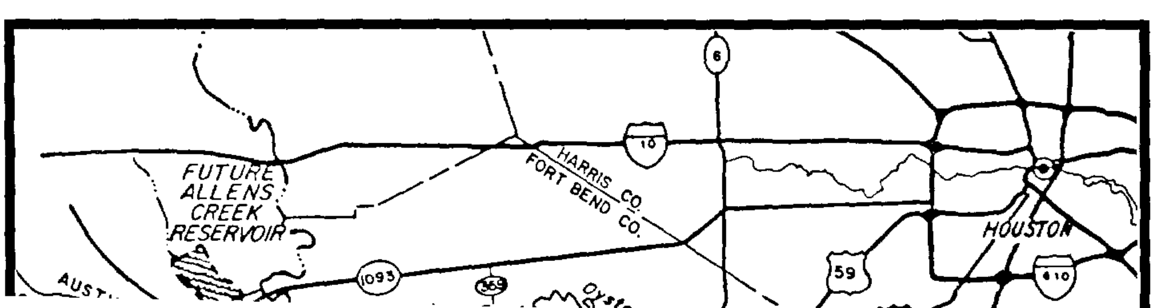
REGIONAL WATER SUPPLY STUDY

CITIES OF ROSENBERG AND RICHMOND

AND SURROUNDING AREAS



DANNENBAUM ENGINEERING CORPORATION

3100 WEST ALABAMA HOUSTON, TEXAS 77098 P.O. BOX 22292 HOUSTON, TEXAS 77227 (713) 520-9570

August 1, 1989

Mr. Pedram Farahnak, P.E.
Director of Public Works Department
City of Rosenberg
P.O. Box 32
Rosenberg, Texas 77471-0032

Subject: **City of Rosenberg**
Regional Water Supply Study

Dear Mr. Farahnak:

We are pleased to submit the enclosed Regional Water Supply Study for the City of Rosenberg and surrounding areas.

This report includes an analysis of existing and future water demands, existing groundwater conditions, surface water supply availability, a technical and economic evaluation of the need for a long term surface water supply program and recommendation on future surface water conversions. This report, also, conceptually analyzes the viability of utilizing the required termination storage facility as a recreational lake with regional park facilities located adjacent to the lake facility.

It is our opinion that the City should adopt this report as their plan for implementing an orderly conversion to partial use of surface water beginning in the year 2000. We believe that by integrating the termination storage facility with recreational development that the City would be able to assure the citizens of Rosenberg a safe long term supply of drinking water while creating facilities that will enhance the quality of life for the citizens of Rosenberg.

Sincerely yours,

Louis H. Jones, Jr., P.E.
Project Manager

STATE OF TEXAS
LOUIS H. JONES, JR.
54450
REGISTERED
PROFESSIONAL ENGINEER
8/1/89

LHJ/tlb
2454-01
Attachments

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ACKNOWLEDGMENTS

The issue of providing an alternate source of water supply is a vital ingredient in assuring that future generations in the Rosenberg-Richmond area are able to obtain a safe, economical source of drinking water. We would like to commend the co-sponsors of this plan, the City of Rosenberg and the Texas Water Development Board, for having the foresight to begin planning for the future. We would, also, like to express our appreciation to the following public and private agencies for their support and assistance in the development of this plan.

- City of Richmond
- Brazos River Authority
- Galveston County Water Authority
- Fort Bend County Engineers Office
- Fort Bend County Drainage District
- Houston Lighting and Power Company
- Richmond Irrigation Company
- Richmond-Rosenberg Chamber of Commerce
- Rice Center
- City of Houston
- Municipal Utility Districts within the Planning Area.

AUTHORIZATION

The City of Rosenberg applied for a grant from the Texas Water Development Board (the "TWDB") on October 15, 1987. On January 21, 1988 the Texas Water Development Board approved 50% matching funds grant for the preparation of the Regional Planning Study including the Cities of Rosenberg, Richmond and numerous surrounding municipal utility districts. Dannenbaum Engineering Corporation was authorized on May 11, 1988 by the City of Rosenberg to prepare its Regional Water Supply plan.

EXECUTIVE SUMMARY

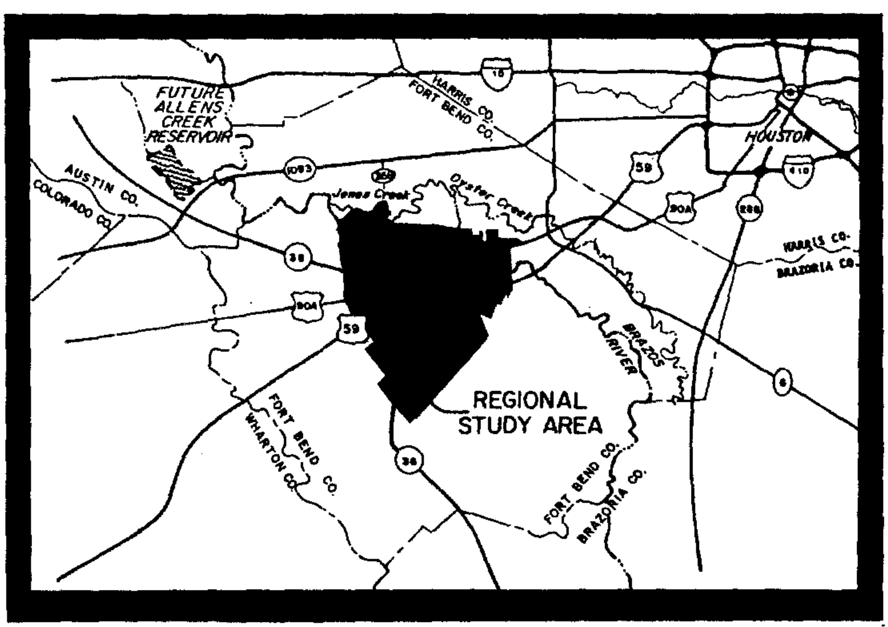
ROSENBERG REGIONAL WATER SUPPLY STUDY

BACKGROUND

The rapid development and population growth in the Rosenberg-Richmond area as well as northeast Fort Bend and southwest Harris Counties has resulted in significant increases in groundwater pumpage. This increased pumpage has directly resulted in water table declines and land subsidence. These projected water table declines are expected to result in severe land subsidence on the order of seven to ten feet by the year 2030. As a result the City of Rosenberg approached the Texas Water Development Board and obtained a planning grant to create a long term surface water conversion plan that, if implemented; would assure the City of Rosenberg, Richmond and surrounding area a safe dependable water supply for future generations.

PLAN OBJECTIVE

The purpose of this study was to produce an implementation program that would provide a reliable, long term supply of surface water to the mentioned planning area. The plan was developed around the concept of developing a conjunctive water supply system utilizing both available groundwater and surface water to minimize the projected long term subsidence within the planning area. The development of this system also includes the creation of a small multi-purpose reservoir that would serve as a water quality enhancement facility and a focal point for creation of a recreational facility further enhancing the area for possible park and residential development.

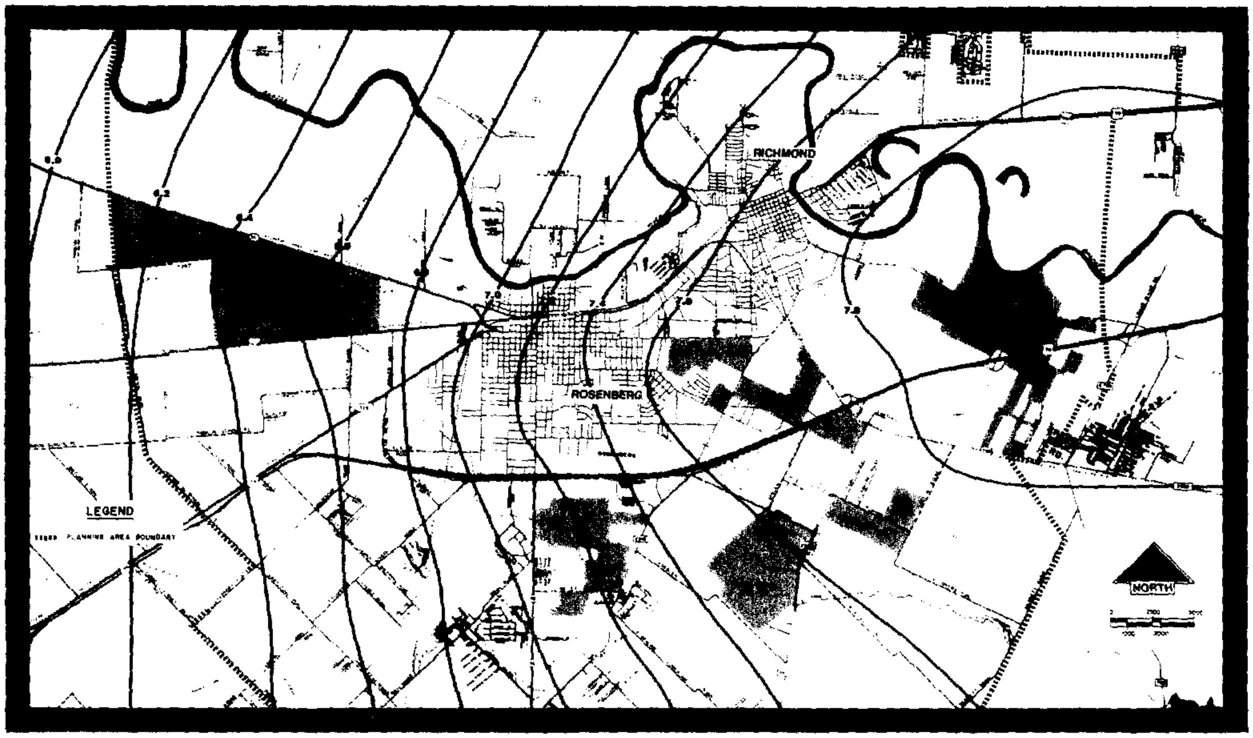


CITIES OF ROSENBERG AND RICHMOND

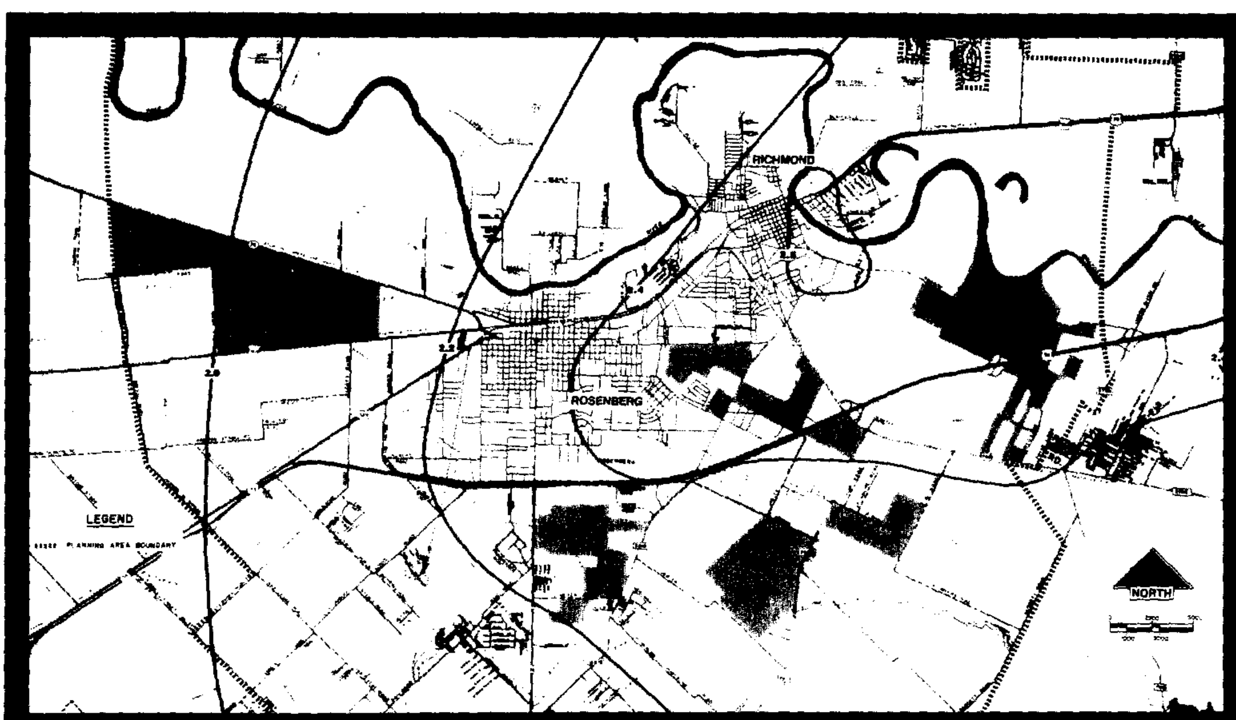
AND SURROUNDING AREAS

SUBSIDENCE

The plan objective to bring surface water into the Rosenberg-Richmond area will minimize long term subsidence in the area. Presently no surface water system exists and according to this study if surface water is not developed then the area will experience up to 7-8 feet of subsidence by the year 2030.

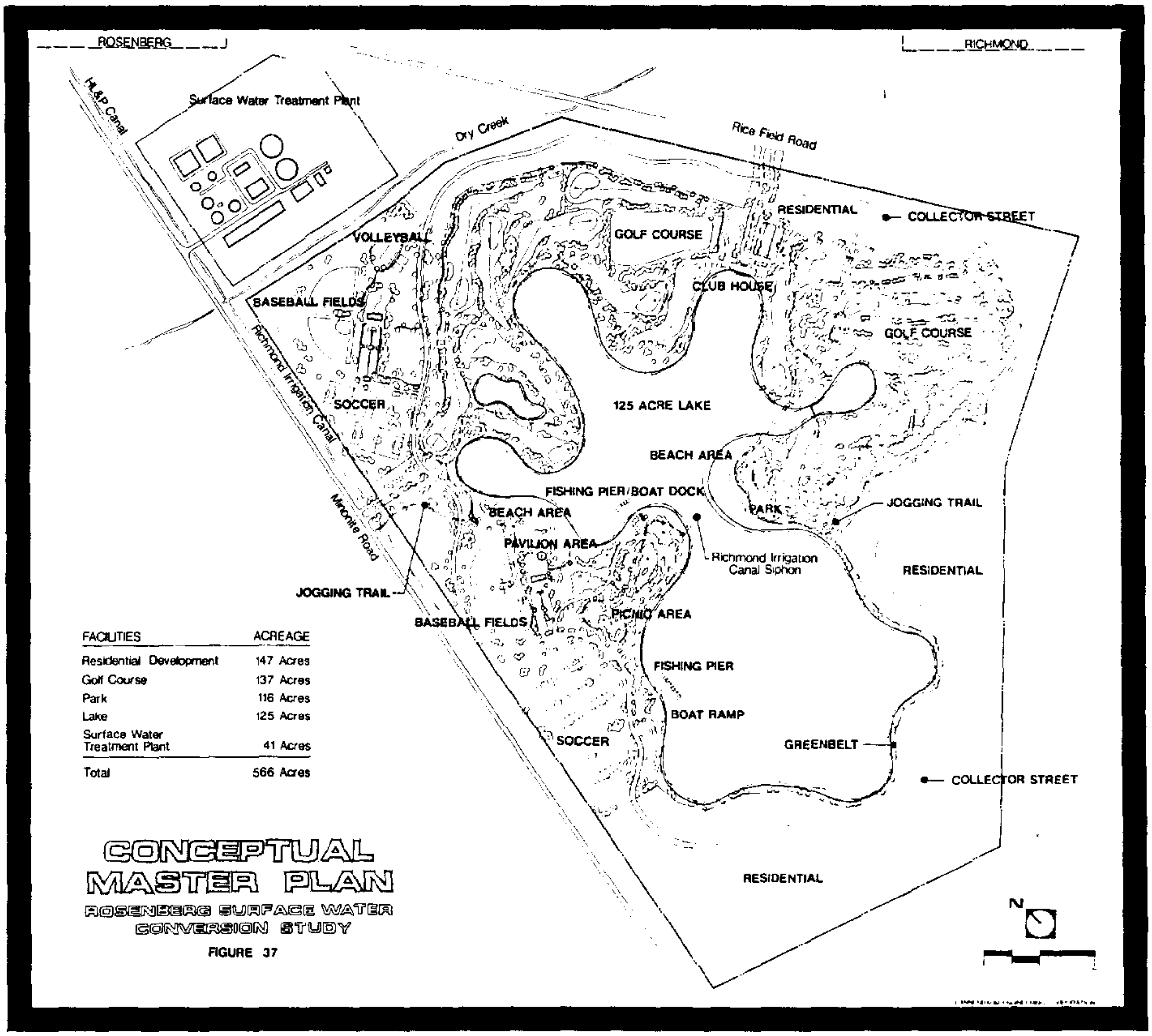


However, if surface water supplies are made available and surface water conversion is implemented by the year 2000, then the projected rate of subsidence would be reduced by as much as five feet.



FACILITIES PLAN

The selected plan consists of developing a surface water treatment plant with an ultimate capacity of 20.5 MGD constructed in three phases with the first phase producing treated water at a capacity of 10.2 MGD by the year 2000. The raw water supply source would be obtained from the Brazos Basin and transported through the Richmond Irrigation Canal (H.L. & P. Canal) to a proposed 125 acre reservoir (Termination Storage Facility) located just south of the Minonite-Rice Field Road intersection adjacent to Dry Creek. The reservoir could, also, be used as a focal point for possible development of a municipal park, private golf course and residential development.



FACILITIES	ACREAGE
Residential Development	147 Acres
Golf Course	137 Acres
Park	116 Acres
Lake	125 Acres
Surface Water Treatment Plant	41 Acres
Total	566 Acres

CONCEPTUAL MASTER PLAN
ROSENBERG SURFACE WATER CONVERSION STUDY
FIGURE 37

The plan, also, includes developing a phased conjunctive use groundwater - surface water system to treat and deliver treated water to the existing mud's within both the City of Rosenberg and Richmond's ETJ and as a result eliminating the need for the individual mud's to construct capital facilities in the form of groundwater wells that may need to be abandoned in the future.

Projected Total Average Daily Water Demand
With Conservation (MGD)

Year	*Rosenberg/ETJ*	*Richmond/ETJ*	*Total Study Area*
1990	*4.0*	*2.2*	*6.2*
1995	*4.7*	*2.8*	*7.5*
2000	*6.4*	*3.8*	*10.2*
2010	*10.0*	*5.6*	*15.6*
2020	*13.2*	*7.3*	*20.5*
2030	*16.5*	*8.9*	*25.4*

Projected Average Daily Surface Water Demand
With Conservation (MGD)

Year	*Rosenberg/ETJ*	*Richmond/ETJ*	*Total Study Area*
2000	*6.4*	*3.8*	*10.2*
2010	*10.0*	*5.6*	*15.6*
2020	*13.3*	*7.2*	*20.5*
2030	*13.3*	*7.2*	*20.5*

PLAN DEVELOPMENT COST

The planned development cost represents the total cost associated with the development of the facilities plan including raw water cost, capital cost and operational and maintenance cost. The range of annual cost per thousand gallons shown are approximate and includes all costs associated with plan financing as well as existing indebtness by both the City of Rosenberg and Richmond. The costs presented below do not include the cost associated with oversizing the reservoir or cost associated with development of the associated projects around the reservoir.

Range of Annual Cost/1000 Gallons to Customers

Phase	*Period*	*Rosenberg*	*Richmond*
Present	*1990*	*$0.94*	*$0.60*
I	*1991-2001*	*$0.97-$1.78*	*$0.68-$1.81*
II	*2002-2011*	*$1.68-$1.51*	*$1.76-$1.57*
III	*2012-2030*	*$1.50-$0.85*	*$1.53-$0.79*

Refer to Table 8.5 and 8.6 in the Report for further details.

