_____

_____

_____

(4) Capacity(ies): Design capacities and/or actual present capacities of surface water treatment plants. _____

_____

_____

_____

_____

(5) Date of construction or initial service of treatment plant(s); also, any information on subsequent expansion, upgrading, rehabilitation, etc. _____

_____

_____

_____

(6) Any available design data: raw water quality; design output quality or purpose; design life of plant(s); design average and peak capacity; etc. **You may wish to lend us a copy of any available design report and/or specification book.**

(7) Allowable raw water withdrawal rate *(as specified in water rights permit, contract with LNVA, etc.)* _____

_____

(8) General condition of water treatment plants(s) and intake facilities. Please note specific problems, including raw water quality or quantity problems, if identified.

_____

_____

_____

_____

_____

_____

(9) Please provide copies of any TNRCC permits which you may hold in connections with your surface water plant, including rights to withdraw surface water.

5. Other Water Facilities:

a. Storage facilities, including raw water reservoirs, clearwells, other ground storage, elevated storage. Please identify each facility as to type and volume. Please show approximate locations on enclosed map. _____

_____

_____

_____

_____

b. Pressure maintenance facilities, if other than elevated tanks: hydropneumatic tanks, high service pumps, and booster pumps within system. Please identify each facility as to type, number of units, and size *(volume of pressure tanks, gpm of pumps)*. Please show approximate locations on enclosed map. _____

_____

_____

_____

_____

_____

c. Please lend us a water system map if possible, showing distribution system and other facilities *(such as wells, water treatment plants, raw water intakes, transmission line or canal routes, tanks, pumping stations, etc.)*.

6. Water Usage: *Please show for entire system and/or for each source as appropriate your total water production including in-house usage, system losses, water lost in treatment plant backwash, etc.:*

a. Current annual average usage. _____

b. Peak historical monthly usage. _____

c. Peak historical daily usage. _____

d. Please provide copies of water production reports for last twelve months. If inapplicable *(such as water source or plant used for nonpotable water only)*, please explain.

e. Approximate percentage or quantity of water lost *(leaks, backwash, etc)*. _____

_____

7. Information on any known plans for major improvements to water facilities (ongoing, in near future, or planned for future phase), including actual or projected year of implementation. This includes plans to construct, expand, deactivate, or abandon existing water facilities. _____

_____

_____

_____

_____

_____

8. Please provide a copy of your current rate structure, if you have resale customers.

9. Please show on map your preferred point(s) of delivery for (a) raw surface water and (b) treated water in the event that your system should in the future be supplied with water by a regional system. *In essence, you would be requesting that a pipeline or canal be constructed to that point (if none exists now).*

February __, 1995

[Name, address of industrial water user]

Re: Lower Neches Valley Authority
Regional Water Supply Study
Inventory of Existing Water Supply
Facilities and Users
Information Survey Form

Dear _____:

Schaumburg & Polk, Inc., has been retained to conduct a Regional Water Supply Planning Study for a designated area in Jefferson and Hardin Counties as shown on the attached map. This study is sponsored by the Lower Neches Valley Authority with the assistance of twelve local governments in the two counties. The study is partially funded by the Texas Water Development Board.

The study will identify the region's water supply needs for the next fifty years, and a master plan will be prepared accordingly. Large volumes of water in the planning area are used for domestic, industrial, and agricultural purposes. This water comes from two sources--ground and surface water. The region's ground water supply is gradually becoming less feasible as a major water source because of declining aquifer levels and, in some area, deteriorating water quality. At the same time, surface water is becoming a precious commodity in some regions, and even in Southeast Texas the supply is not unlimited during prolonged droughts.

The study will examine whether continued use of ground water will remain feasible over the long term. If the study should indicate the need for future conversion to surface water, or if a regionalized surface water supply system should prove more feasible than long-term use of local facilities, the most cost effective mode of regional supply will be determined.

The enclosed questionnaire addresses one of the primary tasks of the study, an inventory of existing water treatment/supply facilities within the study area. This questionnaire is designed to provide information on existing water sources, production/treatment facilities, storage facilities, and usage. You will also be asked to designate your preferred point(s) of delivery for raw or treated water, in the event that a regionalized supply should become feasible in the future.

This planning effort is not for the purpose of forcing any individual water supplier to abandon any of its own water facilities in favor of a regional system. However, many communities in the area have already begun to face increased difficulties in producing water and then treating it to acceptable standards. Problems which the Southeast Texas area faces include declining ground water levels, intrusion of salt water into fresh water aquifers, and upgraded standards in the Safe Water Drinking Act. This study is designed to identify feasible methods for each supplier to meet its needs in the event that its existing source of supply becomes unfeasible or uneconomical in the future.

Enclosed is one copy each of the following:

1. Industrial Survey Form.

2. Map showing planning area for LNVA study.

3. Enlarged map of the portion of the planning area in which your facilities are located.

4. Summary page listing items to be supplied and to be marked on map.

We request that the survey form and requested materials be returned to us _____[time frame] _____ as follows:

Carl D. McConnell
Schaumburg & Polk, Inc.
Consulting Engineers
8865 College Street
Beaumont, Texas 77707

[Should we provide self-addressed envelopes w/postage for municipal, industrial, and agricultural users?]

Please call me or Gary Graham, P. E. of this office if you have any questions.

Sincerely,
SCHAUMBURG & POLK, INC.

Carl D. McConnell
Project Manager

CDM/DE

encl.

cc: Lower Neches Valley Authority

[I do not know how much data from the various types of questionnaires will be shown in report. If it is intended for any data to go into report directly, I recommend providing separate envelope or other method for industries to designate part of information as confidential.]