CONCLUSIONS

1. *The Rosenberg/Richmond area will experience substantial growth in the next 40 years. Population is expected to increase from the present 42,421 to approximately 176,000 in 2030. Municipal water demand is expected to increase from the present 6.2 MGD to approximately 25.4 MGD in 2030.*

2. *The existing groundwater production facilities will not be adequate to serve future demands.*

3. *Total dependence on groundwater in the Rosenberg/Richmond area is projected to cause approximately 7-8 feet of subsidence by 2030, exclusive of additional subsidence caused by groundwater withdrawal by other regional groundwater users.*

4. *Developing surface water treatment facilities to supply approximately, 83% of the water demand will reduce projected subsidence by up to 5 feet. A comprehensive water conservation plan can reduce water demand by up to ten percent.*

5. *The Brazos River Authority can make Brazos River water available between $0.25-$0.39 per thousand gallons. The H.L. & P. Co. pump station and canal system can provide Brazos River water at approximately $0.05 per thousand gallons.*

6. *A surface water treatment plant located at the confluence of the Richmond Irrigation canal and Dry Creek can provide low pressure treated water to storage/pumping facilities in Rosenberg and Richmond. The storage/pumping facilities will then provide high pressure service to areas north of US 59. The treatment plant can provide direct high pressure service to areas south of US 59.*

7. *Due to occasional periods of high chloride content in the Brazos River, an 18 day raw water storage facility is required near the treatment plant. The Rosenberg/Richmond area would benefit from a joint-use storage/recreational facility.*

8. *Surface water supply facilities and additional supplemental groundwater supply facilities would result in user costs varying between $0.94/1000 gallons in 1990 to $1.78/1000 gallons in 2000 eventually reducing to $0.85/1000 gallons in year 2030.*

RECOMMENDATIONS

1. *Implement the water conservation plan.*

2. *Research the possibility of developing an regional administration for surface water treatment facilities planning, construction; and operation.*

3. *Negotiate a water supply contract with the Brazos River Authority and a raw water transportation contract with Houston Lighting and Power Company for the right to use the Richmond Irrigation Canal.*

4. *Negotiate land purchase contracts and/or land donations for the treatment plant and storage/recreational facility sites including the park site.*

5. *Set-Up a non-profit organization to accept land donations until such time as Texas Parks and Wildlife grants are organized.*

6. *File for Texas Parks and Wildlife grant for Phase I of park.*

CHAPTER 1.0 - INTRODUCTION

The rapid development and population growth in the Rosenberg-Richmond area as well as northeast Fort Bend and southwest Harris Counties has resulted in significant increases in groundwater pumpage. This increased pumpage has directly resulted in water table declines and land subsidence. These existing water table declines included with future projected declines are expected to severely affect the operation and capacity of existing groundwater facilities, if groundwater pumping remains unabated. Furthermore, these projected water table declines are expected to result in severe land subsidence on the order of seven to ten feet by the year 2030. Although this projected subsidence does not put the planning area at risk from tidal flooding, it will impact inland area storm drainage and levee protection systems as well as dramatically increase the potential for underground utility line and building structural failures.

The Harris-Galveston County area recognized the need to partially convert to surface water in order to reduce subsidence and as a result the Harris-Galveston Coastal Subsidence District (the "HGCSD") was born. The HGCSD began a regional program to monitor the groundwater withdrawal and the orderly conversion to surface water by the Harris-Galveston Region. As a result of this program, the areas of Galveston and southeast Harris Counties have dramatically decreased the rate of subsidence. However, the western portion of Harris County, and all of Fort Bend County presently have no means or requirements of converting to surface water. According to recent studies by the HGCSD, if alternate sources of water supplies are not provided to augment groundwater production, then it is expected that nine to ten feet of subsidence will occur in east Fort Bend County by the year 2020.

Purpose and Scope

The purpose of this study is to produce an implementation program that will provide a reliable, long term source of surface water supply to the planning area, an area which encompasses the city limits and extraterritorial jurisdictional boundaries of the Cities of Rosenberg and Richmond. The plan is developed around the concept of developing a conjunctive water supply system utilizing both available groundwater and surface water to minimize the projected long term subsidence within the planning area. The development of this system also includes the creation of a small multi-purpose reservoir that would serve as a water quality enhancement facility, a focal point for creation of a recreational facility and, if practical, a facility for controlling drainage in the immediate area.

The scope of this plan was limited to the following elements:

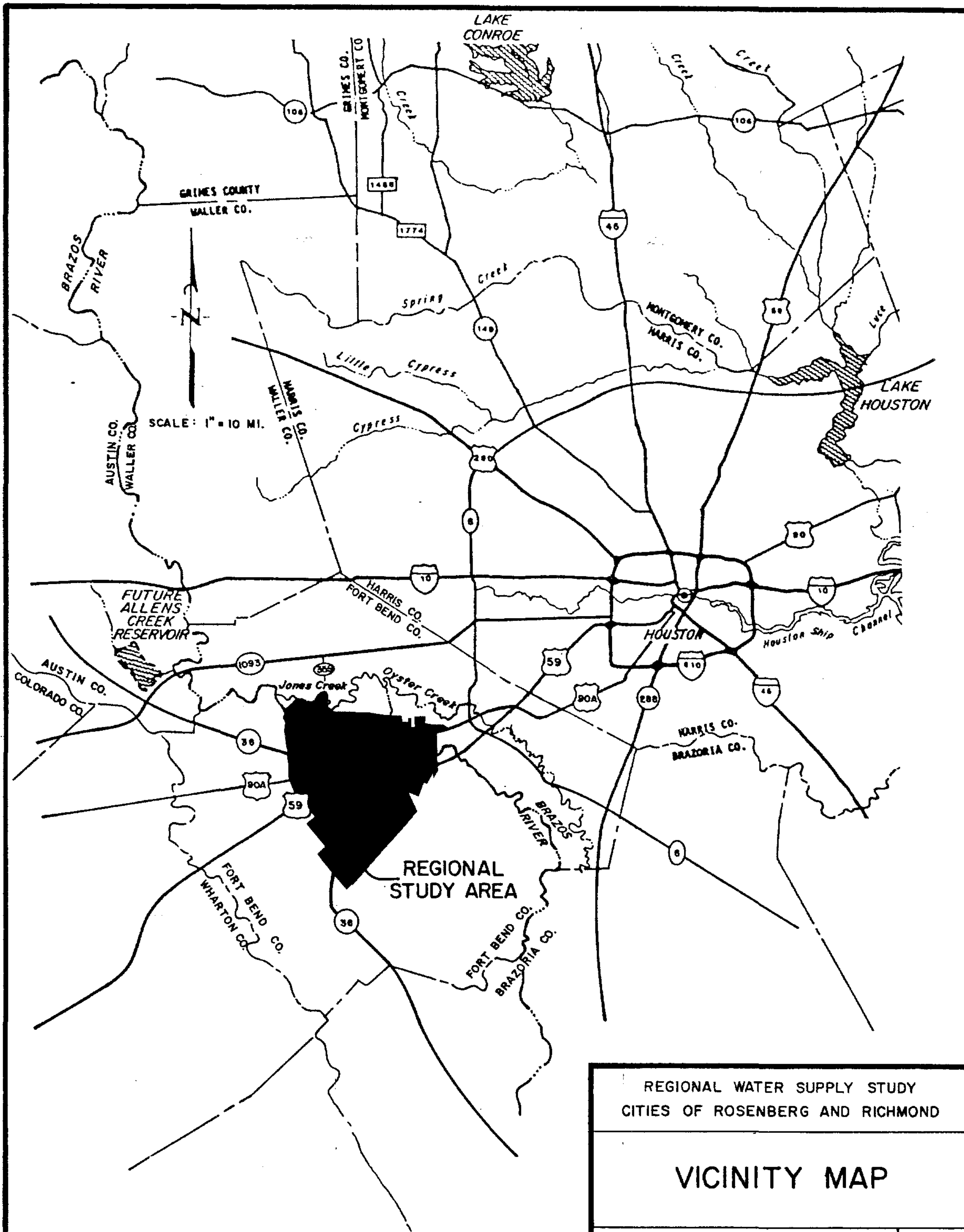
- o Preparation of a Water Conservation Plan
- o Demographic Analysis of the Planning Area
- o Evaluation of Water Demands and Supply Sources
- o Evaluation of Existing Water Supply Facilities
- o Evaluation of Potential Reservoir/Park Sites

- Evaluation of the Effects of Continual Groundwater Withdrawal on Underground Aquifers, Including Associated Land Subsidence
- Identification, Evaluation and Screening of Surface Water Supply Alternatives
- Identification and Evaluation of Final Facility Plans Required to Create a Ground/Surface Water Conjunctive Use System to Meet the Area's Future Needs
- Financial Analysis of Final Selected Plan, Including the Effects on Future Water Rates

Location and Description of Planning Area

The regional planning area consists of approximately 100 square miles in Fort Bend County centered around the Rosenberg-Richmond area. This planning area is located approximately 28 miles southwest of downtown Houston, in one of the fastest growing counties in the United States (Refer to Figure 1, Planning Area Location Map).

The regional planning area is more accurately defined as the existing city limits and extraterritorial jurisdictional (the "ETJ") boundaries of the Cities of Rosenberg and Richmond, and the incorporated area of Pleak. The planning area also includes twelve municipal utility districts (MUD's) within the ETJ of Rosenberg, and the Fort Bend Partner's Venture, a future development within the ETJ of Richmond (Refer to Figure 2, Regional Water Supply Planning Area).



BASE MAP OBTAINED FROM F.B.C.W.C. & I.D. NO. 2 AND CITY OF SUGARLAND REGIONAL WATER SUPPLY AND PLANNING STUDY.

REGIONAL WATER SUPPLY STUDY
CITIES OF ROSENBERG AND RICHMOND

VICINITY MAP

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FIGURE No. 1

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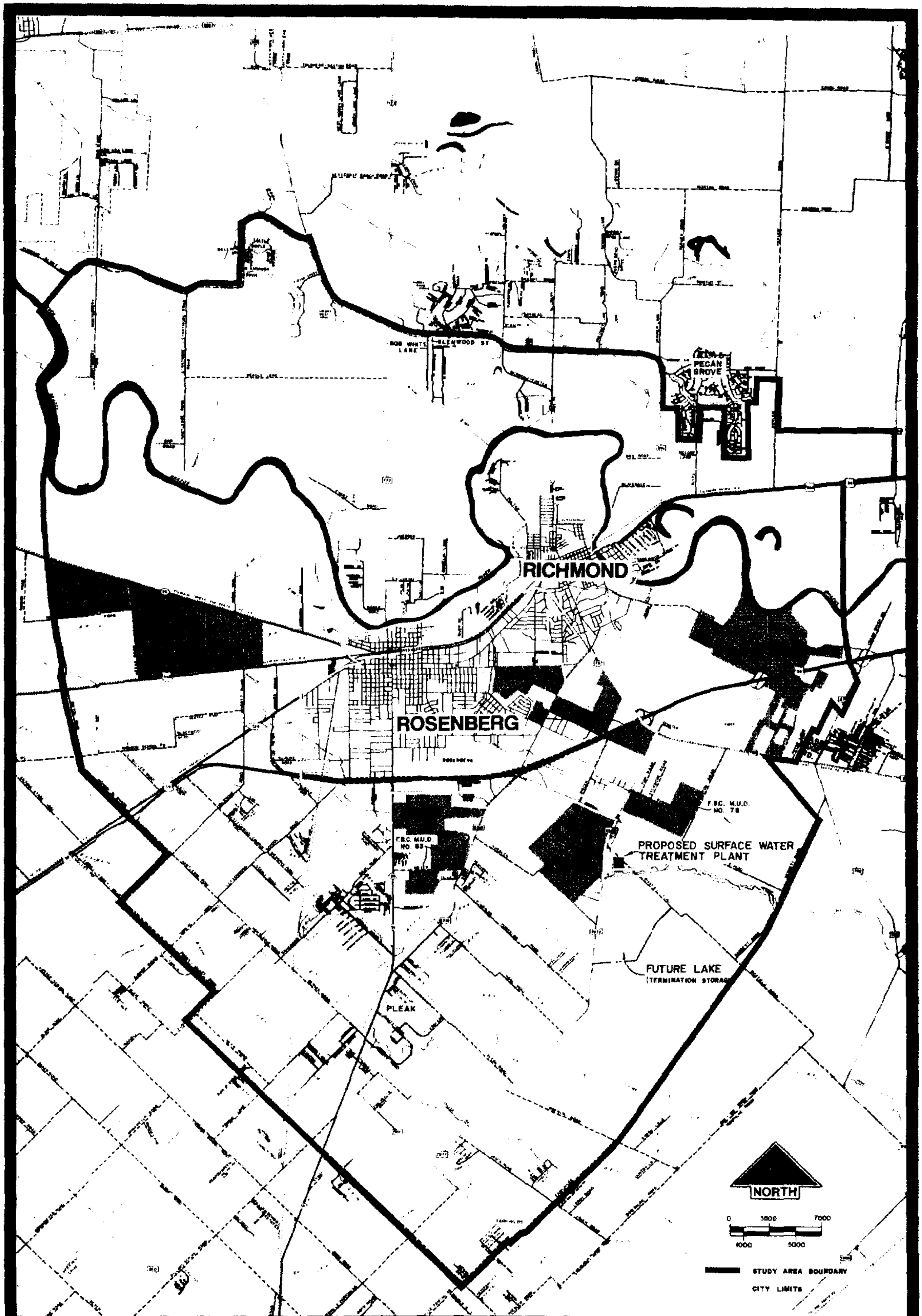


REGIONAL WATER SUPPLY STUDY AREA

FIGURE NO.2

Coordination with Adjacent Regional Plans

The existence of several planning studies presently being prepared or recently completed requires close coordination to avoid duplication of efforts. This coordination is a contractual obligation being monitored by the Texas Water Development Board. The regional studies mentioned above are primarily located in northeast Fort Bend County, northwest and west Harris County and northwest Brazoria County. All of these studies include the development of long range plans for partial conversion to surface water. The known entities studying partial conversion include the following:

- Fort Bend County Water Control and Improvement District No. 2 and the City of Sugar Land
- West Harris County Surface Water Supply Corporation
- Brazos Bend Water Authority
- City of Houston - Water Master Plan (the "HWMP")

All of the above plans except the HWMP have been partially funded by the Texas Water Development Board. The geographic relationships of these plans can be seen in Figure 3, Adjacent Planning Areas.

Fort Bend County Water Control and Improvement District No. 2 and the City of Sugar Land

This regional plan consists of a plan of staged conversion to eighty percent (80%) surface water starting in the year 2000. The plan recommends the construction of an ultimate (2030) surface water treatment plant with a capacity of 24 MGD with ultimate conveyance lines to provide surface water to WC & ID No. 2, Sugar Land and portions of First Colony. The plan also projects subsidence of approximately six to seven feet by the year 2030, if groundwater withdrawal is not abated. The raw water source for this plan is expected to originate from the Brazos Basin and be purchased from the Galveston County Water Authority (the "GCWA"), with the raw water take point located on the GCWA's Canal "A". This plan has been completed and approved by the TWDB.

West Harris County Surface Water Supply Corporation

The WHCSWSC plan consists of developing a major surface water treatment plant with a capacity of 150 MGD by the year 2030, and associated major transmission lines to deliver surface water, on a wholesale basis, to groups of users in the planning area. The WHCSWSC planning area consists of all of west Harris County south of FM 149 to just north of Sugar Land. The planning area also includes a large portion of southwest Houston, west of Blalock-Fondren to the present City of Houston City limit line. The plan recommends the use of surface water from the Brazos Basin, including the initial purchase of 59.4 MGD from the GCWA Canal, with the remainder (after the year 2010) being purchased from the Brazos River Authority (the "BRA"). The plan requires that the BRA construct the proposed Allens Creek Reservoir by the year 2012. The plan also has the flexibility to reduce the amount of GCWA water purchased and increase the amount from the BRA without affecting the viability of the plan, and the added capacity built-in to allow service to northeast and east Fort Bend County, if entities within those areas deem it economically feasible.

Brazos Bend Water Authority

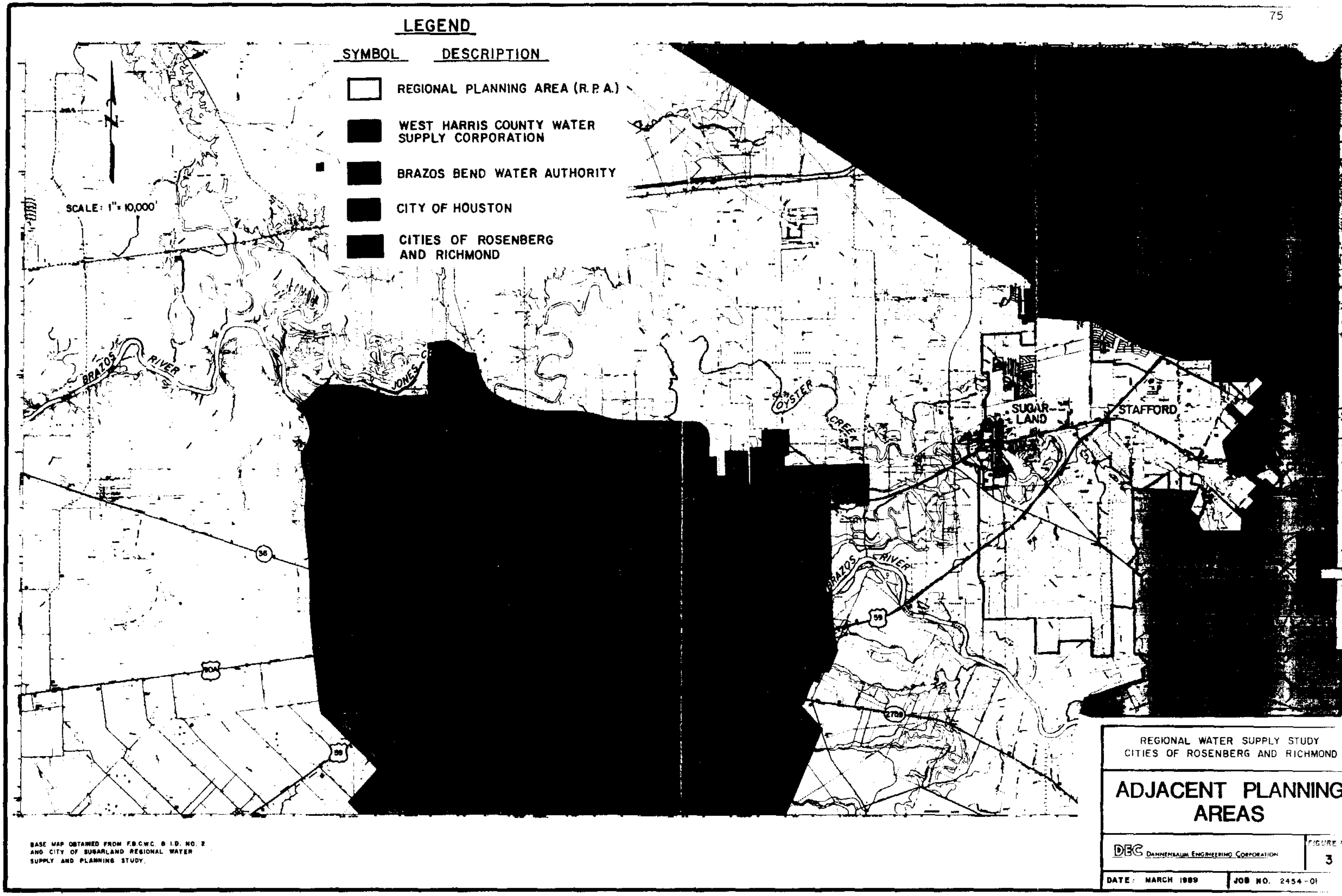
The Brazos Bend Water Authority (BBWA) was created on behalf of the Cities of Missouri City, Pearland, Manvel, and Brookside Village. The BBWA has obtained financial assistance from the Texas Water Development Board. The service area contains 100,670 acres, and is divided into two large areas. The western area includes Missouri City and the eastern area includes the other three municipalities. The study is evaluating the use of Brazos River Authority Canal "A" water and the City of Houston Southeast Water Purification Plant as sources of raw or treated water, respectively.

The BBWA study has only recently started. Preliminary growth projections for the BBWA area show water demand to be 14 MGD in the year 2000 and 22 MGD in 2020. The study conclusions and recommendations will be released subsequent to this report.

City of Houston Water Master Plan

The City of Houston Water Master Plan addresses the long term water supply needs for the City and the surrounding eight-county area. The study addresses such things as area growth, water use, groundwater availability, subsidence, existing and potential future surface water sources, and water distribution. Much of the study effort has been completed and published in interim draft reports, and the final City of Houston Water Master Plan Report is anticipated to be published in January, 1989.

The final screening of additional water supply alternatives yielded three candidates: the Toledo Bend Alternative; the Western Water Alternative (including the Bedias Reservoir); and the Toledo Bend and Wallisville Alternative. The City has stated that the Western Water Alternative has been eliminated and one of the two Toledo Bend Alternatives will be finally selected. The eight-county area master plan also includes the development of a Southwest Water Purification Plant for portions of west Harris County and east Fort Bend County.


LEGEND
SYMBOL DESCRIPTION
REGIONAL PLANNING AREA (R.P.A.)
WEST HARRIS COUNTY WATER SUPPLY CORPORATION
BRAZOS BEND WATER AUTHORITY
CITY OF HOUSTON
CITIES OF ROSENBERG AND RICHMOND
N
SCALE: 1" = 10,000'
BRAZOS RIVER
JONES C
OYSTER CREEK
SUGAR LAND
STAFFORD
BRAZOS RIVER
36
59
90A
59
2759
BASE MAP OBTAINED FROM F.B.C.W.C. & I.D. NO. 2 AND CITY OF SUGARLAND REGIONAL WATER SUPPLY AND PLANNING STUDY.
REGIONAL WATER SUPPLY STUDY
CITIES OF ROSENBERG AND RICHMOND
ADJACENT PLANNING AREAS
DEC DANNENBAUM ENGINEERING CORPORATION
FIGURE No.
3
DATE: MARCH 1989
JOB NO. 2454-01

Report Organization

This report is presented in ten major chapters as outlined in the Table of Contents. The report also contains appendices that include a Water Conservation/Drought Contingency Plan in accordance with the Texas Water Development Board requirements, inventories of Rosenberg's and Richmond's existing water systems, a subsidence evaluation, an inventory of Rosenberg area park facilities; capital improvement plans for both Rosenberg and Richmond and a projected debt service schedule produced by the City of Rosenberg financial advisors.

CHAPTER 2.0 - WATER DEMAND ANALYSIS

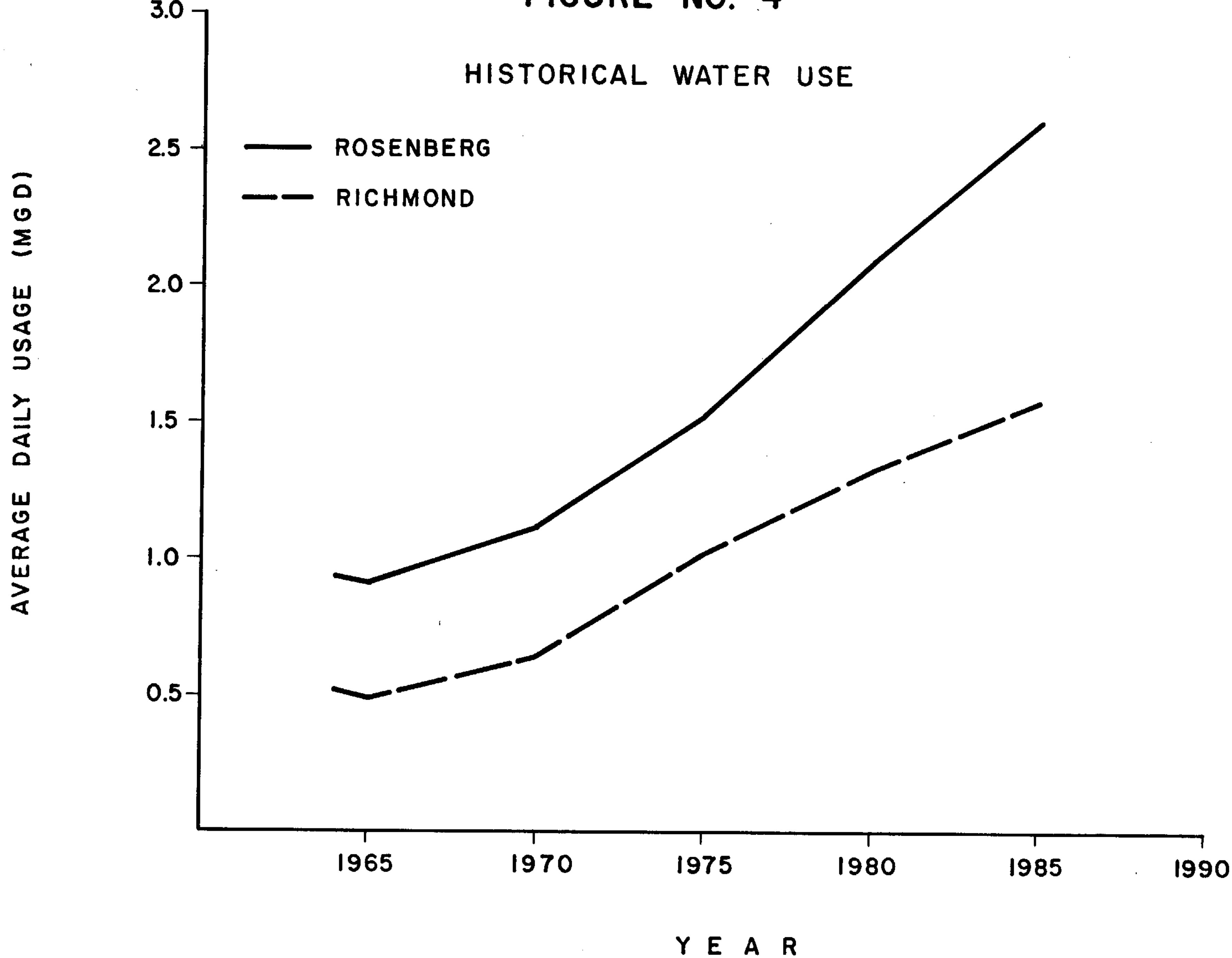
Historic Water Demand

The Rosenberg-Richmond Area has served as the center of Fort Bend County government for many years. However, it was not until the late 1960's and early 1970's that the area began to experience significant growth. According to records from the Texas Water Development Board, the City of Rosenberg used 0.80 MGD of groundwater in 1965, 1.1 MGD in 1970, and 2.6 MGD in 1985, an increase of 325% in 20 years. In 1987 the City of Rosenberg pumped 2.65 MGD, reflecting a significant slow-down which is consistent with the present downturn in the area economy.

The City of Richmond used approximately 0.5 MGD of groundwater in 1965, 0.65 MGD in 1970, and 1.6 MGD in 1985, an increase of 320% in 20 years. In 1987 the City of Richmond pumped 1.62 MGD of groundwater, approximately equal to the 1985 level (see Figure 4 for a graphical representation of historic water usages from 1965 to 1987).

FIGURE NO. 4

HISTORICAL WATER USE



Projected Water Demand

General

Projections of water demands were used to define the proposed facilities required to serve the entities within the planning area. Water demand projections are a direct result of the demographic analysis which outlines population projections associated with residential development as well as commercial and industrial activity expected to materialize during the planning period.

The majority of the present development within the planning area is within the City limits of Rosenberg and Richmond. The majority of the ETJ of each City is presently undeveloped. The majority of the water demand presently experienced within Rosenberg and Richmond is from residential and light commercial development such as shopping centers and small office complexes.

Population Projections

As mentioned previously the study area includes the Cities of Rosenberg, Richmond and Pleak, and the majority of each City's extra-territorial jurisdiction (ETJ). There are ten municipal utility districts (MUDs) in the Rosenberg ETJ (MUDs No. 59, 63, 65, 66, 77, 78, 101, 102, 103 and 104), and two MUDs within the Rosenberg city limits (MUDs No. 31 and 94), all of which are mostly or entirely undeveloped. There is one MUD (MUD No. 19-partially developed) in the Richmond ETJ. The proposed Fort Bend Partners Venture will be comprised of future MUDs No. 82, 83 and 84. There are no other known major developments in either ETJ at this time.

TABLE 2.1

POPULATION PROJECTIONS - ROSENBERG & ETJ

Political Subdivision	1985	1990	1995	(Population) 2000	2010	2020	2030
City of Rosenberg & ETJ within Study Area*	26,145	27,560	32,463	37,138	48,300	56,705	65,311
MUD No. 59	0	0	0	768	2304	3840	5376
MUD No. 63	0	0	0	625	1875	3125	4375
MUD No. 65	0	0	0	776	2326	3877	5427
MUD No. 66	0	0	0	428	1283	2139	2994
MUD No. 77	0	0	0	962	2886	4809	6732
MUD No. 78	0	0	0	654	1962	3270	4578
MUD No. 101	0	0	0	728	2184	3640	5096
MUD No. 102	0	0	0	758	2273	3788	5303
MUD No. 103	0	0	0	714	2142	3570	4998
MUD No. 104	0	0	0	580	1739	2898	4057
SUB-TOTAL	26,145	27,560	32,463	6,993	20,974	34,956	48,936
TOTAL	26,145	27,560	32,463	44,131	69,274	91,661	114,247

*Includes MUD's 31 and 94 and Remaining Property Within ETJ Outside of Existing MUDs.

TABLE 2.2

POPULATION PROJECTIONS - CITY OF RICHMOND & ETJ

Political Subdivision	1985	1990	1995	2000	2010	2020	2030
City of Richmond & ETJ Within Study Area**	14,024	14,861	17,800	22,919	32,768	41,000	50,202
MUD No. 82, 83 & 84 (Fort Bend Partners Venture)	0	0	1,427	2,853	5,706	8,559	11,412
TOTAL	14,024	14,861	19,227	25,772	38,474	49,559	61,614

**Includes MUD 15 and Remaining Property Within ETJ Outside of Projected MUDs in Fort Bend Partners Venture

TABLE 2.3

POPULATION PROJECTION - TOTAL STUDY AREA

1985	1990	1995	2000	2010	2020	2030
40,169	42,421	51,690	69,903	107,748	141,220	175,861

Water Demand

Water demands for the MUDs were obtained from creation reports and preliminary development plans. A procedure typically used in the reports involved calculating water demand based on a per capita water use for residents, and "equivalent population" for commercial/retail/industrial (CRI) development. Equivalent population is established by calculating the total water demand from CRI developments, and dividing that demand by the daily water demand for one person (typically 120-150 gallons per day). The resulting number is an "equivalent population" that would produce the same water demand as the CRI development. The number of residents plus the CRI equivalent population is the total equivalent population for the MUD. The total equivalent population for the MUD is then multiplied by the per capita demand, and the result is the water demand for the MUD.

Water demands for areas other than MUDs were determined by multiplying the Rice Center population projection by a per capita water demand. Texas Water Development Board data indicates that the yearly average per capita water demand in the Rosenberg-Richmond area between the years 1975 and 1985 varied between 96 and 148 gallons per day; the high value of 148 gallons per capita per day was selected to assure conservative demand projections.

Projected water demands for the Rosenberg area and the Richmond area are listed in Table 2.4 and Table 2.5, respectively.

TABLE 2.4

PROJECTED WATER DEMANDS - ROSENBERG AREA
(Without Conservation)

Political Subdivision	1985	1990	Average Day (MGD) 1995	2000	2010	2020	2030
Rosenberg & ETJ	3.87	4.07	4.80	5.50	7.15	8.39	9.66
Fort Bend County MUD 59				0.11	0.32	0.53	0.75
Fort Bend County MUD 63				0.09	0.27	0.46	0.63
Fort Bend County MUD 65				0.11	0.32	0.54	0.76
Fort Bend County MUD 66				0.08	0.24	0.40	0.57
Fort Bend County MUD 77				0.14	0.43	0.71	1.00
Fort Bend County MUD 78				0.10	0.29	0.49	0.68
Fort Bend County MUD 101				0.14	0.43	0.71	1.00
Fort Bend County MUD 102				0.16	0.46	0.76	1.05
Fort Bend County MUD 103				0.13	0.40	0.67	0.93
Fort Bend County MUD 104	—	—	—	0.12	0.36	0.60	0.83
Total Rosenberg Area:	3.87	4.07	4.80	6.68	10.67	14.26	17.86

TABLE 2.5

PROJECTED WATER DEMANDS - RICHMOND AREA
(Without Conservation)

Political Subdivision	1985	1990	Average Day (MGD) 1995	2000	2010	2020	2030
Richmond & ETJ	2.08	2.20	2.65	3.39	4.85	6.08	7.42
Fort Bend Partners Venture (MUD 82,83,84)	—	—	0.29	0.57	1.15	1.72	2.29
Total Richmond Area:	2.08	2.20	2.94	3.96	6.00	7.80	9.71

Water Conservation Effects

The City of Rosenberg will supply treated surface water to a service area of approximately 100 square miles (64,000 acres). The Cities of Richmond and Pleak, and thirteen existing political subdivisions are included in the service area and will be supplied water on a wholesale basis. A Water Conservation Plan will be an integral part of the supply system design, operation, and administration.

The Texas Revised Civil Statutes grant general law cities the authority to establish and enforce water conservation measures within their service areas. The City of Rosenberg will therefore establish a comprehensive Water Conservation Plan with:

Non-regulatory measures including -

- Public education and information programs
- Leak detection and repair programs
- Recycle/reuse programs

and Regulatory measures including -

- Water-saving landscaping requirements
- Water-saving plumbing codes
- Universal metering and meter testing/repair program
- Water-conserving rate structure
- Drought Contingency Plan

The Statutes also grant general law cities the authority to require wholesale customers to establish and enforce water conservation measures within their service areas. The City of Rosenberg will therefore require all wholesale customers to establish and enforce similar plans.

Voluntary water conservation programs can produce demand reductions of approximately five to ten percent, and stringent water conservation programs can produce demand reductions of approximately ten to fifteen percent. The Water Conservation Plan must be broad-based, uniformly applied among affected users, and continuously monitored and enforced to be effective. The above-listed measures, which are discussed in detail in Appendix No. I, are expected to reduce water demand by approximately ten percent.

The benefits of reduced water demand include:

- Increased ability of existing water (and wastewater) facilities and supplies to serve existing and future demand;
- Capital and debt service cost savings resulting from delayed construction of new facilities;
- Capital cost savings resulting from decreased facility capacity requirements;
- Cost savings resulting from reduced debt service requirements;
- Cost savings resulting from reduced operation and maintenance costs;
- Qualification for loan assistance from State agencies;
- Qualification for bond sales.

Beginning in 1990, the projected additional water demands previously shown are assumed to be reduced by 10% for defining and evaluating the final recommended implementation plan. The resulting water demands for the Rosenberg area, the Richmond area, and the entire study area are listed in Tables 2.6 through 2.8, respectively. The effect of conservation measures on water demand is shown graphically on Figures 5 through 7.

TABLE 2.6
PROJECTED WATER DEMANDS - ROSENBERG AREA
(With Conservation)

Political Subdivision	1985	1990	1995	2000	2010	2020	2030
			Average Day (MGD)				
Rosenberg & ETJ	3.87	4.07	4.73	5.35	6.85	7.97	9.10
Fort Bend County MUD 59				0.10	0.29	0.48	0.67
Fort Bend County MUD 63				0.08	0.24	0.41	0.57
Fort Bend County MUD 65				0.10	0.29	0.49	0.68
Fort Bend County MUD 66				0.07	0.22	0.36	0.51
Fort Bend County MUD 77				0.13	0.39	0.64	0.90
Fort Bend County MUD 78				0.09	0.26	0.44	0.61
Fort Bend County MUD 101				0.13	0.39	0.64	0.90
Fort Bend County MUD 102				0.14	0.41	0.68	0.95
Fort Bend County MUD 103				0.12	0.36	0.60	0.84
Fort Bend County MUD 104	—	—	—	0.11	0.32	0.54	0.75
TOTAL	3.87	4.07	4.73	6.42	10.02	13.25	16.48

TABLE 2.7
PROJECTED WATER DEMANDS - RICHMOND AREA
(With Conservation)

Political Subdivision	1985	1990	1995	2000	2010	2020	2030
			Average Day (MGD)				
Richmond & ETJ	2.08	2.20	2.60	3.28	4.58	5.70	6.91
Fort Bend Partners Venture (MUD 82,83,84)	—	—	0.26	0.52	1.03	1.55	2.07
TOTAL	2.08	2.20	2.86	3.80	5.61	7.25	8.98

TABLE 2.8
PROJECTED WATER DEMANDS - TOTAL STUDY AREA
(With Conservation)

City	1985	1990	1995	2000	2010	2020	2030
			Average Day (MGD)				
Rosenberg & ETJ & MUDs	3.87	4.07	4.73	6.42	10.02	13.25	16.48
Richmond & ETJ & MUDs	2.08	2.20	2.86	3.80	5.61	7.25	8.98
Total Study Area	5.95	6.27	7.59	10.22	15.63	20.50	25.46