SUMMARY PAGE

INDUSTRIAL SURVEY FORM

Items to be Provided or Shown on Maps

A. Items for Map

1. Service area for water system *(including any resale customers).*
2. Water wells serving industry and/or resale customers.
3. Surface water treatment plants serving system.
4. Raw water intake points *(on stream or LNVA canal, as applicable).*
5. Transmission routes from raw water intakes to treatment plants (if applicable).
6. Storage facilities *(raw water reservoirs, clearwells, ground storage, elevated tanks).*
7. Pressure maintenance facilities.
8. Preferred delivery point(s) for raw or treated water.

B. Supplementary Items

1. Design report, specification book, and/or other design data for wells.
2. Water quality analysis for well(s).
3. Flow diagram for surface water treatment facilities.
4. Design report, specification book, and/or other design data for surface water treatment plants.
5. Any applicable TNRCC permits related to surface water intake and/or treatment plant operation.
6. Water system map.
7. Copies of water production reports for last twelve months.
8. Copy of your current rate structure.

AGRICULTURAL SURVEY FORM

REGIONAL WATER SUPPLY PLANNING STUDY

SPONSORED BY

LOWER NECHES VALLEY AUTHORITY

1. Name and address of agricultural user. _____
   _____
   _____
   _____

2. Description of agricultural operations, including livestock, chickens, crawfish, etc. _____
   _____
   _____
   _____

3. Service Area *for Water Service*:

   a. Approximate acreage for each type of agricultural operation requiring irrigation.
      _____
      _____
      _____

   b. Number of each type of livestock for which water must be supplied *(other than from on-site ponds)* _____

   c. Water usage for each type of irrigation or other agricultural operation (total annual, peak) _____
      _____
      _____
      _____

   d. Estimated volume of potable water used *(for non-agricultural purposes)* if water service includes domestic use. Please explain if such domestic use is other than single residence.
      _____
      _____
      _____
      _____

e. Information on any resale water customers *(example: your farm resells a portion of its water supply to a neighboring farm, business, etc.)*: name *(if other than individual residences)*, location, nature of business, population *(if applicable)*, volume of water usage, etc. _____

_____

_____

_____

f. Please mark location of your service area (including any resale users) on the enclosed map.

4. Water Production Facilities or Other Sources:

a. Is all or part of your water supply purchased as treated water? If so, please indicate supplier and quantity. _____

_____

_____

b. Ground water, surface water, or both? If both, please indicate approximate percentage or volume from each source. Ground _____%

Surface _____%

c. For your own wells:

(1) Please show approximate location(s) on enclosed map.

(2) Capacity(ies): Design capacities and/or actual present capacities.

_____

_____

(3) If one or more wells is inactive or maintained for emergency use only, please explain *(such as mechanical problems, water quality or quantity problems, other supply which is more economical, etc.)* _____

_____

_____

_____

(4) Depths: total, screen intake, etc.; including any information on current water table level. _____

_____

_____

(5) Date of construction or initial service of well(s); also, any information on subsequent reworking or improvements to wells. If wells were purchased from others, please note previous owner and date of purchase. _____

_____

_____

_____

(6) Any available design data: aquifer supplying water; design life of well; design average and peak demand; number/type of pumps *(note if multiple stage)*; horsepower, pump capacity including total dynamic head, etc. If you do not have this information, please show name of well driller. **You may wish to lend us a copy of any available design report and/or specification book.** _____

_____

_____

_____

_____

_____

(7) Treatment provided to well water for domestic use if applicable -- chlorination, aeration, water softening, etc. _____

_____

(8) Please provide copy of latest water quality analysis, if applicable.

(9) General condition of well(s). Please note specific problems, including lowered water tables or water quality problems, if identified. _____

_____

_____

_____

_____

d. For your surface water usage:

(1) Please show approximate location(s) of raw water intake(s) on enclosed map. Please note name of stream or canal if known. _____

_____

(2) Please describe transmission facilities [pipeline(s) including size; your own lateral canal including size; any pumping facilities at intake point or other location, including pumping capacity] required to transmit water from intake source to your reservoir or points of usage. Please show route of transmission facilities on map, if applicable. _____

(3) If you treat any of your surface water *(as for domestic use)*, please describe treatment facilities.

(4) Allowable raw water withdrawal rate *(as specified in water rights permit, contract with LNVA, etc.)* _____

(5) General condition of intake facilities. Please note specific problems, including raw water quality or quantity problems, if identified. _____

(6) Please provide copies of any TNRCC permits which you may hold in connection with your surface water usage, including rights to withdraw surface water.

5. Storage facilities, including tanks and raw water reservoirs. Please identify each facility as to type and volume. Please show approximate locations on enclosed map. _____

6. Information on any known plans for major improvements (ongoing, in near future, or planned for future phase), including actual or projected year of implementation. This includes plans to construct, expand, deactivate, or abandon existing facilities. _____

_____

_____

_____

_____

_____

7. Please provide a copy of your current rate structure, if you have resale customers.

8. Please show on map your preferred point(s) of delivery for (a) raw surface water and (b) treated water in the event that your farm should in the future be supplied with water by a regional system. *In essence, you would be requesting that a pipeline or canal be constructed to that point (if none exists now).*

February __, 1995

[Name, address of agricultural user]

Re: Lower Neches Valley Authority
Regional Water Supply Study
Inventory of Existing Water Supply
Facilities and Users
Information Survey Form

Dear _____:

Schaumburg & Polk, Inc., has been retained to conduct a Regional Water Supply Planning Study for a designated area in Jefferson and Hardin Counties as shown on the attached map. This study is sponsored by the Lower Neches Valley Authority with the assistance of twelve local governments in the two counties. The study is partially funded by the Texas Water Development Board.

The study will identify the region's water supply needs for the next fifty years, and a master plan will be prepared accordingly. Large volumes of water in the planning area are used for domestic, industrial, and agricultural purposes. This water comes from two sources--ground and surface water. The region's ground water supply is gradually becoming less feasible as a major water source because of declining aquifer levels and, in some area, deteriorating water quality. At the same time, surface water is becoming a precious commodity in some regions, and even in Southeast Texas the supply is not unlimited during prolonged droughts.