FIGURE NO. 5

WATER DEMAND & WELL CAPACITY
CITY OF ROSENBERG & ETJ

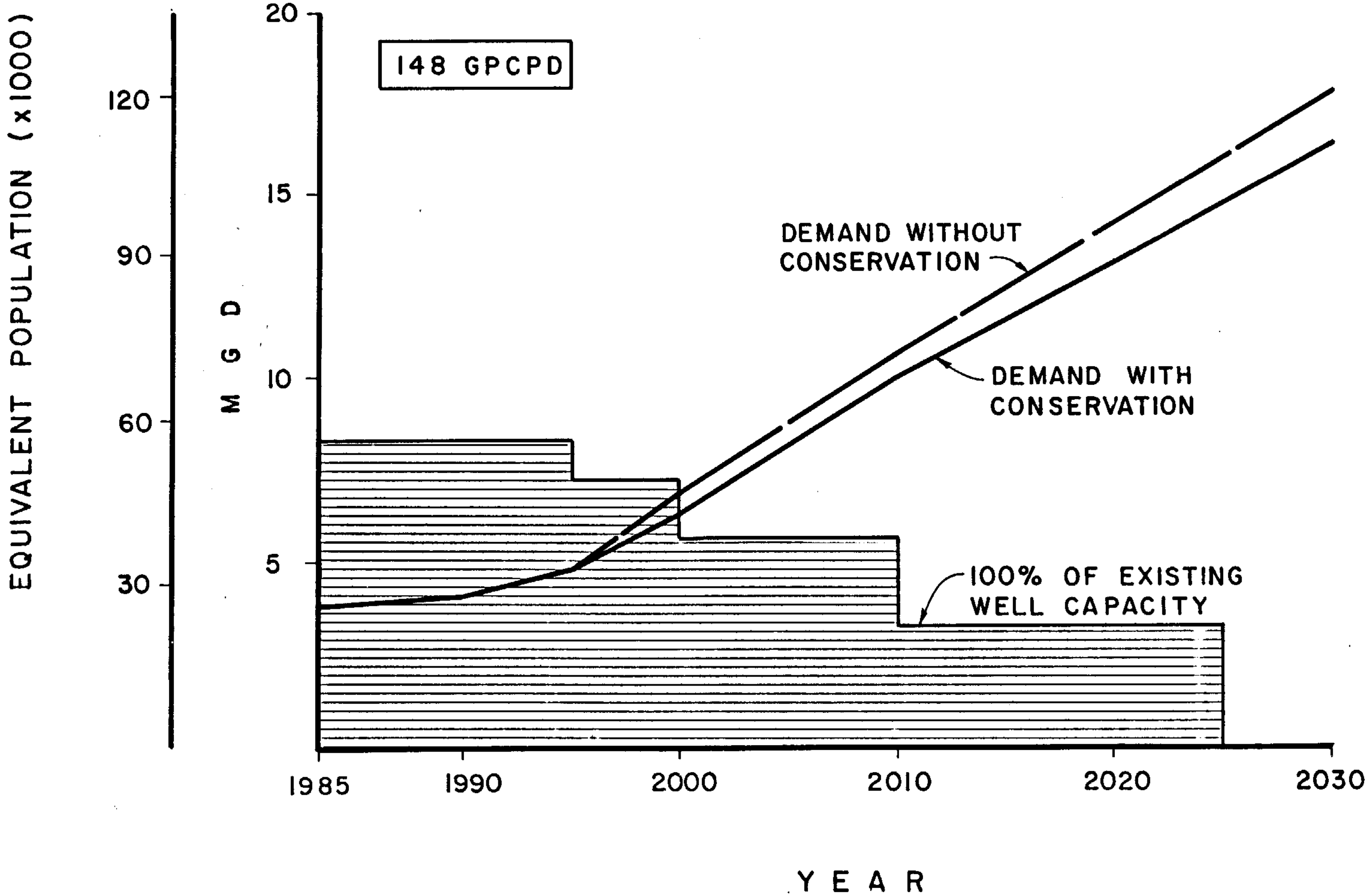


FIGURE NO. 6

WATER DEMAND & WELL CAPACITY
CITY OF RICHMOND & ETJ

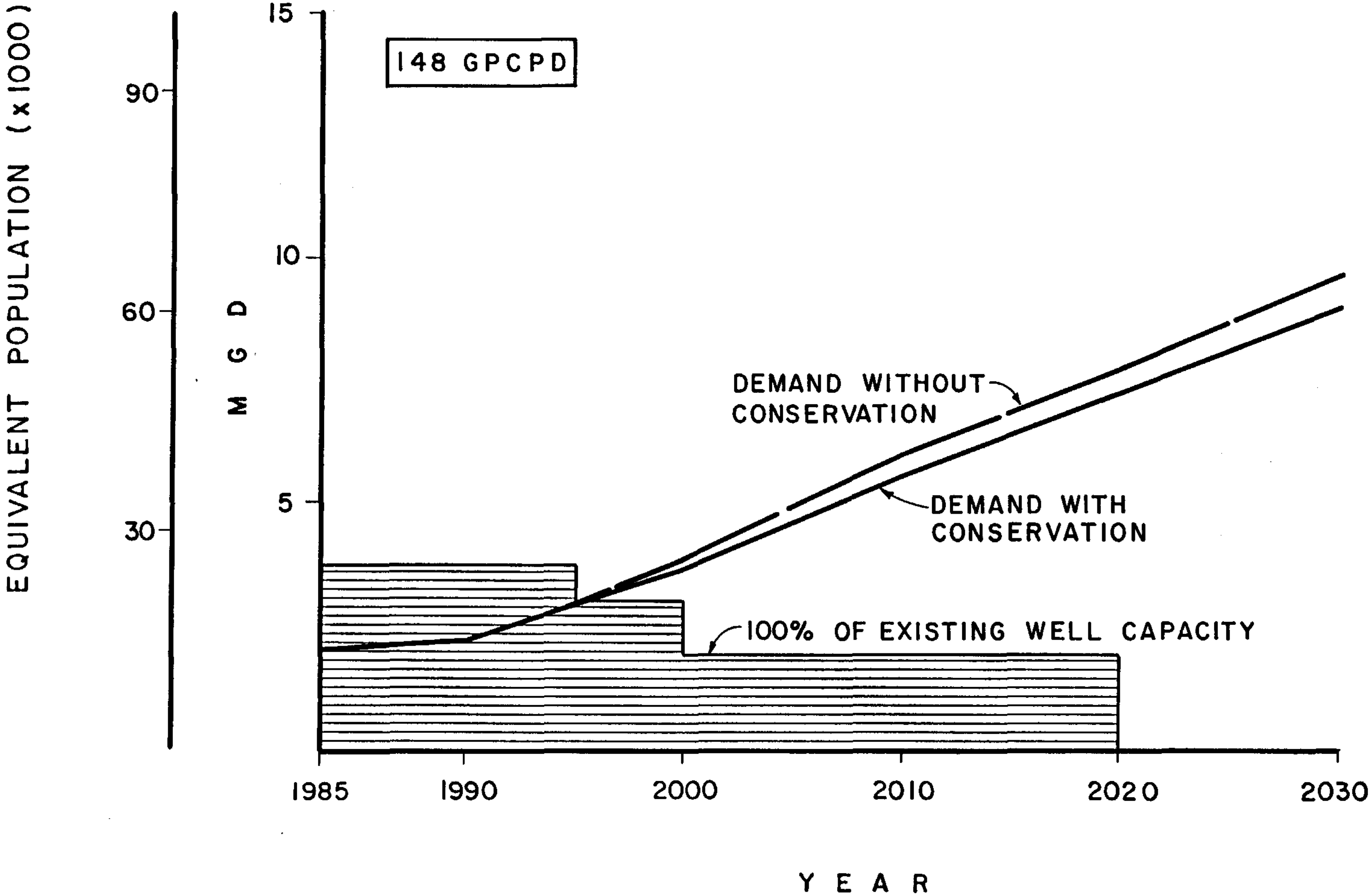
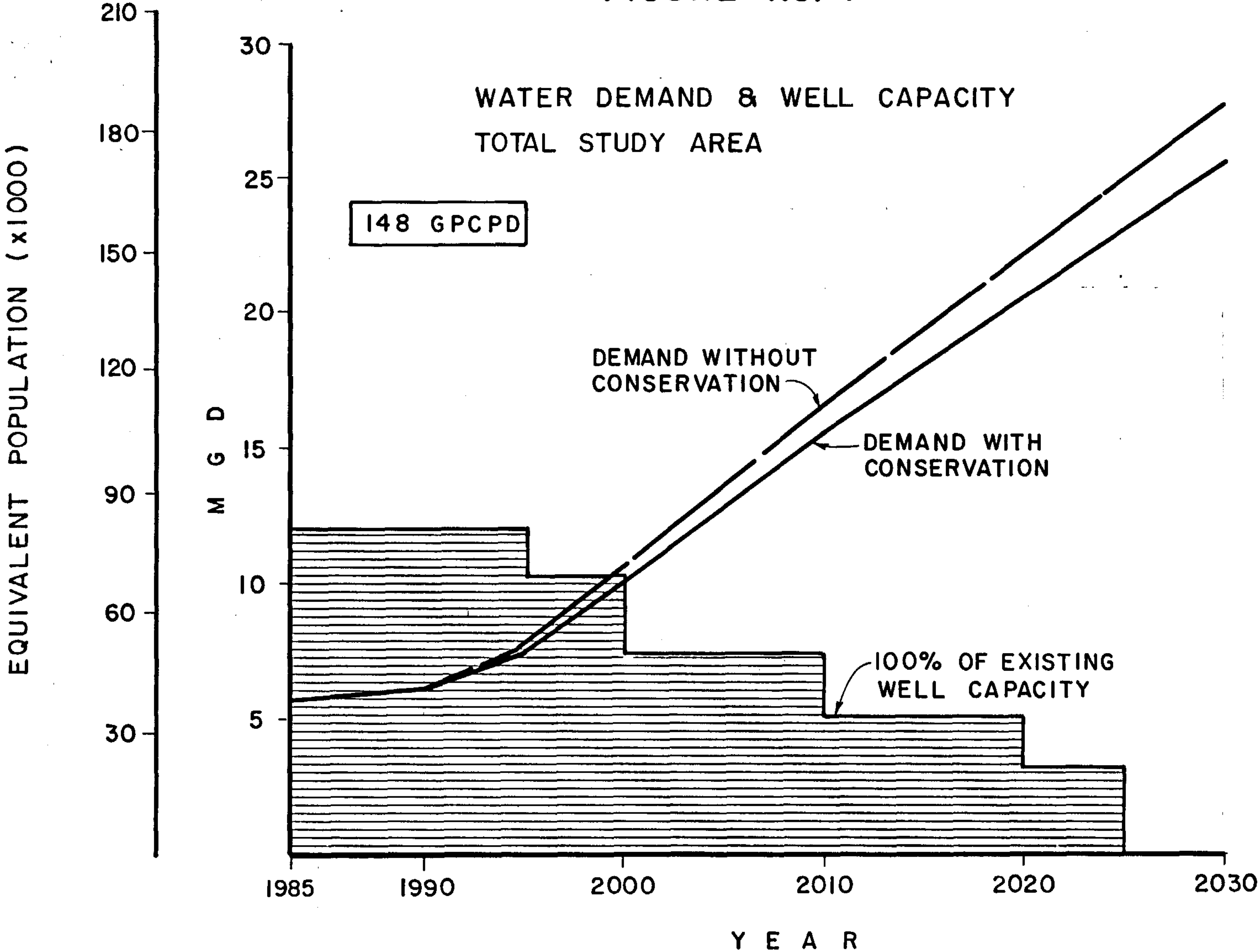


FIGURE NO. 7


WATER DEMAND & WELL CAPACITY
TOTAL STUDY AREA
148 GPCPD
DEMAND WITHOUT CONSERVATION
DEMAND WITH CONSERVATION
100% OF EXISTING WELL CAPACITY
EQUIVALENT POPULATION (x1000)
210
180
150
120
90
60
30
M G D
30
25
20
15
10
5
1985
1990
2000
2010
2020
2030
Y E A R

CHAPTER 3.0 - GROUNDWATER SUPPLY AND AVAILABILITY

General

The water demand analysis in Chapter 2.0 projects the total 2030 water demand for the planning area to be three to four times the 1985 demand. It is therefore very important that government entities within the planning area find and develop new sources of water supply. The following sections will examine the current sources which supply the water demands of the planning area, and potential sources of future water supplies that may be available. This chapter will also discuss the raw water quality of these supplies in comparative terms to the drinking water standards for raw water.

Fort Bend County presently relies entirely on groundwater supplies to meet its water demands. Harris County presently meets 65% of its overall demand through the use of groundwater. However, prior to 1954, the entire Harris County area including the City of Houston relied entirely on groundwater. At that time Houston was the largest City in the United States with a municipal water supply obtained solely from groundwater sources. Unprecedented economic growth in the region increased the demands on the water supplies, resulting in severe water table declines that were directly responsible for coastal subsidence which threatened the economic growth of southeast Harris County as well as parts of Galveston County. To diminish subsidence, major surface water sources were developed which dramatically reduced east and southeast Harris County's dependence on groundwater. Harris and Galveston Counties created the Harris Galveston Coastal Subsidence District to monitor and regulate the withdrawal of groundwater.

Increases in population and associated groundwater pumpage in the southwestern portion of Harris County and east-northeast portion of Fort Bend County has made subsidence a critical issue. The HGCSD has established a specific time-table and target date for substantial conversion to surface water by Harris County. The planning area and all of Fort Bend County is not within the jurisdictional boundaries of the HGCSD plan, but is and will be significantly affected by groundwater withdrawal in the HGCSD area.

Hydrogeology

Understanding the hydrogeology of the Texas Gulf Coast is important for providing the best possible development of groundwater resources. The characteristics of the aquifers along the Texas Gulf Coast determine location, availability, and quality of groundwater.

An aquifer is a geologic formation, group of formations, or part of a formation that contains and transmits water. The two aquifers which provide groundwater to Fort Bend County are the Evangeline and Chicot aquifers. It should be noted that a third aquifer, the Jasper aquifer, also underlies Fort Bend County. Within Fort Bend County, the Jasper aquifer contains saline water ranging from slightly saline to highly saline. Therefore, the Jasper aquifer is not used as a water source within Fort Bend County. Also, a very shallow layer of water-bearing sands called the Brazos River Alluvium parallels the Brazos River. This alluvium is prevalent in the planning area, however, the quality of water is similar to the surface water located in the Brazos River and therefore requires extensive treatment before it can be used as potable water. The alluvium is therefore not being considered as a potential source of water for municipal use.

The two aquifers used for municipal water in Fort Bend County are the Evangeline aquifer and the Chicot aquifer. The Evangeline aquifer overlies the Burkeville aquiclude and underlies the Chicot aquifer. Within the planning area, the base of the Evangeline aquifer lies at a depth of 2,200 to 2,500 feet below mean sea level. The Evangeline aquifer ranges from 1,200 to 2,000 feet thick, with approximately 400 to 700 feet of the total thickness accounting for the water bearing sands. The Chicot aquifer overlies the Evangeline aquifer. Within the planning area, the base of the Chicot aquifer lies at a depth of 500 to 700 feet below mean sea level. The Chicot aquifer ranges from 600 to 800 feet thick with between 200 and 300 feet of the total thickness comprising the water bearing sands.

Differences in the distinguishable characteristics of the aquifers include stratigraphic position, lithology, and permeability. The Chicot aquifer has more porous sands which often contain undesirable chemicals. The Evangeline aquifer water quality is excellent, requiring only chlorine disinfection. The wells in the Evangeline aquifer can have greater screened lengths than Chicot wells, allowing higher productivity.

Saline water at various concentrations is present in the Evangeline and Chicot aquifers at several different locations throughout Fort Bend County. The presence of saline water is related, at least in part, to the presence of salt domes. Eight salt domes have been located in Fort Bend County. In locations where the aquifers have been pierced by salt domes, the water in the aquifer will typically have a high saline content. Water wells can act as a catalyst to draw saline rich water away from salt dome locations. As wells continue to pump and lower the hydraulic pressure within the aquifer, the saline-rich water will begin to migrate to these areas of lower pressure.

The geologic formations along the Texas Gulf Coast generally dip toward the Gulf at an angle greater than the slope of the land surface, with the dip increasing as the formations reach the coastline These formations also tend to thicken as this depth increases (Figure 8 shows a graphic representation of this phenomenon).

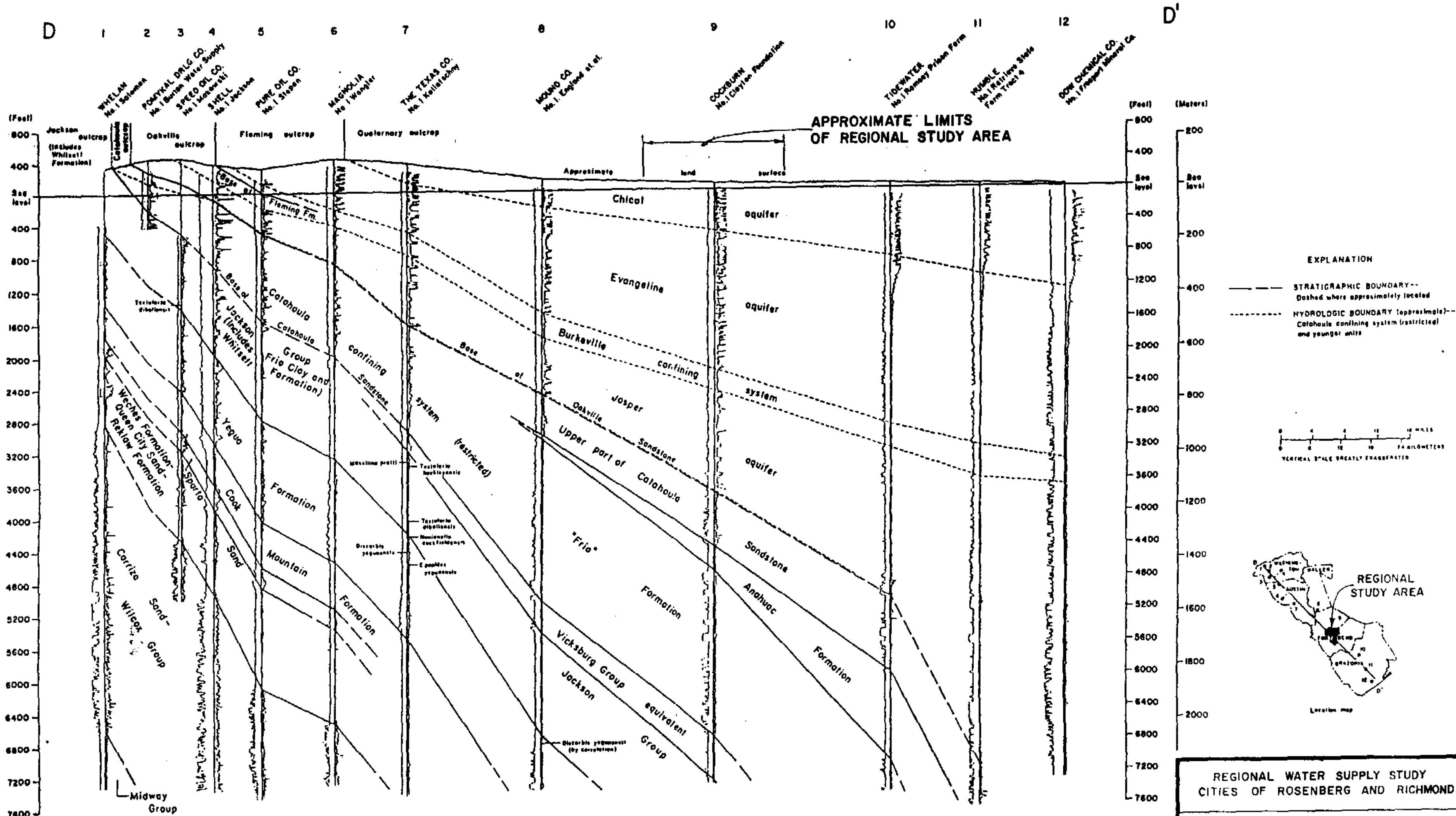


Figure 5

Stratigraphic and Hydrogeologic Section D-D'

Courtesy of Texas Department of Water Resources
Report 236 July, 1979

REGIONAL WATER SUPPLY STUDY
CITIES OF ROSENBERG AND RICHMOND

HYDROGEOLOGIC CROSS SECTION

DEC DANNENBAUM ENGINEERING CORPORATION	FIGURE NO. 8
DATE: MARCH 1980	JOB NO. 2454-01

Existing Well Characteristics

Presently the City of Rosenberg and Richmond utilize the Chicot and Evangeline aquifers to provide the groundwater needed to meet the demands (Table 3.1 lists details on well production). The majority of the existing City wells in the planning area were developed before 1960 and have limited expected remaining life. Also, the production rates of the shallow wells are limited and water quality can be a problem. As a result, abandonment and replacement of these wells and/or development of surface water supply sources will be needed to meet the projected demands. If new wells are developed, only the Evangeline aquifer is recommended for groundwater production.

TABLE 3.1

EXISTING CITY WELL PRODUCTION CHARACTERISTICS

Rosenberg	Present Production	Screen Settings
Well No. 1	Abandoned	
Well No. 2	Abandoned	
Well No. 3	300 GPM	545'-837'
Well No. 4	350 GPM	N/A
Well No. 5	1200 GPM	545'-837'
Well No. 6	1700 GPM	545'-837'
Well No. 7	2200 GPM	545'-837'
Richmond		
Well No. 1	Abandoned	
Well No. 2	125 GPM	545'-837'
Well No. 3	425 GPM	545'-837'
Well No. 4	800 GPM	545'-837'
Well No. 5	1325 GPM	545'-837'

CHAPTER 4.0 - GROUNDWATER/SUBSIDENCE ANALYSIS

General

Subsidence is a gradual sinking of the surface on a local and/or regional scale. Simply stated, subsidence is caused by pumping water from underground aquifers at a rate that is faster than the rate at which the aquifer is recharged by rainwater migrating from the surface. The net effect is depressurization of clay layers in the aquifers, which allows the clay layers to be compressed by the weight of the overlaying soils; the overlaying soils therefore move downward.

Areas affected by subsidence experience drainage problems ranging from minor, localized ponding to major flooding and drainage pattern alterations, depending on the severity of the subsidence. Additional subsidence related problems include damage to building foundations, roads, and underground utilities, caused by shifting soils, and the associated repair costs.

Subsidence can be slowed or stopped by reducing the amount of groundwater withdrawn to a level less than the aquifer recharge rate. However, an area which has experienced subsidence will experience only minimal, if any, rebound. It is, therefore, important to eliminate the cause of subsidence as soon as possible.