The study will examine whether continued use of ground water will remain feasible over the long term. If the study should indicate the need for future conversion to surface water, or if a regionalized surface water supply system should prove more feasible than long-term use of local facilities, the most cost effective mode of regional supply will be determined.

The enclosed questionnaire addresses one of the primary tasks of the study, an inventory of existing water treatment/supply facilities and water usage within the study area. This questionnaire is designed to provide information on existing water sources, production/treatment facilities, storage facilities, and usage. You will also be asked to designate your preferred point(s) of delivery for raw or treated water, in the event that a regionalized supply should become feasible in the future.

This planning effort is not for the purpose of forcing any individual water user to abandon any of its own water sources in favor of a regional system. However, many communities in the area have already begun to face increased difficulties in producing water and then treating it to acceptable standards. Problems which the Southeast Texas area faces include declining ground water levels, intrusion of salt water into fresh water aquifers, and upgraded standards in the Safe Water Drinking Act. This study is designed to identify feasible methods for each supplier to meet its needs in the event that its existing source of supply becomes unfeasible or uneconomical in the future.

Enclosed is one copy each of the following:

1. Agricultural Survey Form.
2. Map showing planning area for LNVA study.
3. Enlarged map of the portion of the planning area in which your farm is located.
4. Summary page listing items to be supplied and to be marked on map.

We request that the survey form and requested materials be returned to us _____ [time frame] _____ as follows:

Carl D. McConnell
Schaumburg & Polk, Inc.
Consulting Engineers
8865 College Street
Beaumont, Texas 77707

Please call me or Gary Graham, P. E. of this office if you have any questions.

Sincerely,
SCHAUMBURG & POLK, INC.

Carl D. McConnell
Project Manager

CDM/DE

encl.

cc: Lower Neches Valley Authority

SUMMARY PAGE

AGRICULTURAL SURVEY FORM

Items to be Provided or Shown on Maps

A. Items for Map

1. Service area for water usage *(including any resale customers)*.
2. Water wells serving farm *(and/or any customers)*.
3. Raw water intake points *(on stream or LNVA canal, as applicable)*.
4. Transmission routes from raw water intakes to storage and/or points of use (if applicable).
5. Storage facilities *(raw water reservoirs, tanks)*.
6. Preferred delivery point(s) for raw or treated water.

B. Supplementary Items

1. Design report, specification book, and/or other design data for wells.
2. Water quality analysis for well(s).
3. Any applicable TNRCC permits related to surface water intake and/or treatment plant operation.
4. Copy of your current rate structure.

APPENDIX B

Baker, E.T., 1964, Geology and ground-water resources of Hardin County, Texas: Texas Water Comm. Bull. 6406, 179 p.

_____ 1979, Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas: Texas Dept. Water Resources Rept. 236, 43 p.

Carr, J.E., Meyer, W.R., Sandeen, W.M., and McLane, I.R., 1985, Digital models for simulation of ground-water hydrology of the Chicot and Evangeline aquifers along the Gulf Coast of Texas: Texas Dept. Water Resources Rept. 289, 101 p.

Miller D.A., and Price, R.D., 1979, Ground-water availability in Texas, estimates and projections through 2030: Texas Dept. Water Resources Rept. 238, 77 p.

Texas Water Commission: 1989, Ground-water quality of Texas - an overview of natural and man-affected conditions: Texas Water Comm. Rept. 89-01, 197 p.

_____ 1971, Ground-water resources of Chamber and Jefferson Counties, Texas: Texas Water Devel. Board Rept. 133, 183 p.

Thorkildsew, D., and Quincy, R., 1990, Evaluation of Water Resources of Orange and Eastern Jefferson Counties, Texas: Texas Water Devel. Board Rept. 320, 34 p.

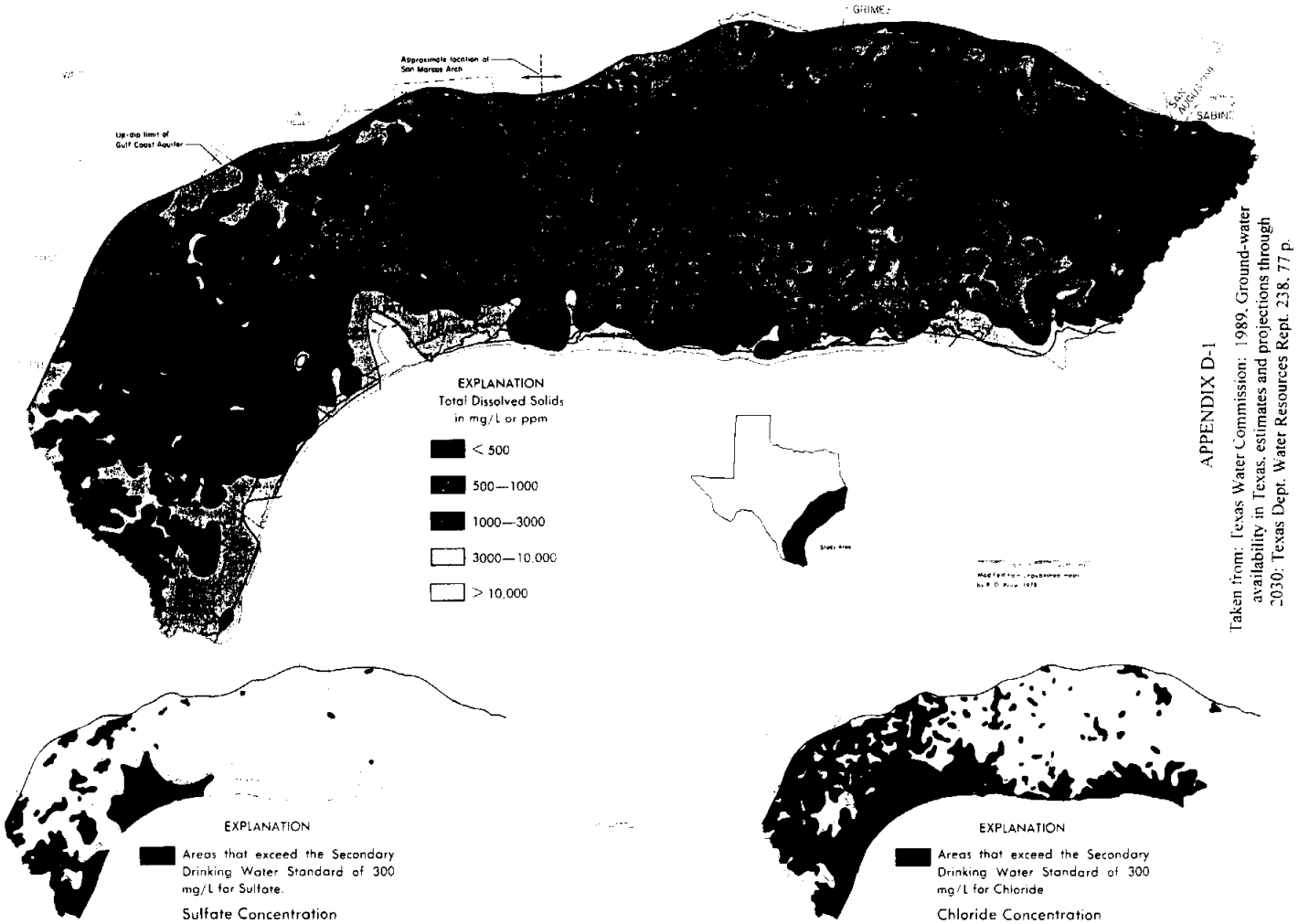
Table 1.--Geologic and Hydrologic Units Used in This Report and in Recent Reports in Nearby Areas

		HARDER (1960)		ROGERS AND CALANDRO (1965)		RECENT TEXAS REPORTS		BAKER (1964)	WESSELMAN (1965)	WOOD AND GABRYSCH (1965)	1/	THIS REPORT	
SYSTEM	SERIES	FORMATION	HYDROLOGIC UNIT	GROUP OR FORMATION	HYDROLOGIC UNIT	FORMATION		HYDROLOGIC UNIT	HYDROLOGIC UNIT	HYDROLOGIC UNIT	HYDROLOGIC UNIT	HYDROLOGIC UNIT	
Quaternary	Holocene	Alluvium		Alluvium	Alluvium	Alluvium 2/		GULF COAST AQUIFER		Beaumont		Upper	Chicot aquifer
	Pleistocene	Prairie Formation	Chicot shallow	Stream terrace and upland deposits	Stream terrace and upland deposits	Beaumont Clay			Upper aquifer		Chicot aquifer	Chicot	
		Montgomery Formation	"200 foot"			Lissie Formation 3/	Montgomery Formation		Middle aquifer	Alta Loma Sand of Rose (1943)		Lower	
		Bentley Formation	"500 foot"				Bentley Formation						
		Willianna Formation	"700 foot"			Willis Sand 4/						Chicot	
Tertiary	Pliocene	Foley Formation	Evangeline aquifer	Fleming Formation of Kennedy (1892)	Blounts Creek Member of Fisk (1940)	Goliad Sand			Lower aquifer	Heavily pumped layer	Evangeline aquifer	Evangeline aquifer	
	?	Fleming Formation of Fisk (1940)	?		Castor Creek Member of Fisk (1940)	Fleming Formation 5/							
	Miocene									Zone 2	Burkeville aquiclude	Burkeville aquiclude	

1/ Wesselman (1967), Tarver (1968a and 1968b), Anders and others (1968), Sandeen (1968), and Wilson (1967).
2/ Floodplain and terrace deposits in Baker (1964).
3/ Lissie Formation in Baker (1964), Wesselman (1965 and 1967), Sandeen (1968), and Anders and others (1968); and Bentley and Montgomery Formations in Wilson (1967) and Tarver (1968a and 1968b).
4/ Pliocene (?).
5/ Shown as the Lagarto Clay of Miocene (?) age in Baker (1964) and Wesselman (1967).

APPENDIX C

Taken From: Wesselman, J.B., 1971, Ground-water Resources of Chambers and Jefferson Counties, Texas: Texas Water Devel. Board Rept. 133. 183 p.



APPENDIX D-1

Taken from: Texas Water Commission: 1989. Ground-water availability in Texas, estimates and projections through 2030: Texas Dept. Water Resources Rept. 238. 77 p.

Figure 15

Existing Ground-Water Quality in the Gulf Coast Aquifer

(Based on Total Dissolved Solids Content of Ground Water From Wells Tapping all Depths, With Sulfate and Chloride Concentration Insets)