Subsidence Model

A computer model was utilized to predict subsidence in the study area. The model generates predicted groundwater levels based on input data regarding aquifer characteristics and location, timing, and amounts of groundwater pumping. A subsidence factor was applied to the drawdown data and predicted subsidence levels were obtained. A description of the model and aquifer parameters is included in Appendix II.

The model developed for this study was based on factors relating to the study area only. It is recognized that subsidence in the Rosenberg/Richmond area will be influenced by groundwater withdrawal in surrounding areas, particularly the southwest Houston metropolitan area; and that the outside influences may modify the results predicted by this study. The model does not attempt to predict absolute subsidence based on regional factors; the model was developed to predict local subsidence based on three different groundwater pumping alternatives within the study area.

Groundwater Pumping Alternatives

Subsidence predictions were developed for the following groundwater pumping alternatives:

- o CASE 1 - This case assumes that groundwater is used to meet all demands until 1995, at which time a surface water treatment plant with a capacity equal to 1995 demands is built. Subsequent increases in water demand are met with groundwater production until 2010, when surface water capacity is expanded to meet 2010 demands. Subsequent increases in water demand are met with groundwater production until 2020, when the surface water capacity is again expanded to meet 2020 demands. Subsequent increases in water demand through the end of the study period are met with groundwater production. Figures 9 through 14 show Case 1 groundwater and surface water production levels. Case 1 assumes that additional wells are installed only if required to meet water demand prior to surface water plant construction or to meet increasing demand during intervals between plant expansions. Small rural wells are assumed to be phased out of production after plant construction. Water conservation practices which reduce new demand by 10% are assumed to begin in 1990.

- CASE 2 - This case follows the assumptions listed above for Case 1 except that construction of the surface water treatment plant is delayed until 2000. Figures 15 through 20 show Case 2 groundwater and surface water production levels.

- CASE 3 - This case represents the "Do Nothing" scenario in terms of conversion to surface water. All water demand throughout the study period is assumed to be met by groundwater production. Pumping continues at existing well sites and new wells are developed as required in the MUDs. Water conservation is not assumed to be in practice.

FIGURE NO. 9

AVERAGE DAILY WATER PRODUCTION

CASE I: 1995 SURFACE WATER PLANT
CITY OF ROSENBERG & ETJ

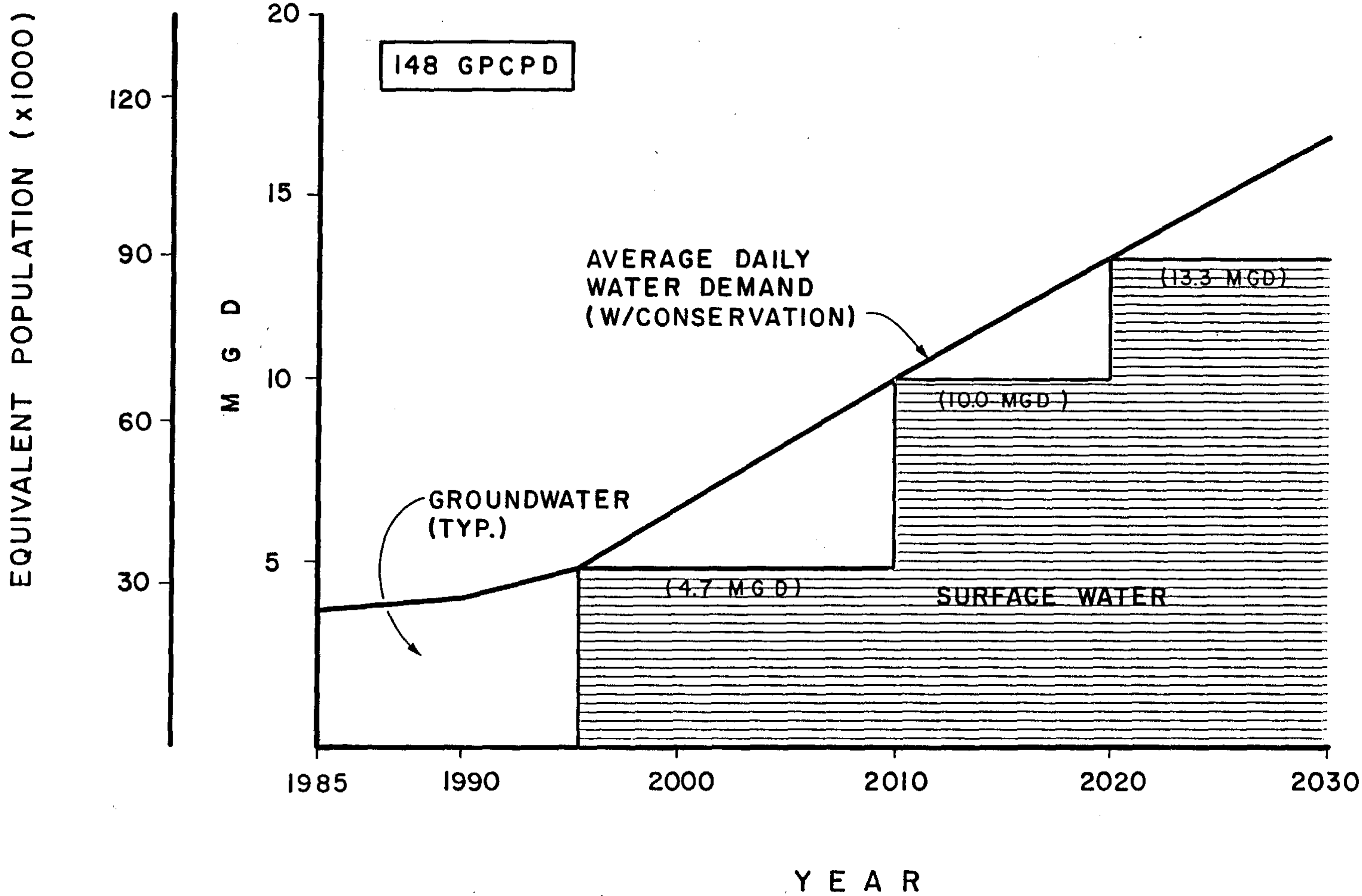


FIGURE NO. 10

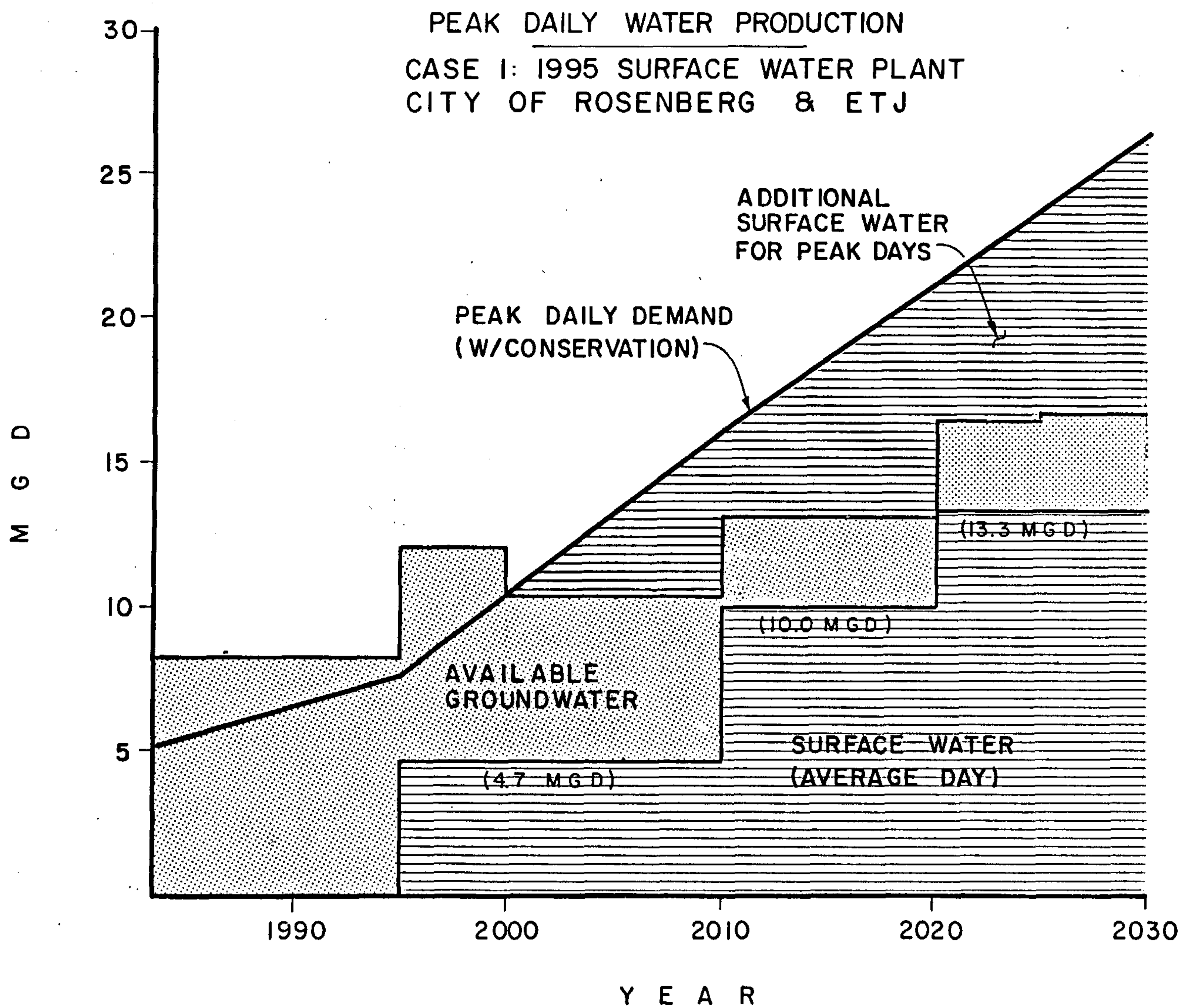

PEAK DAILY WATER PRODUCTION
CASE I: 1995 SURFACE WATER PLANT
CITY OF ROSENBERG & ETJ
30
25
20
15
10
5
MGD
1990
2000
2010
2020
2030
YEAR
ADDITIONAL SURFACE WATER FOR PEAK DAYS
PEAK DAILY DEMAND (W/CONSERVATION)
AVAILABLE GROUNDWATER
SURFACE WATER (AVERAGE DAY)
(4.7 MGD)
(10.0 MGD)
(13.3 MGD)

FIGURE NO. 11

AVERAGE DAILY WATER PRODUCTION

CASE 1: 1995 SURFACE WATER PLANT
CITY OF RICHMOND & ETJ

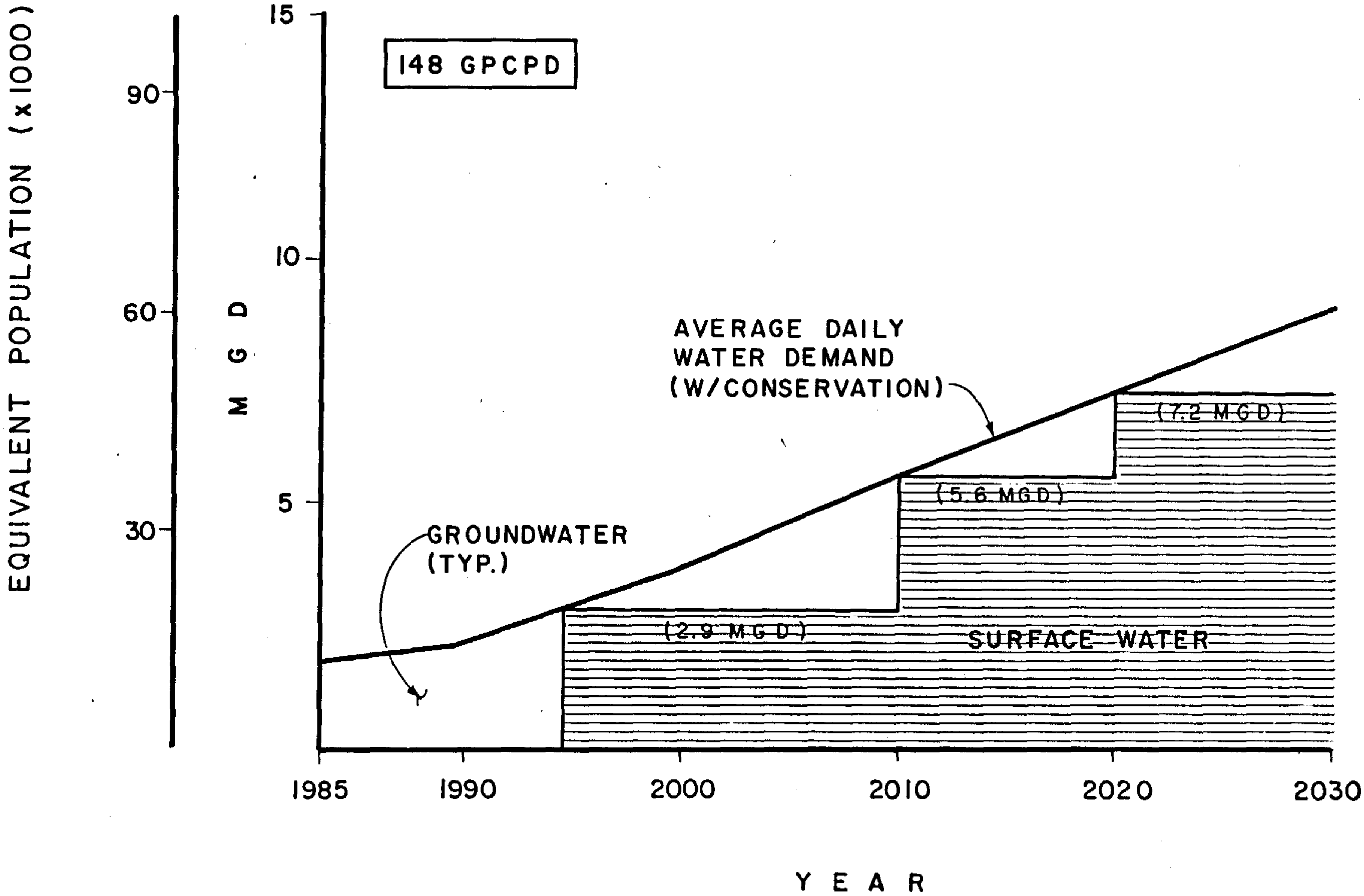


FIGURE NO. 12

PEAK DAILY WATER PRODUCTION

CASE I: 1995 SURFACE WATER PLANT
CITY OF RICHMOND & ETJ

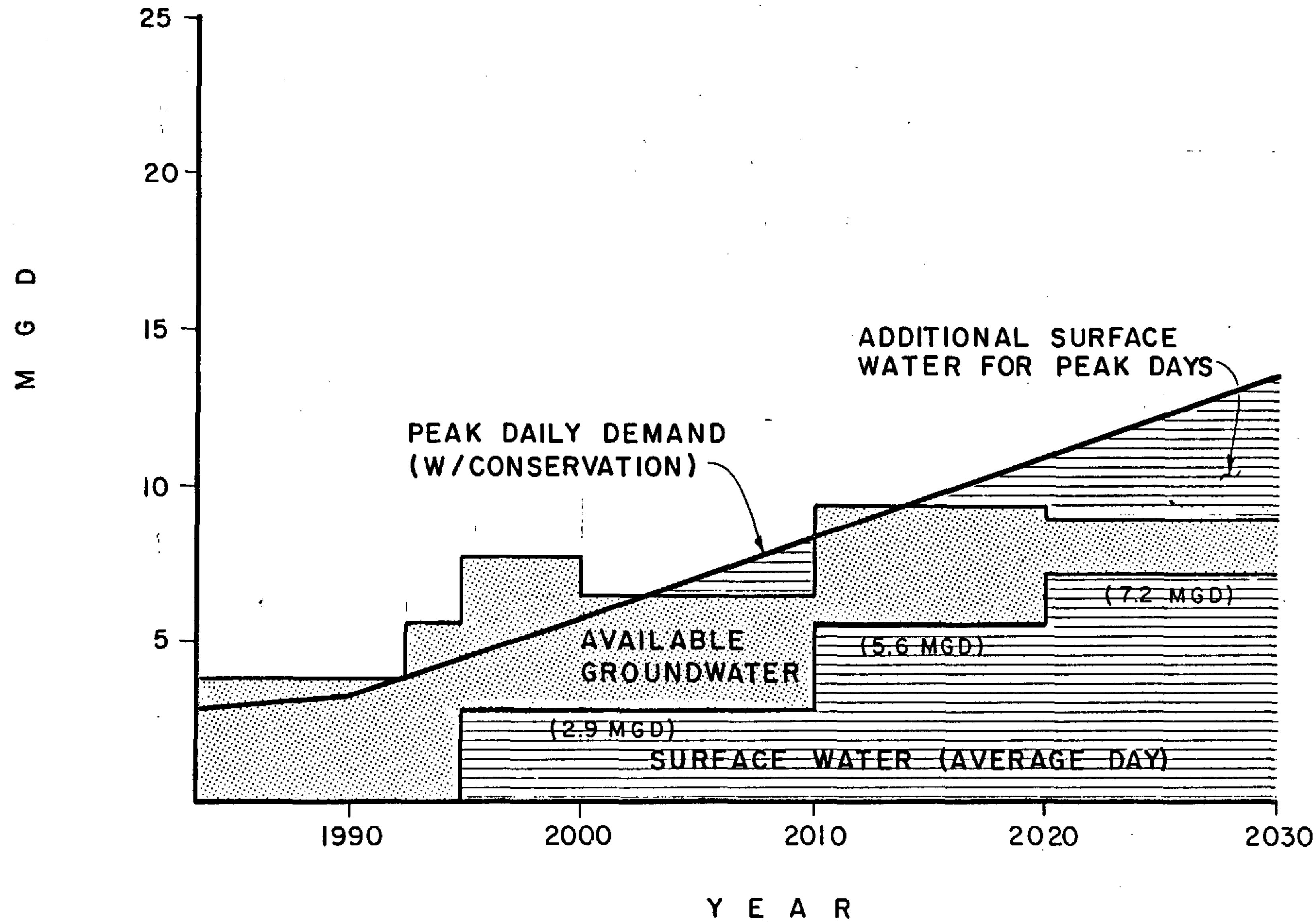


FIGURE NO. 13

AVERAGE DAILY WATER PRODUCTION

CASE I: 1995 SURFACE WATER PLANT

TOTAL STUDY AREA

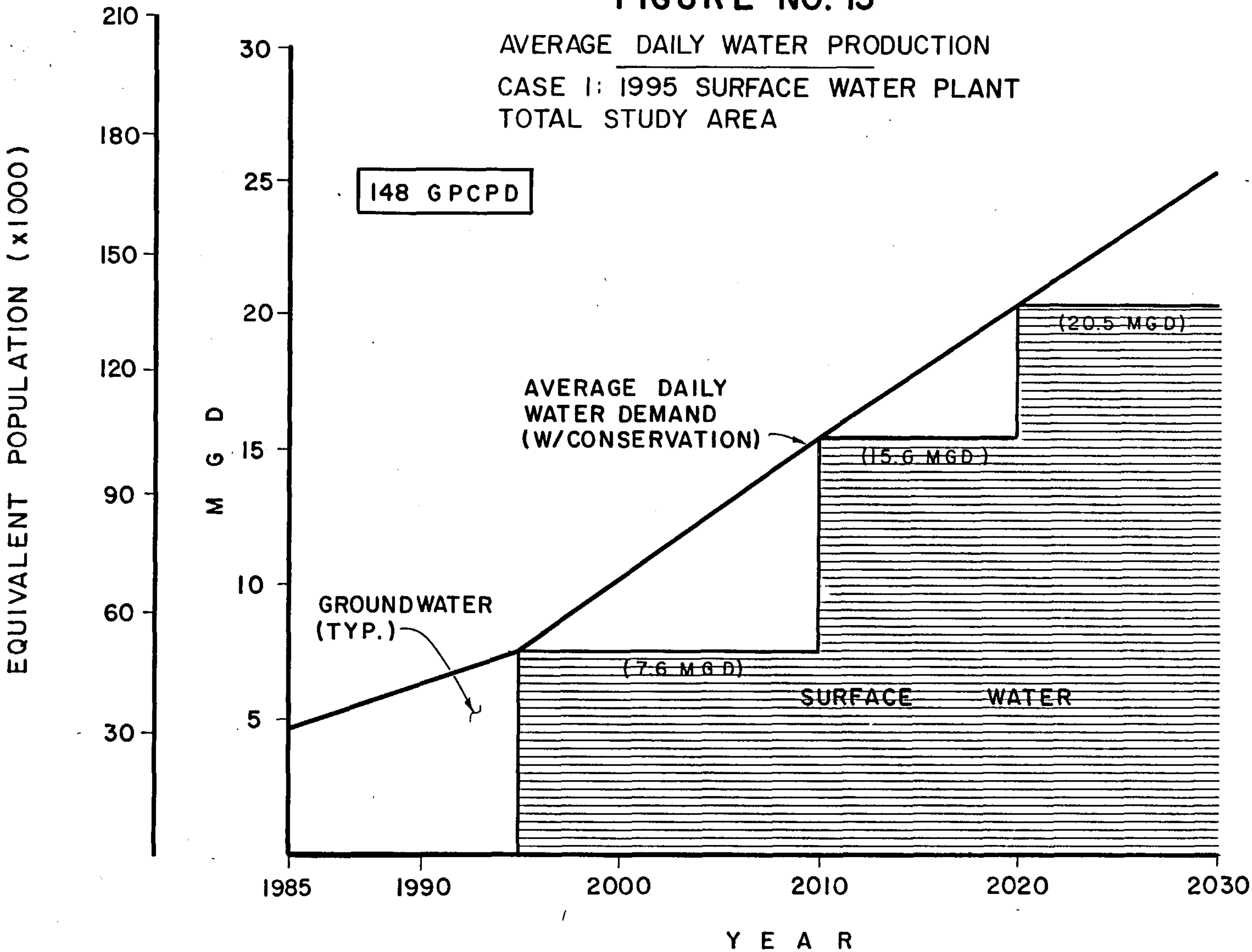


FIGURE NO. 14

PEAK DAILY WATER PRODUCTION

CASE I: 1995 SURFACE WATER PLANT
TOTAL STUDY AREA

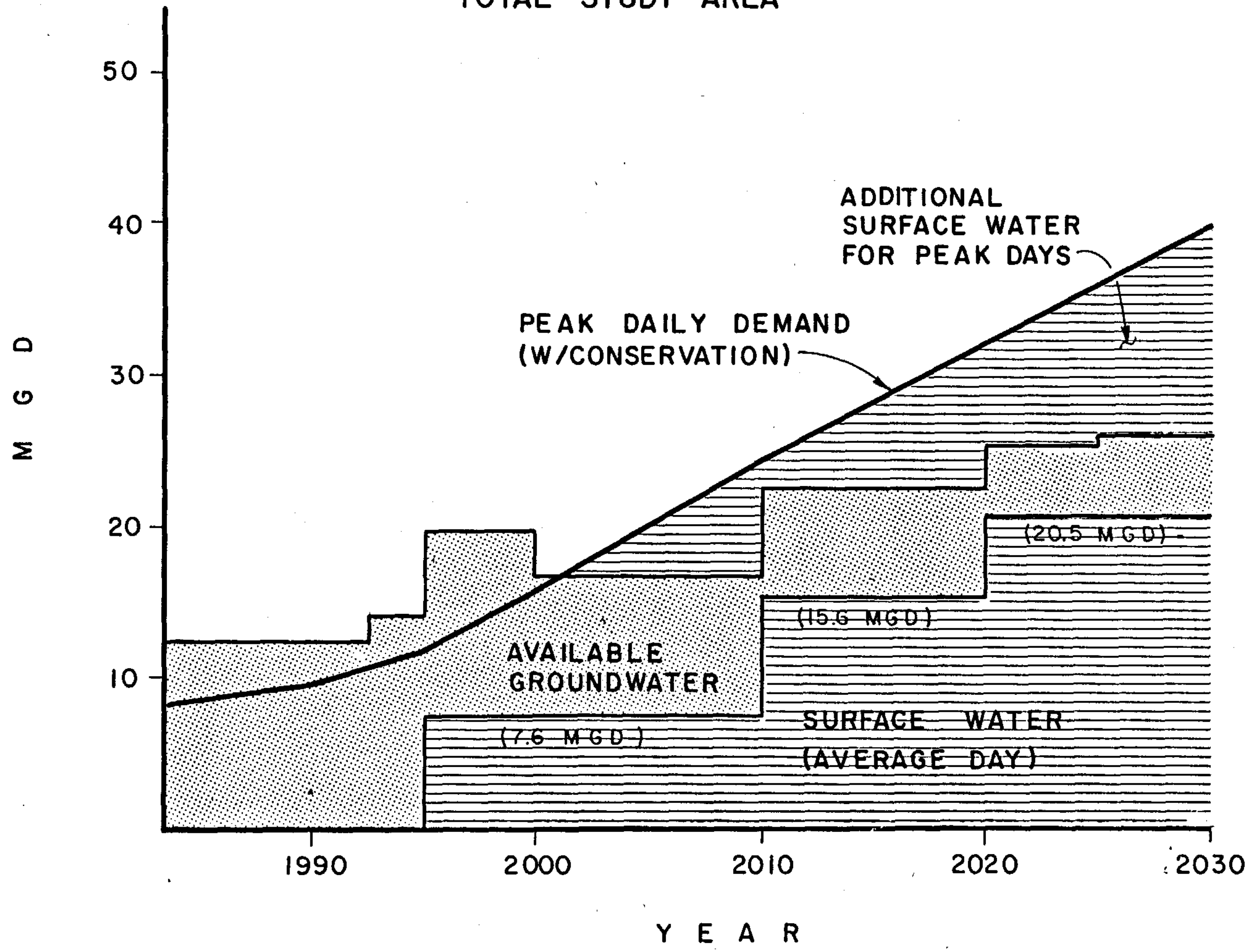


FIGURE NO. 15

AVERAGE DAILY WATER PRODUCTION

CASE 2: 2000 SURFACE WATER PLANT
CITY OF ROSENBERG & ETJ

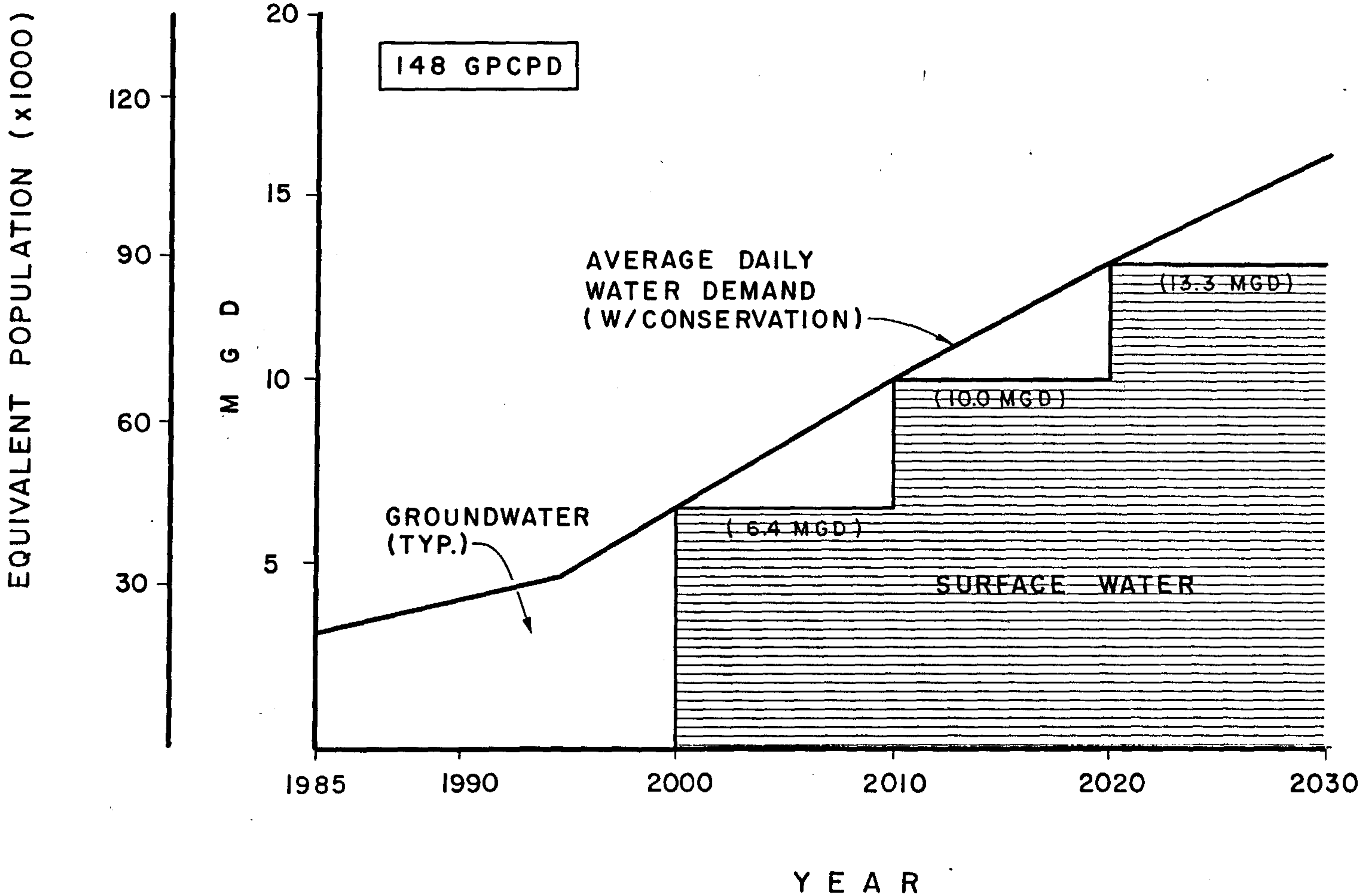


FIGURE NO. 16

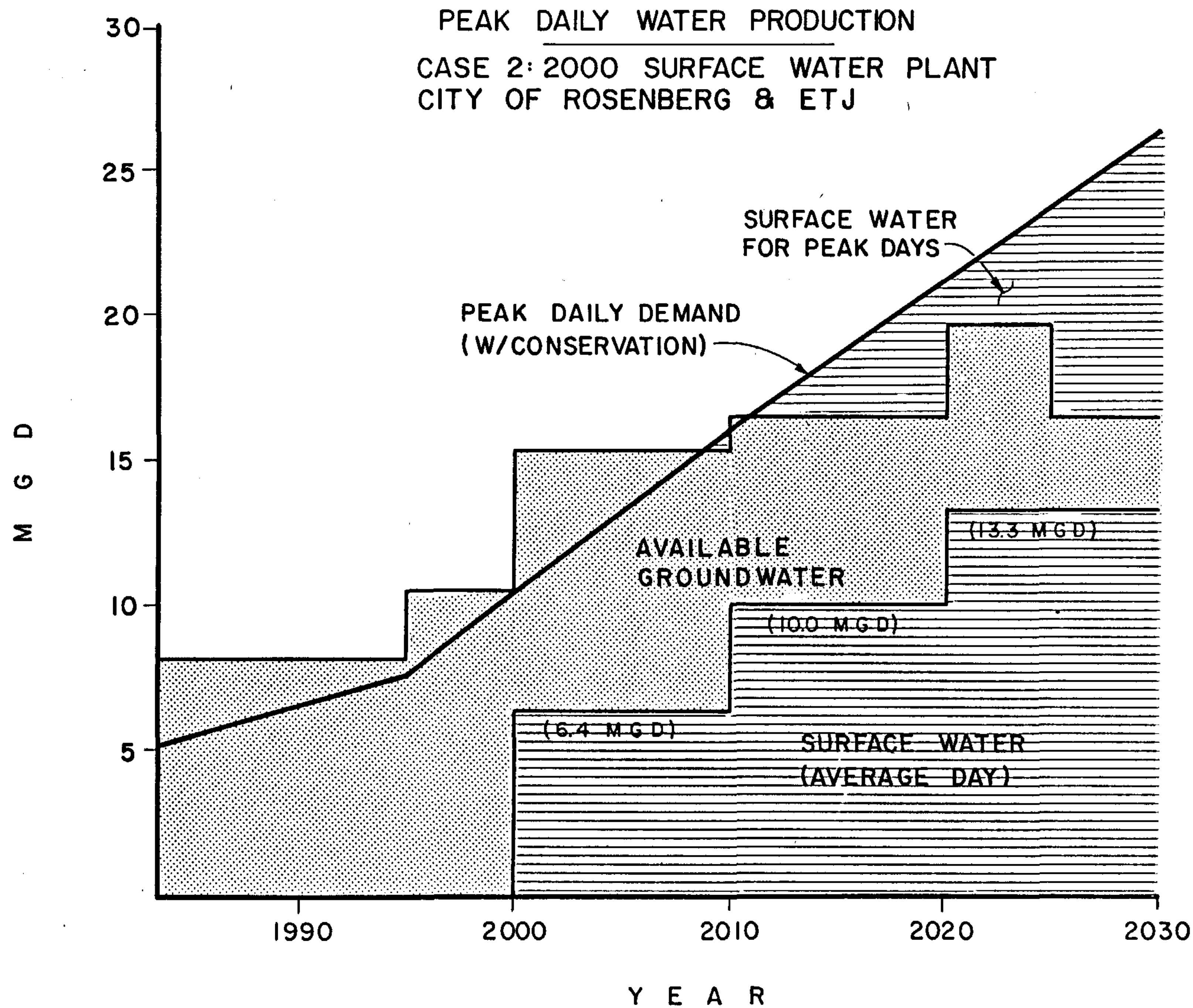

PEAK DAILY WATER PRODUCTION
CASE 2: 2000 SURFACE WATER PLANT
CITY OF ROSENBERG & ETJ
30
25
20
15
10
5
M G D
SURFACE WATER
FOR PEAK DAYS
PEAK DAILY DEMAND
(W/CONSERVATION)
AVAILABLE
GROUNDWATER
(13.3 MGD)
(10.0 MGD)
(6.4 MGD)
SURFACE WATER
(AVERAGE DAY)
1990
2000
2010
2020
2030
Y E A R