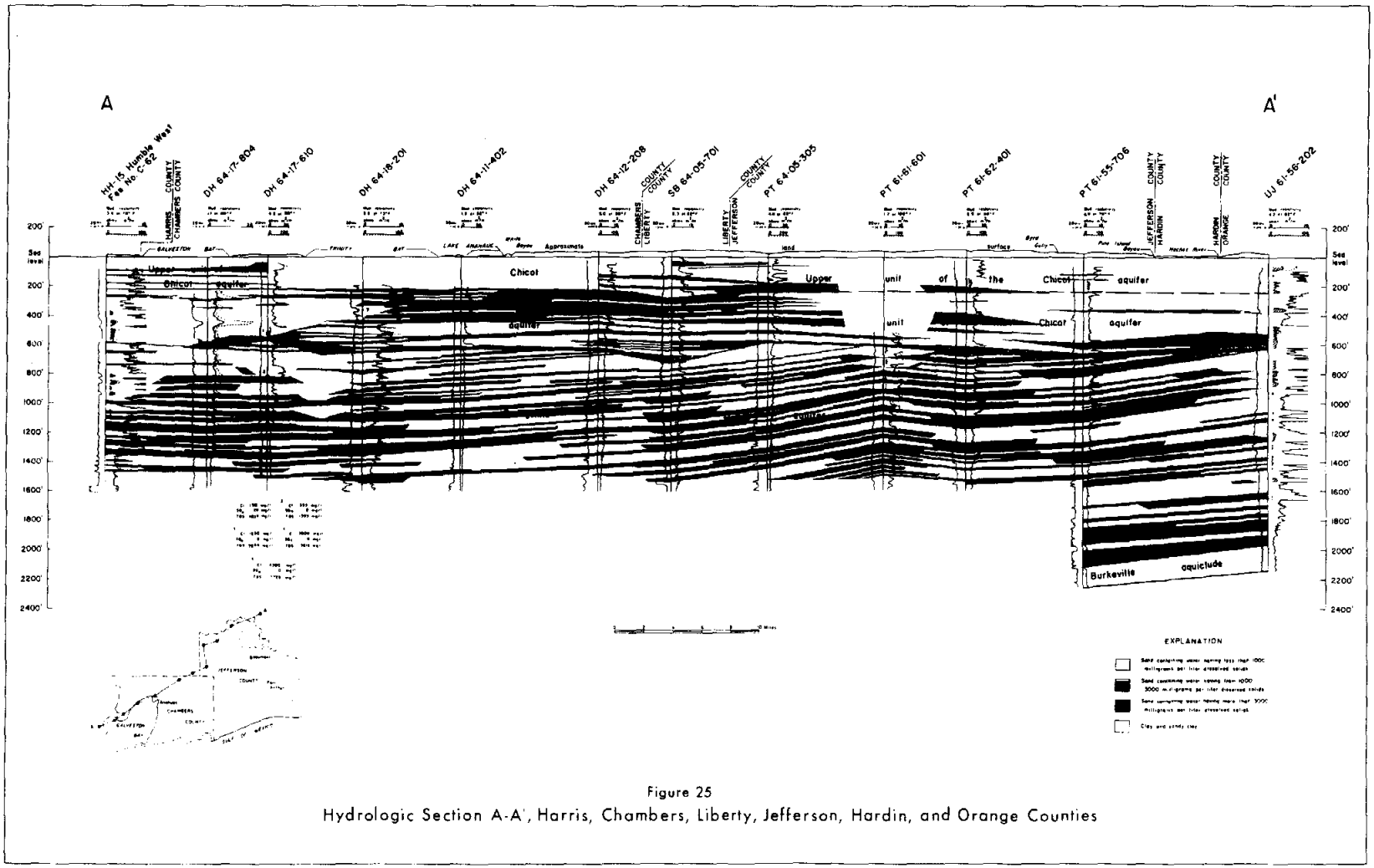


Figure 25
Hydrologic Section A-A', Harris, Chambers, Liberty, Jefferson, Hardin, and Orange Counties

APPENDIX D-2

Taken From: Wesselman, J.B., 1971, Ground-water Resources of Chambers and Jefferson Counties, Texas: Texas Water Devel. Board Rept. 133, 183 p.

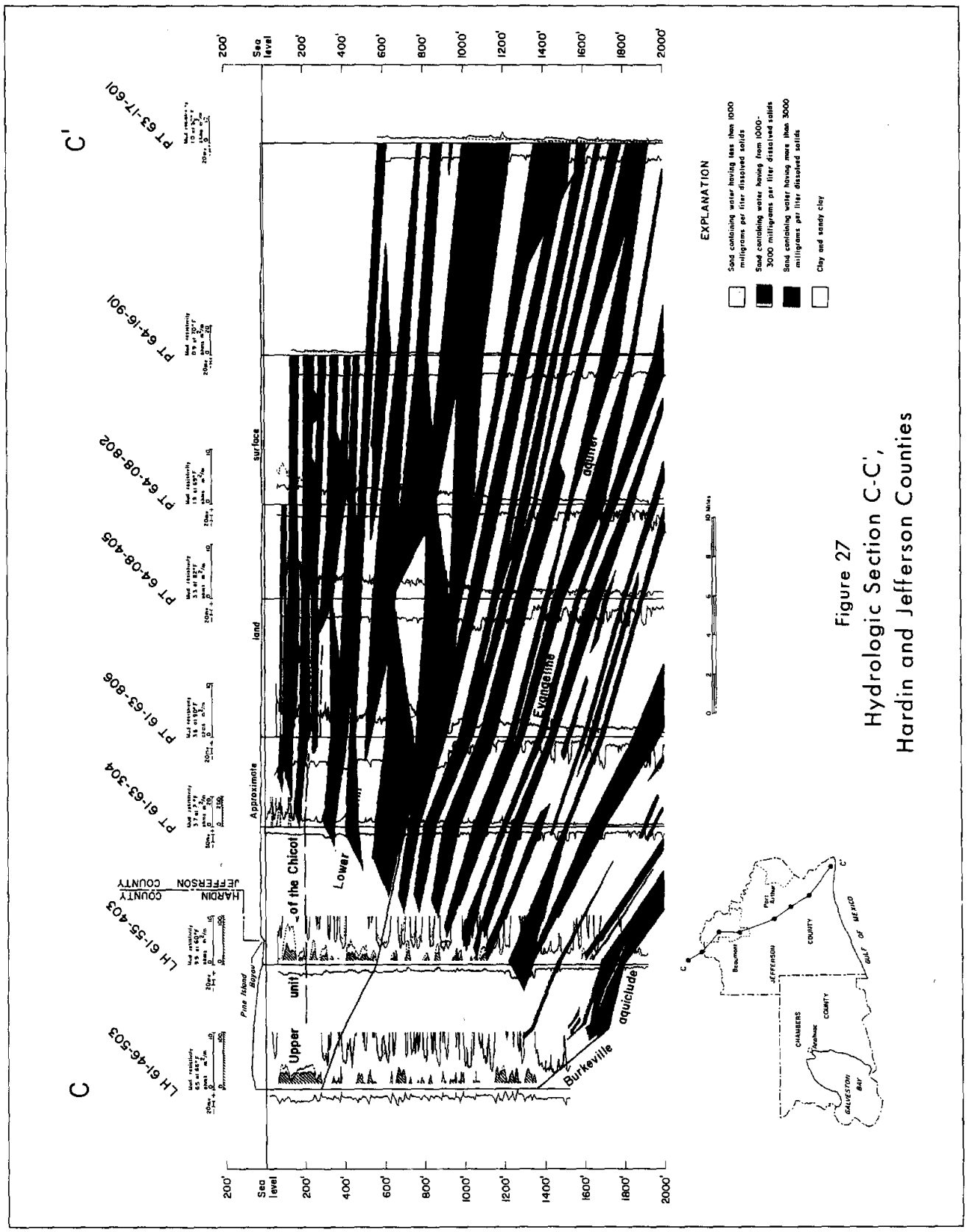


Figure 27
Hydrologic Section C-C',
Hardin and Jefferson Counties

APPENDIX D-3

Taken From: Wesselman, J.B., 1971, Ground-water Resources of Chambers and Jefferson Counties, Texas: Texas Water Devel. Board Rept. 133, 183 p.

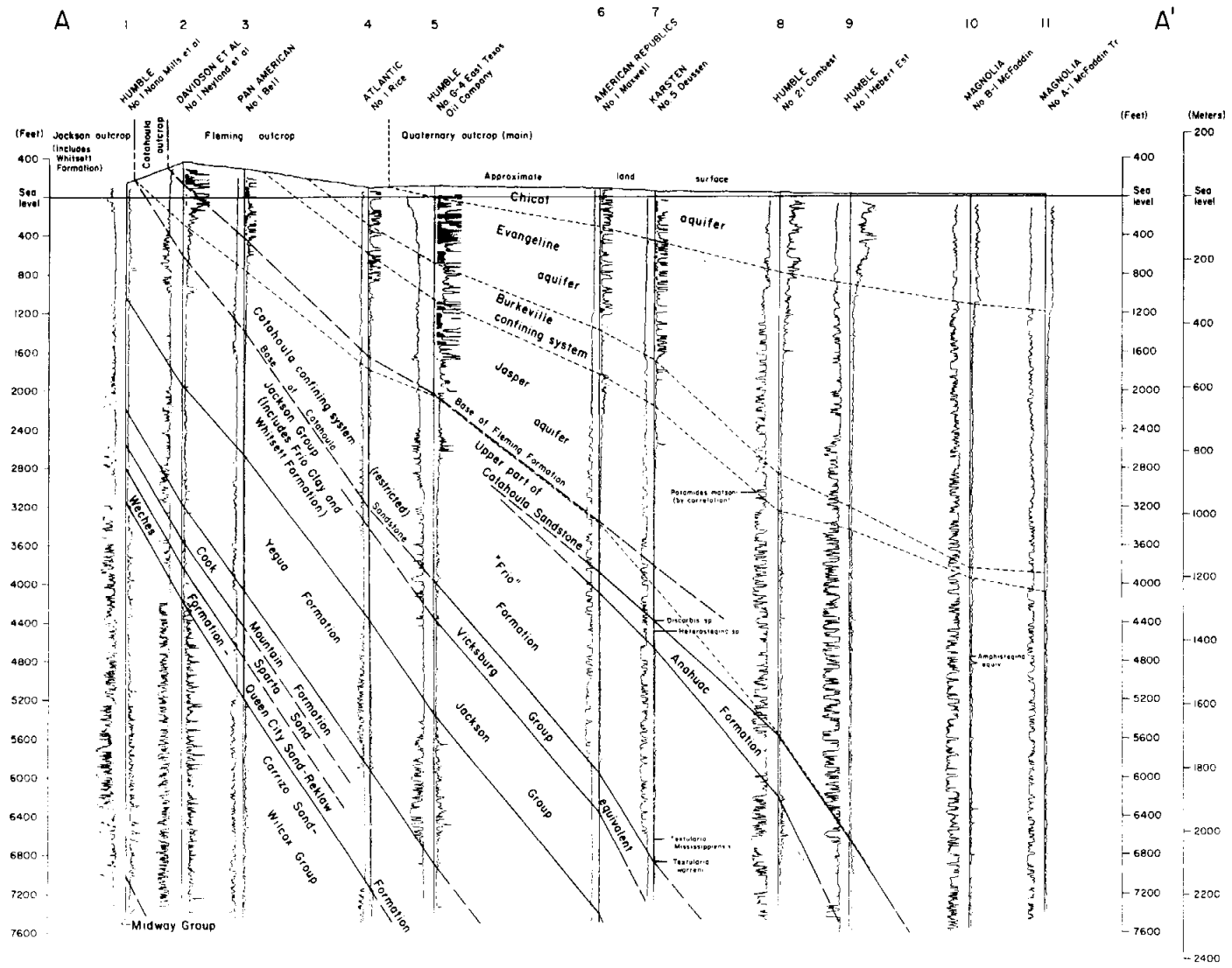


Figure 2
Stratigraphic and Hydrogeologic Section A-A'

APPENDIX D-4

Taken From: Baker, E.T., 1964, Geology and ground-water resources of Hardin County, Texas: Texas Water Comm. Bull. 6406, 179 p.