FIGURE NO. 17

AVERAGE DAILY WATER PRODUCTION

CASE 2: 2000 SURFACE WATER PLANT
CITY OF RICHMOND & ETJ

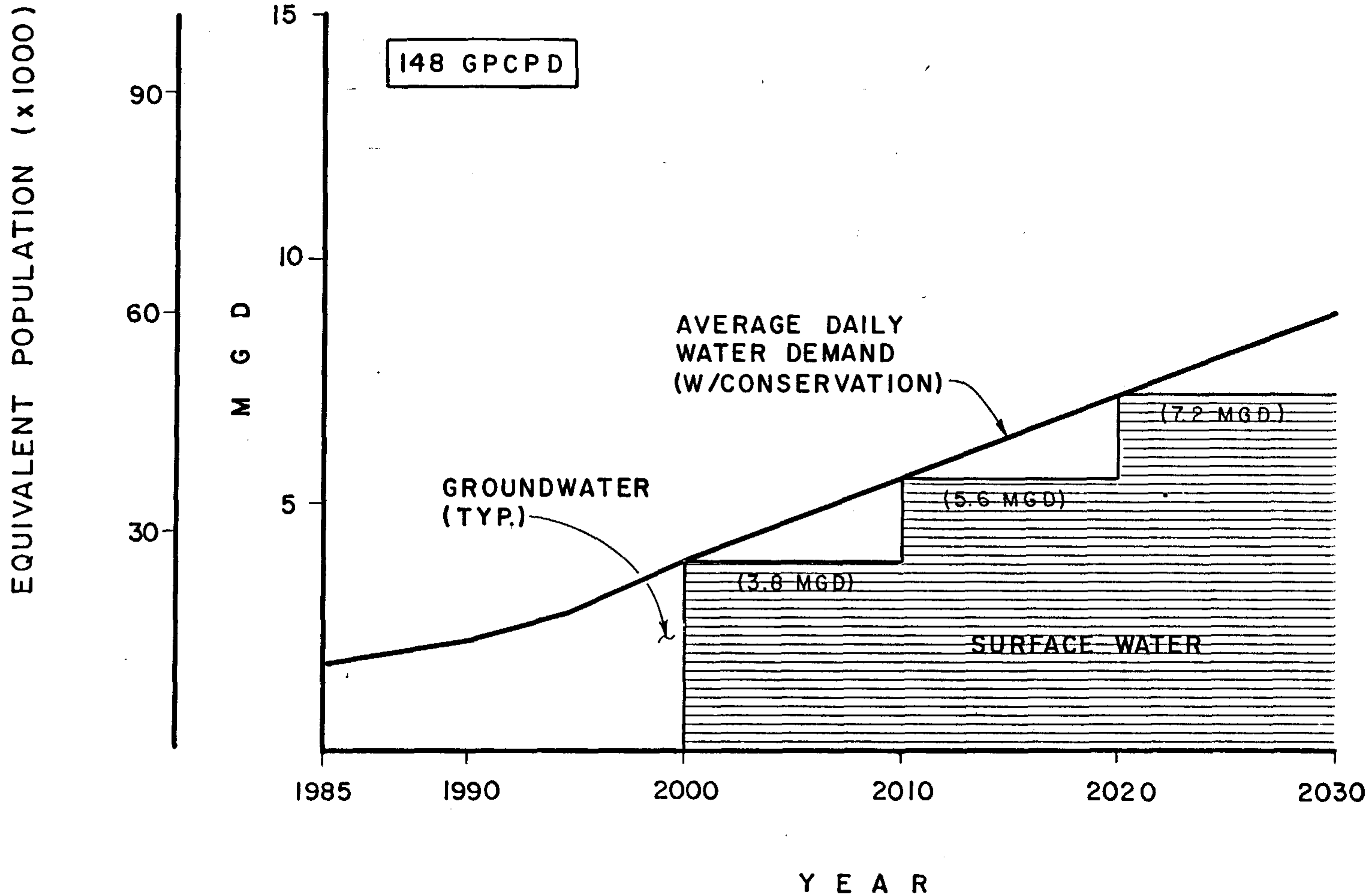


FIGURE NO. 18

PEAK DAILY WATER PRODUCTION

CASE 2: 2000 SURFACE WATER PLANT
CITY OF ROSENBERG & ETJ

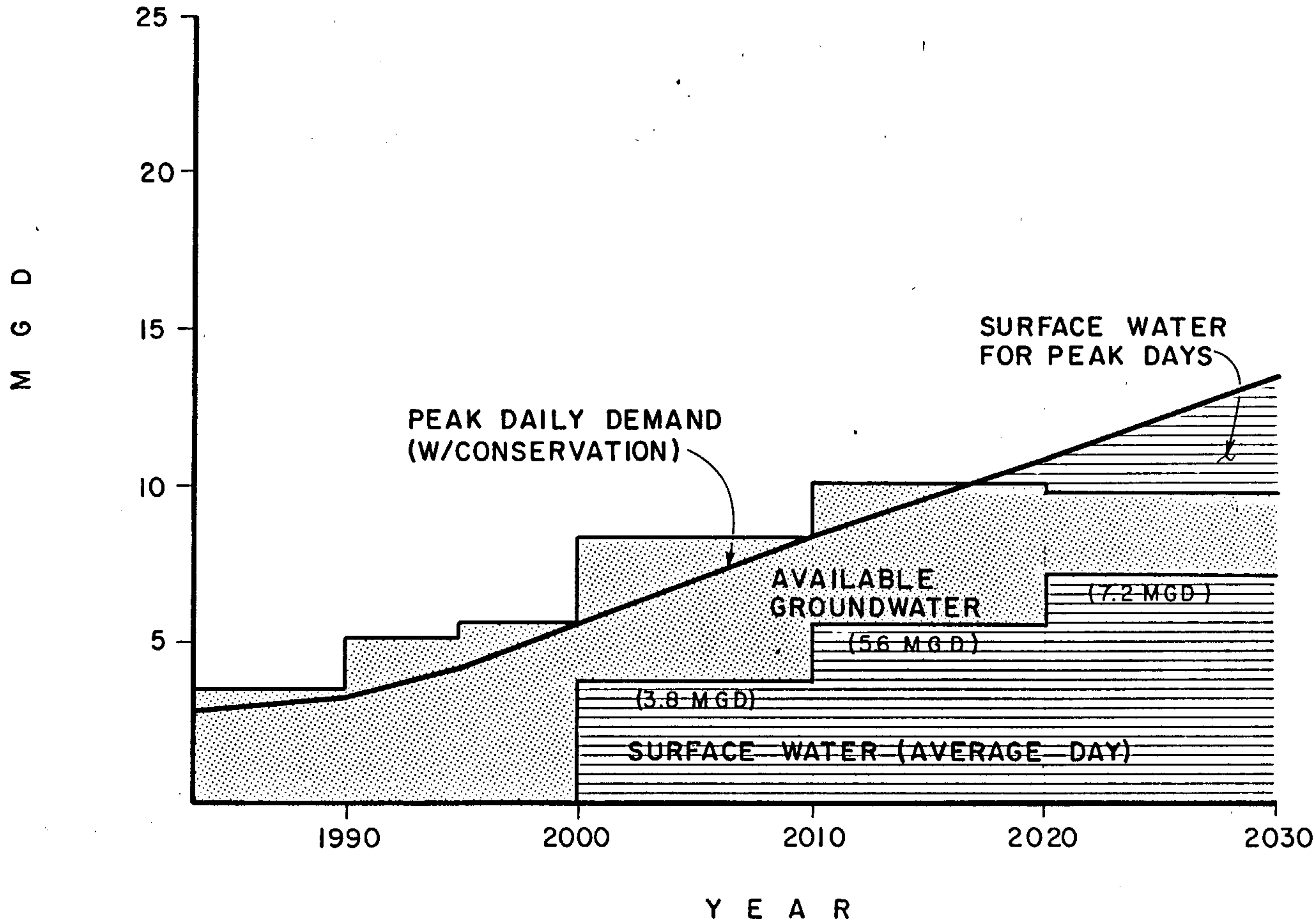


FIGURE NO. 19

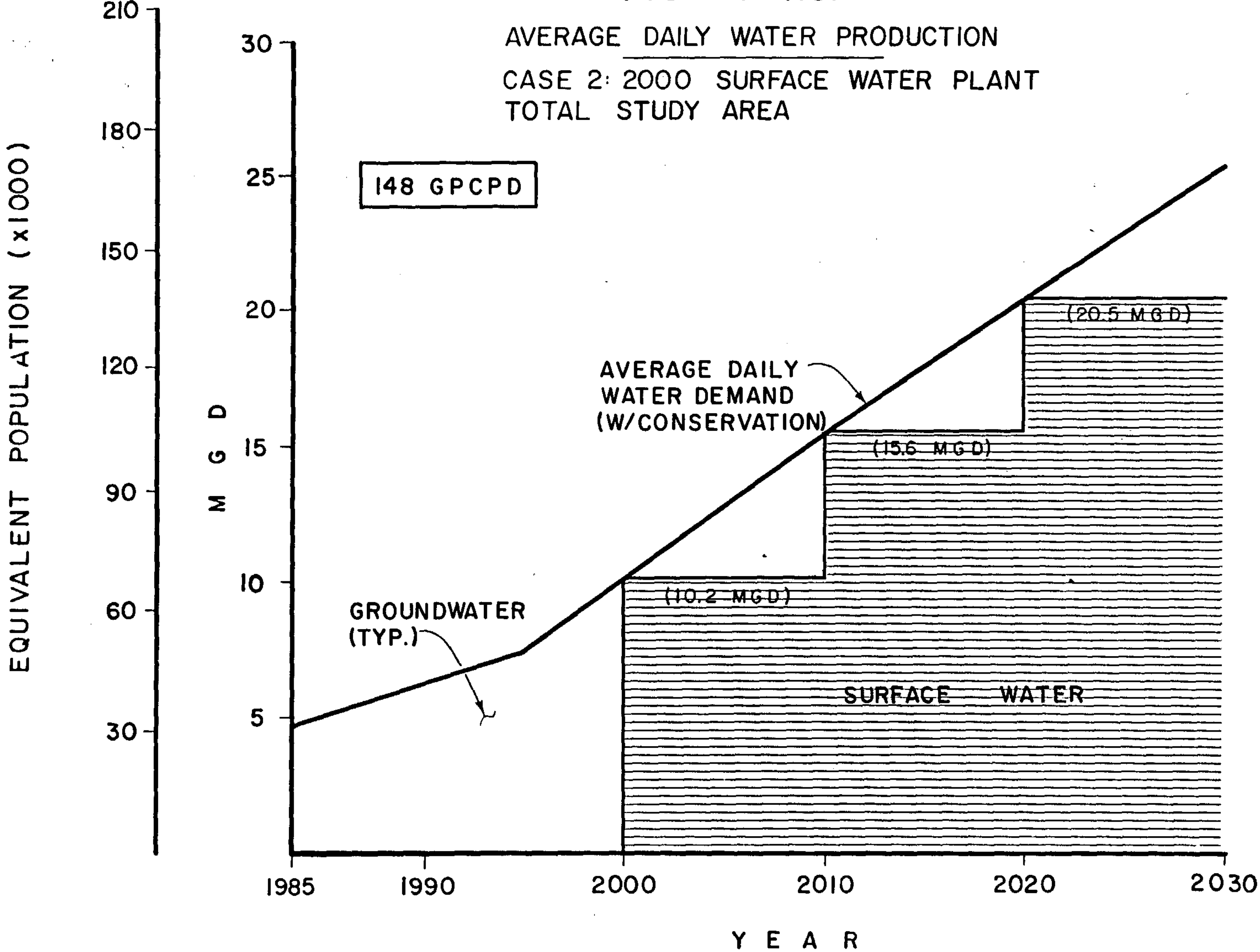
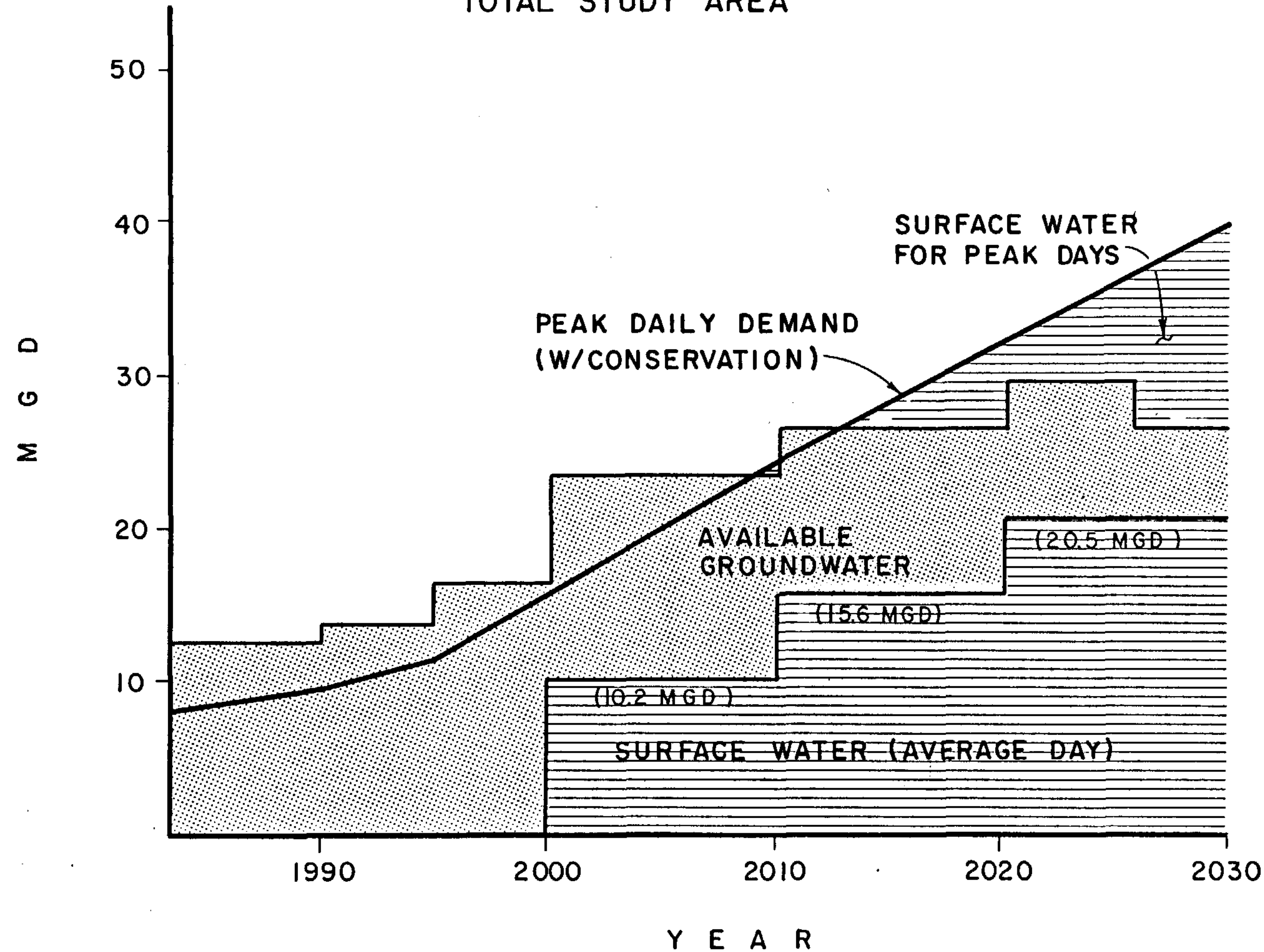
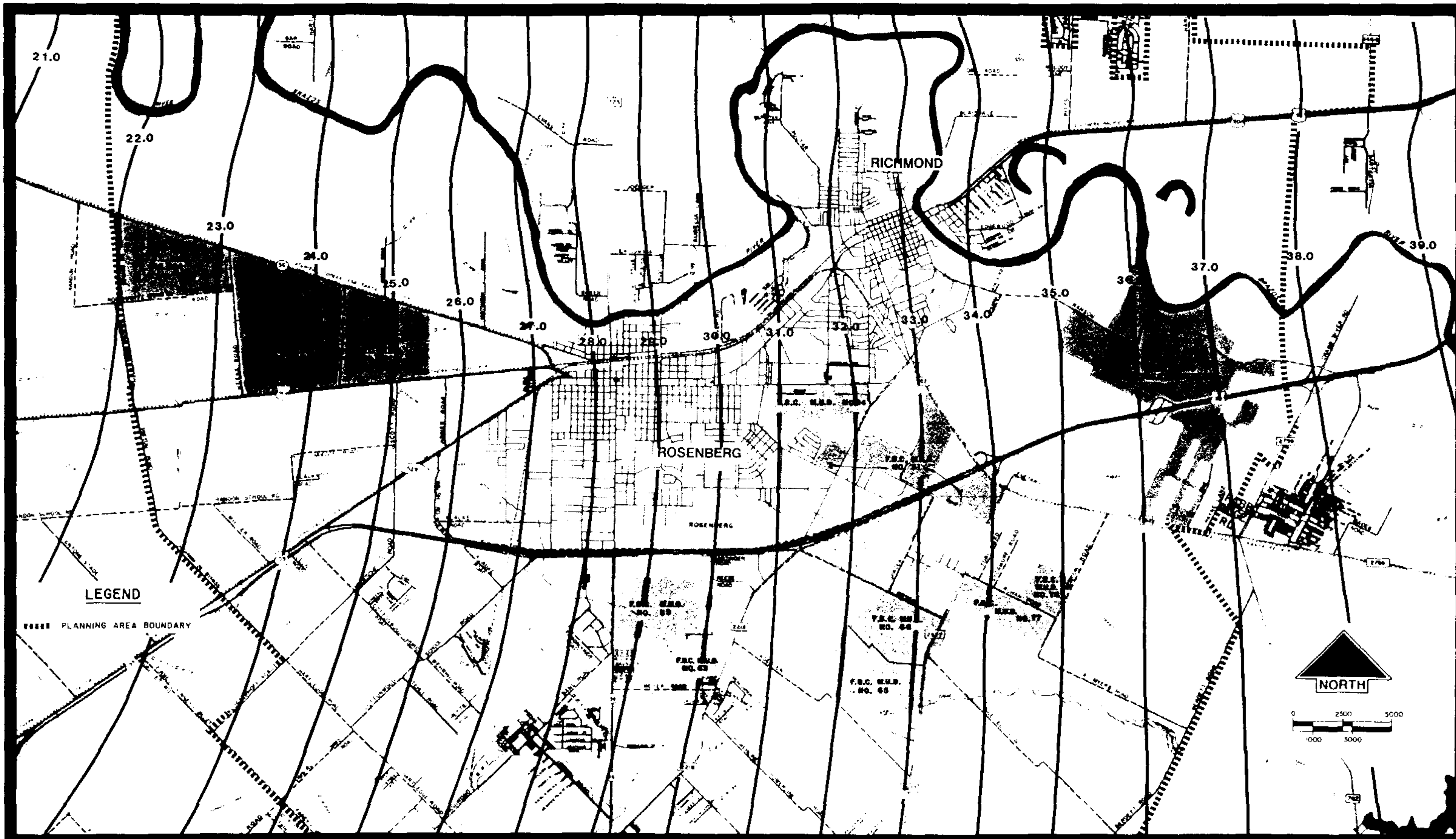

AVERAGE DAILY WATER PRODUCTION
CASE 2: 2000 SURFACE WATER PLANT
TOTAL STUDY AREA
148 GPCPD
EQUIVALENT POPULATION (x1000)
210
180
150
120
90
60
30
MGD
30
25
20
15
10
5
AVERAGE DAILY
WATER DEMAND
(W/CONSERVATION)
GROUNDWATER
(TYP.)
(10.2 MGD)
(15.6 MGD)
(20.5 MGD)
SURFACE WATER
1985
1990
2000
2010
2020
2030
YEAR

FIGURE NO. 20

PEAK DAILY WATER PRODUCTION

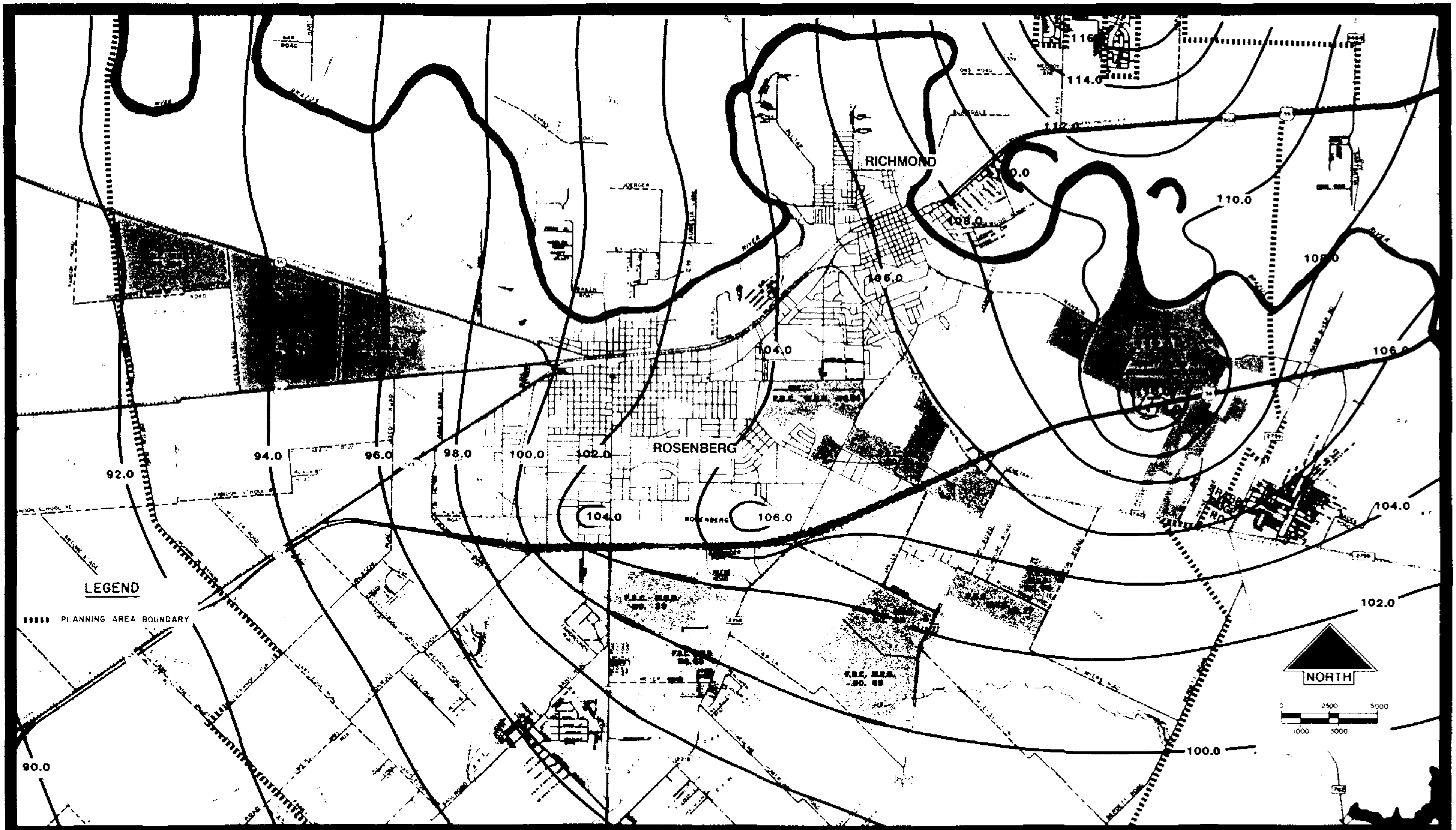
CASE 2: 2000 SURFACE WATER PLANT
TOTAL STUDY AREA