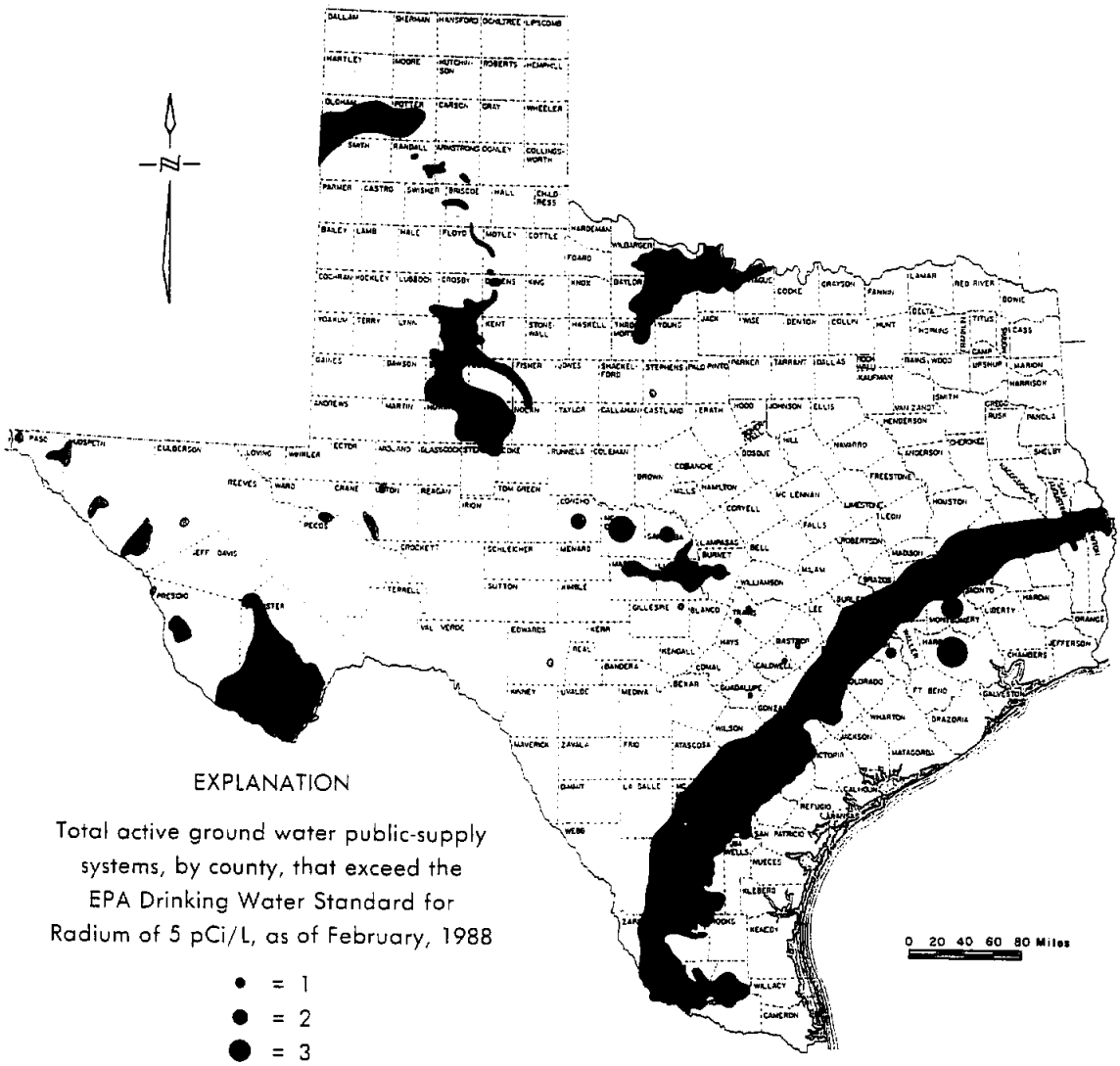


Figure 7

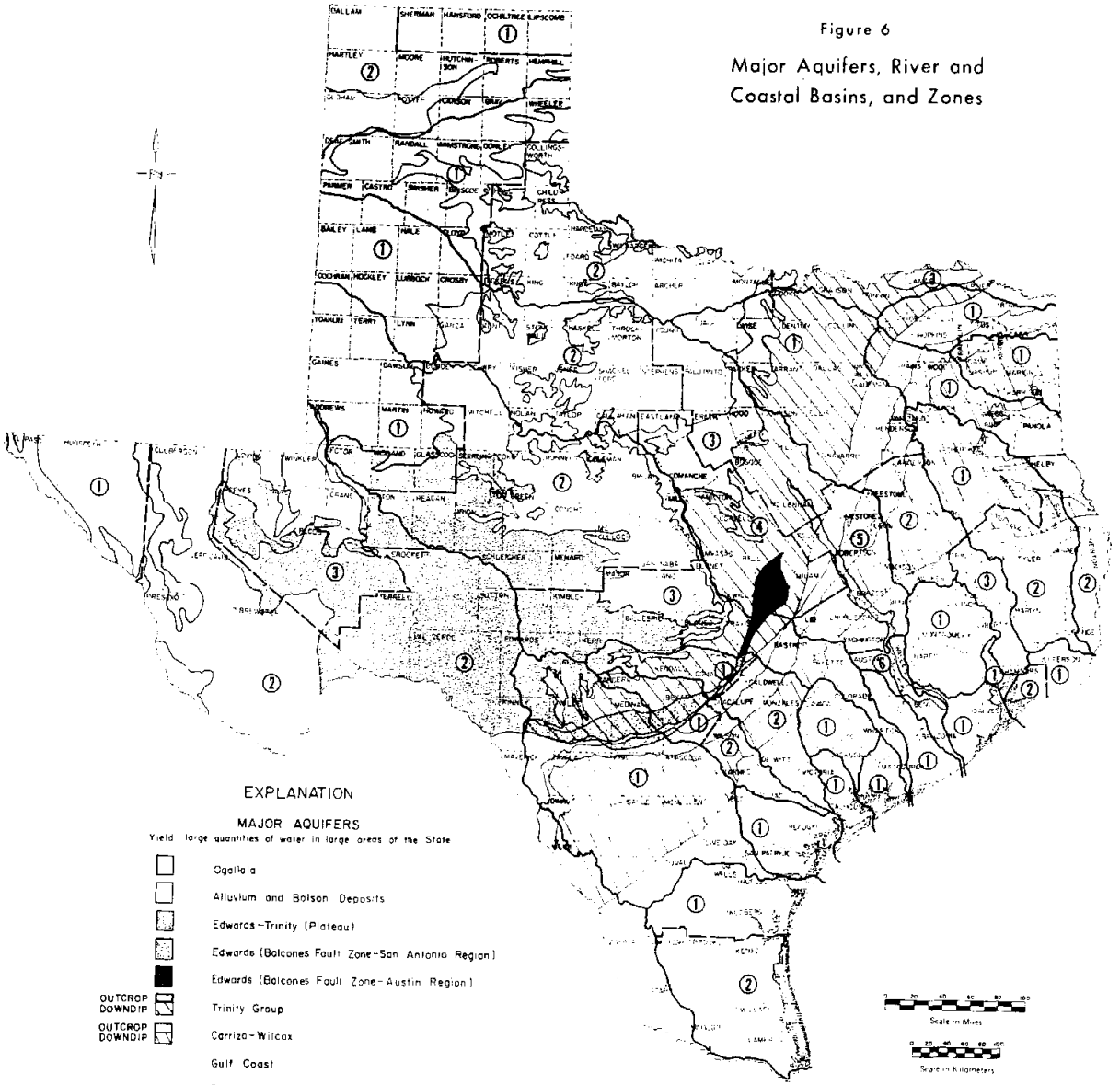
Known Occurrences or Areas of Potentially Radioactive Ground Waters in Texas

APPENDIX D-5

Taken from: Texas Water Development Commission: 1989 Groundwater availability in Texas, estimates and projections through 2030: Texas Dept. Water Resources Rept. 238, 77p.

Figure 6

Major Aquifers, River and Coastal Basins, and Zones



APPENDIX E

Taken from: Muller, Daniel A. and Price, Robert D., September, 1979, Ground-water availability in Texas, Texas Dept. of Water Resources Rept. No. 238.

Appendix A.—Estimates of Ground-Water Availability in Texas by River Basin, Coastal Basin, Zone, and Aquifer—Continued

Basin	Zone	Aquifer	Ground-water availability: Annual effective recharge (acre-feet)	1974 storage: Recoverable (acre-feet)	1974 storage: Total (acre-feet)	Projected average annual ground-water availability (storage depletion and effective recharge), in acre-feet: 1980-1989	1990-1999	2000-2009	2010-2019	2020-2029	2030	Remaining recoverable storage, 2031 (acre-feet)
NECHES	2	Queen City	8,100	[4]	[4]	8,100	8,100	8,100	8,100	8,100	8,100	–
Do.	2	Sparta	23,700[1,3]	[4]	[4]	23,700	23,700	23,700	23,700	23,700	23,700	–
Do.	2	Gulf Coast	101,000	[4]	[4]	101,000	101,000	101,000	101,000	101,000	101,000	–
Do.		Zone Totals	158,200	39,300	–	158,900	158,900	158,900	158,900	158,900	158,200	0
Do.		BASIN TOTALS	566,700	237,700	–	571,200	571,200	571,200	571,200	571,200	566,200	0
TRINITY	1	Trinity Group	45,400	486,800	[4]	54,200	54,200	54,200	54,200	54,200	45,400	0[5]
Do.	1	Woodbine	11,100	[4]	[4]	11,100	11,100	11,100	11,100	11,100	11,100	–
Do.	1	Carrizo-Wilcox	13,400	36,100	[4]	14,100	14,100	14,100	14,100	14,100	13,400	0[5]
Do.	1	Queen City	500	[4]	[4]	500	500	500	500	500	500	–
Do.		Zone Totals	70,400	501,900	–	79,900	79,900	79,900	79,900	79,900	70,400	–
Do.	2	Trinity Group	100	400	[4]	100	100	100	100	100	100	0[5]
Do.	2	Woodbine	0	[4]	[4]	0	0	0	0	0	0	–
Do.	2	Carrizo-Wilcox	65,300	175,500	[4]	68,600	68,600	68,600	68,600	68,600	65,300	0[5]
Do.	2	Queen City	14,500	[4]	[4]	14,500	14,500	14,500	14,500	14,500	14,500	–
Do.	2	Sparta	34,800	[4]	[4]	34,800	34,800	34,800	34,800	34,800	34,800	–
Do.	2	Gulf Coast	6,100	[4]	[4]	6,100	6,100	6,100	6,100	6,100	6,100	–
Do.		Zone Totals	120,800	175,900	–	124,100	124,100	124,100	124,100	124,100	120,800	–
Do.	3	Carrizo-Wilcox	300	600	[4]	300	300	300	300	300	300	0[5]
Do.	3	Sparta	200	[4]	[4]	200	200	200	200	200	200	–
Do.	3	Gulf Coast	55,300	[4]	[4]	55,300	55,300	55,300	55,300	55,300	55,300	–
Do.		Zone Totals	55,800	600	–	55,800	55,800	55,800	55,800	55,800	55,800	–
Do.		BASIN TOTALS	247,000	678,400	–	259,800	259,800	259,800	259,800	259,800	247,000	0
SAN JACINTO	1	Gulf Coast	337,000	[4]	[4]	337,000	337,000	337,000	337,000	337,000	337,000	–
Do.		Zone Totals	337,000	–	–	337,000	337,000	337,000	337,000	337,000	337,000	–
Do.		BASIN TOTALS	337,000	–	–	337,000	337,000	337,000	337,000	337,000	337,000	–

See footnotes at end of table.

APPENDIX E

Taken from: Muller, Daniel A. and Price, Robert D., September, 1979, Ground-water availability in Texas, Texas Dept. of Water Resources Rept. No. 238.