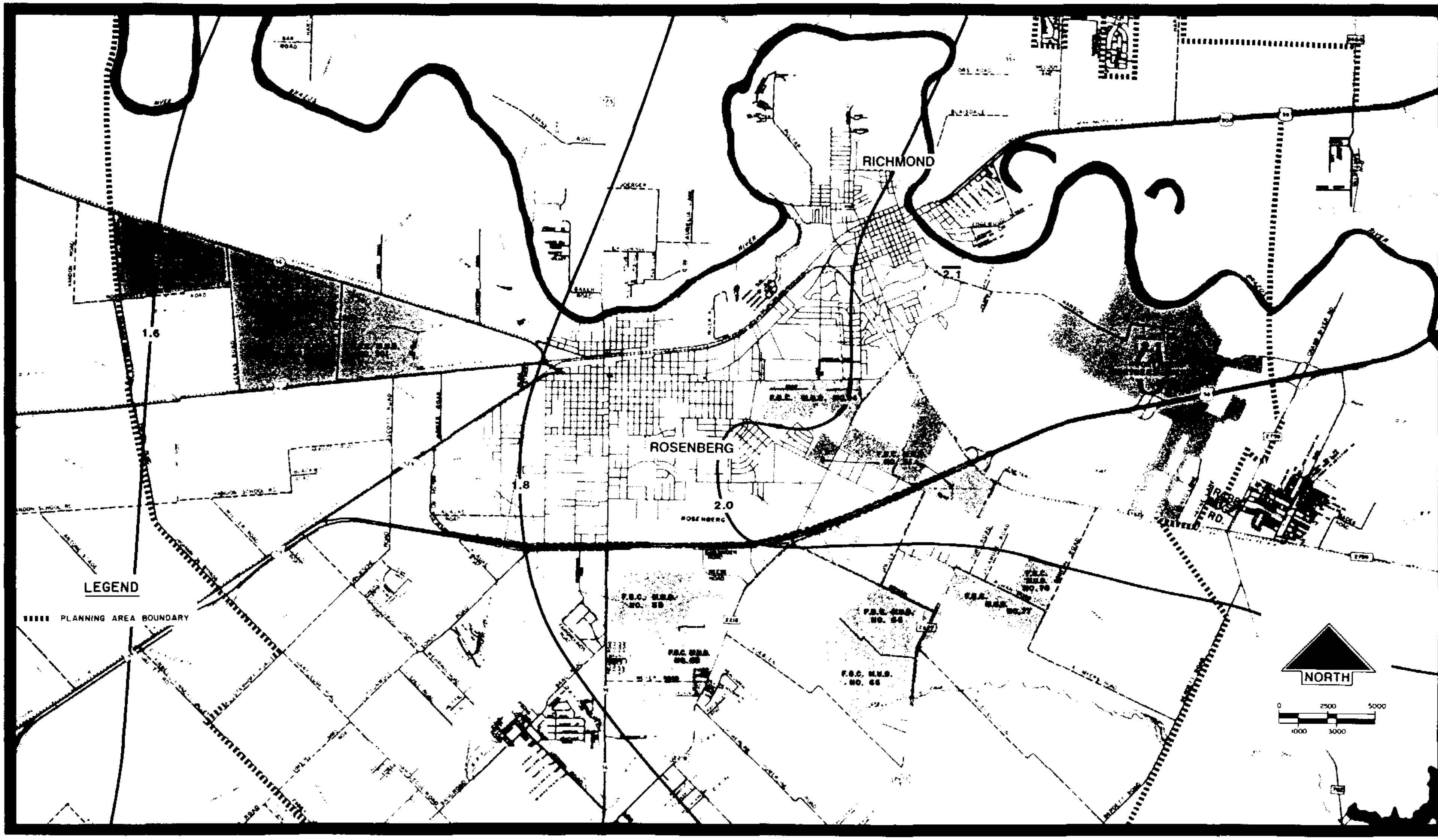
PIEZOMETRIC HEAD AT 2030 - CASE 1: CHICOT

FIGURE NO. 21



PIEZOMETRIC HEAD AT 2030 - CASE 1: EVANGELINE

FIGURE NO. 22

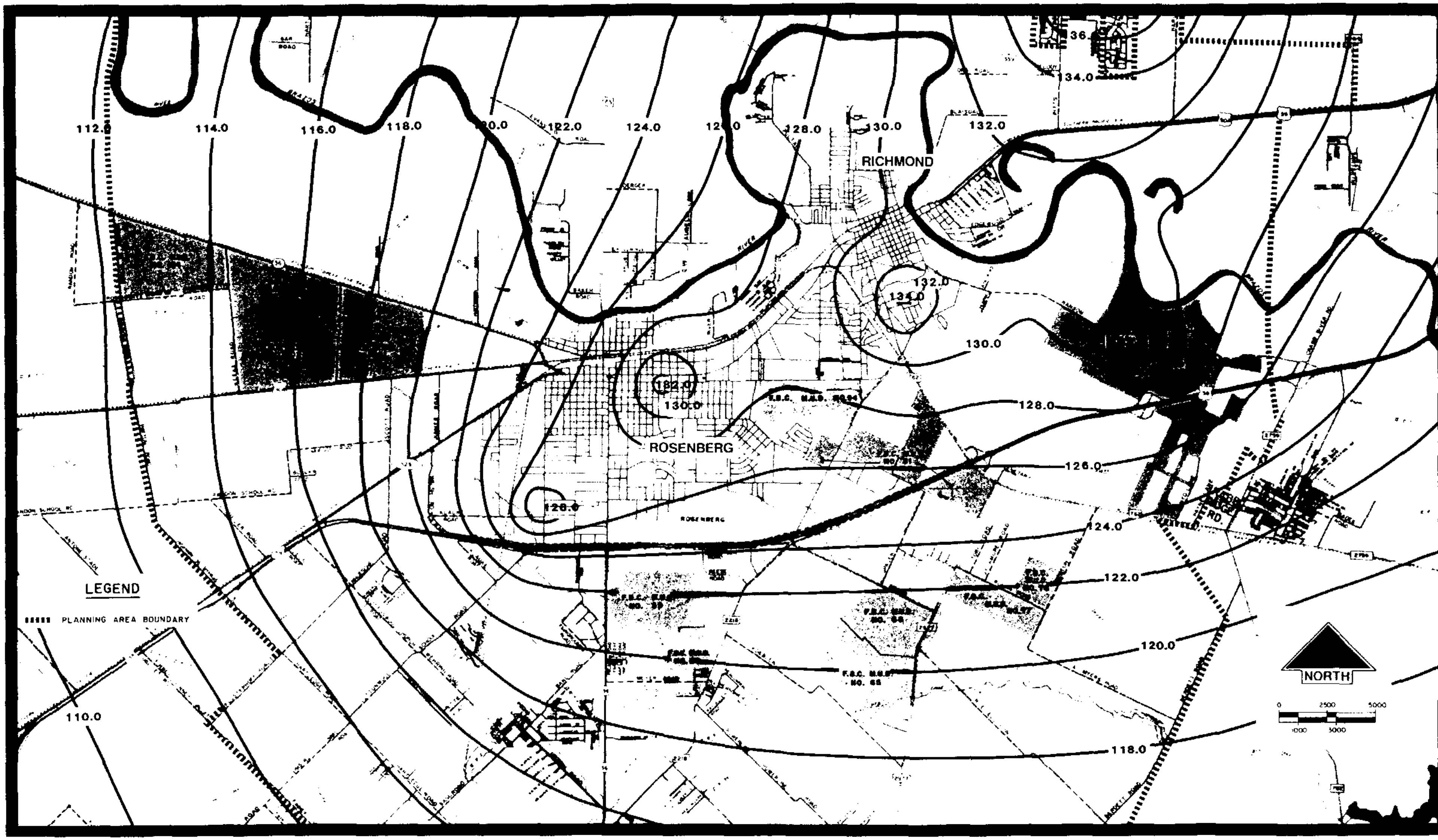


SUBSIDENCE AT 2030 - CASE 1

FIGURE NO. 23

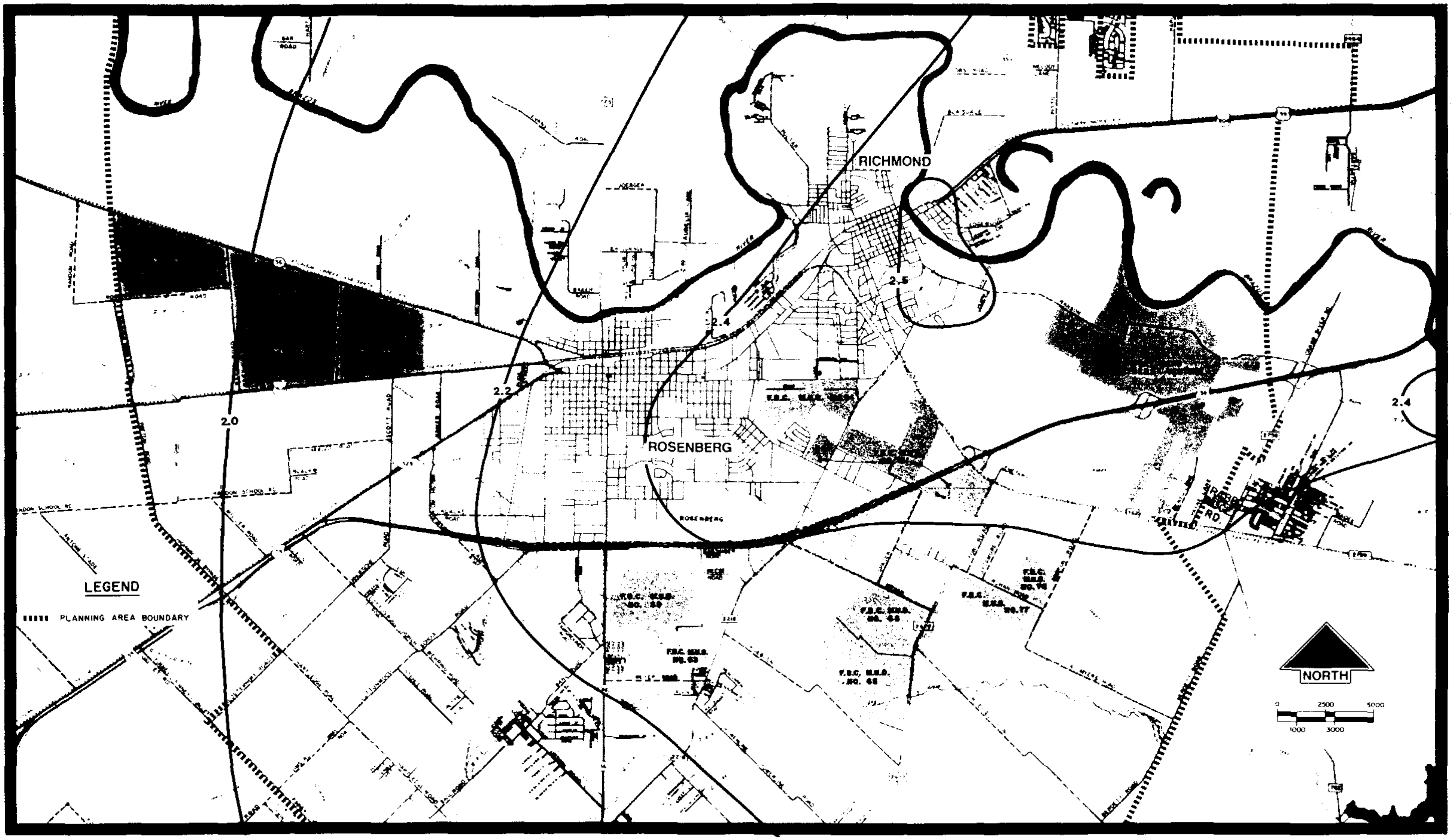
PIEZOMETRIC HEAD AT 2030 - CASE 2: CHICOT

FIGURE NO. 24



PIEZOMETRIC HEAD AT 2030 - CASE 2: EVANGELINE

FIGURE NO. 25

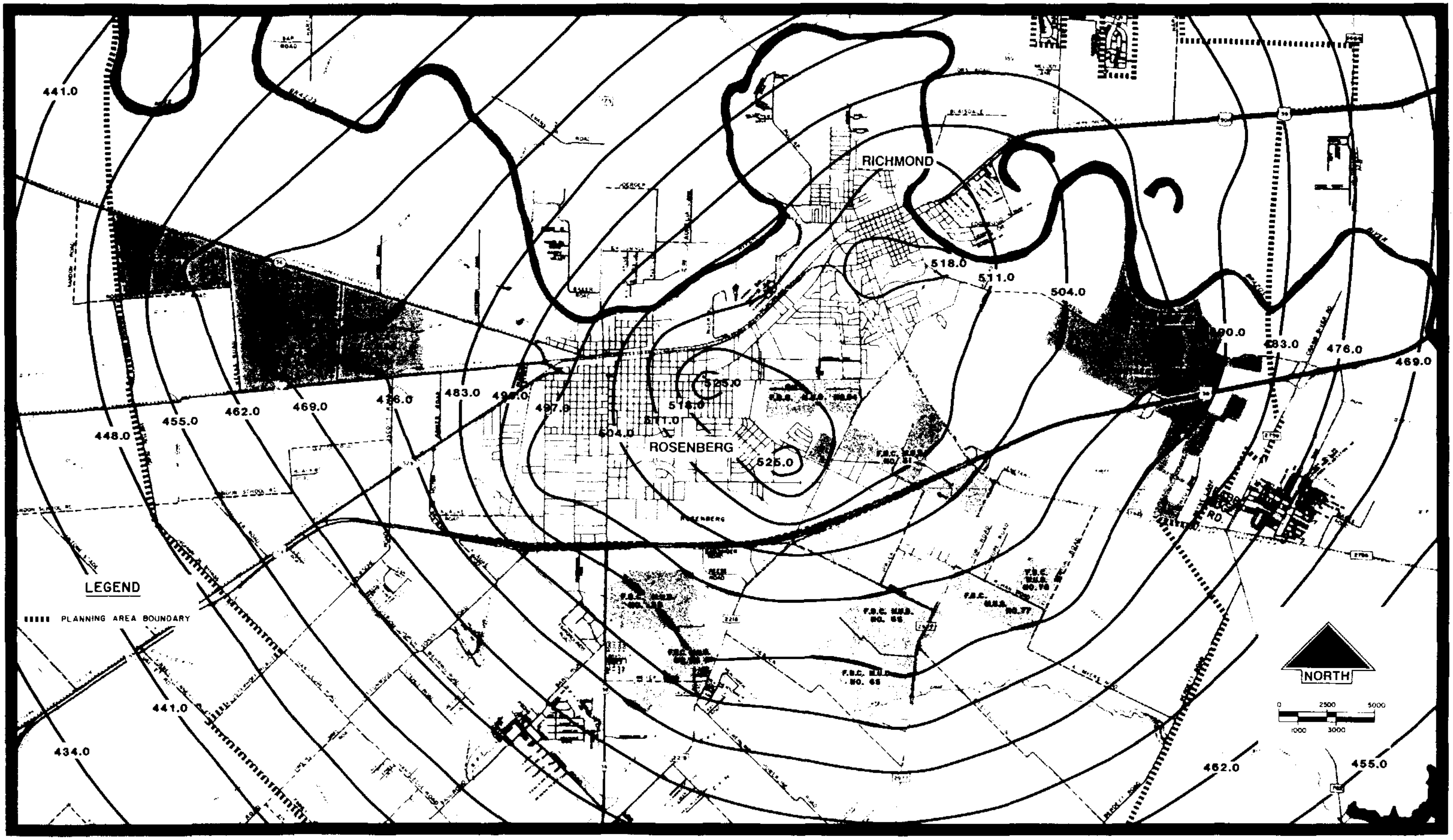


SUBSIDENCE AT 2030 - CASE 2

FIGURE NO. 26

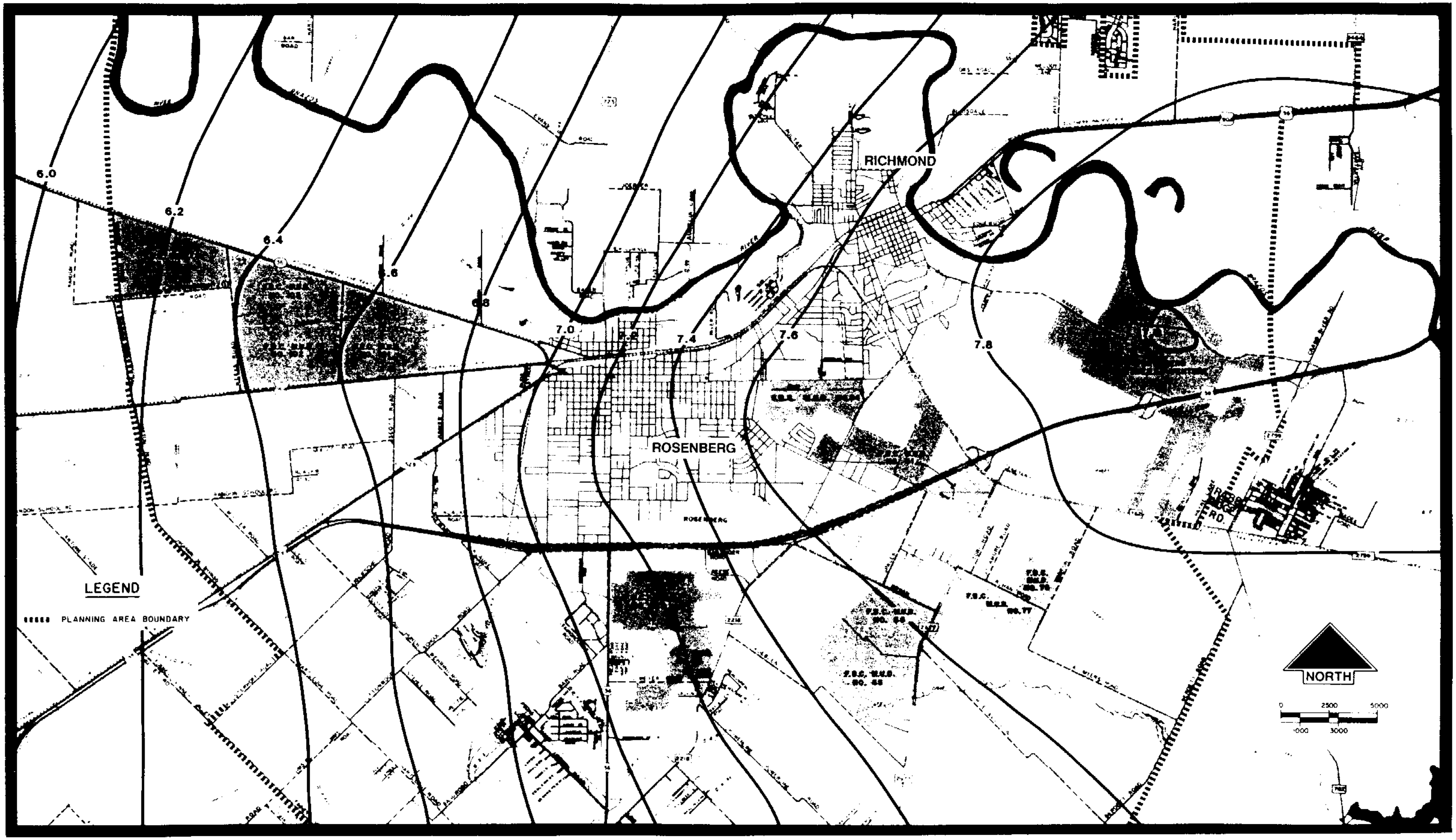
PIEZOMETRIC HEAD AT 2030 - CASE 3: CHICOT

FIGURE NO. 27



PIEZOMETRIC HEAD AT 2030 - CASE 3: EVANGELINE

FIGURE NO. 28



SUBSIDENCE AT 2030 - CASE 3

FIGURE NO. 29

CHAPTER 5.0 - SURFACE WATER SUPPLY AND AVAILABILITY

Surface Water Requirements

Development of a surface water conversion plan requires definition of an adequate and economical surface water supply source. This amount is related to both conversion objectives and to system operation and design philosophy.

The surface water plan must provide for minimal disruption in current system operations, minimize the capital cost of facilities, and maximize the use of available groundwater while at the same time meeting conversion objectives. This can be accomplished through a conjunctive use system which delivers treated surface water to existing ground storage tanks. During peak periods, surface water is supplemented by groundwater.

This approach allows essentially unchanged operation of the distribution systems within the planning area. Each entity can continue to operate its own system independently. The treatment facilities and conveyance lines are smaller because peak demands are met in part by existing groundwater facilities. The conjunctive use system proposed is designed to provide surface water at a steady rate sufficient to meet conversion objectives, with peak demands satisfied by groundwater and surface water. Furthermore, the development of a conjunctive use system will allow the Cities of Rosenberg and Richmond to develop a reliable long term water supply sufficient to meet the projected water needs of the MUD's within the two cities ETJs. This would allow development within the MUDs to occur without the need for excessive groundwater development which would result in loss of MUD capital investment when surface water conversion becomes a reality.

The analysis of existing groundwater well capacities and well service lives as well as the affects of various projected withdrawal rates has led to the conclusion that the planning area will require 20.5 MGD of surface water by the year 2030. The conjunctive use system to be proposed will phase the development of surface water based on the initial conversion of 10 MGD in the year 2000 increasing to 15 MGD in the year 2010 and finally increasing to the ultimate capacity of 20.5 MGD by the year 2020. The ultimate capacity of 20.5 MGD of surface water will remain constant throughout the remainder of the planning period.

<u>Surface Water Source</u>

Presently there are no treated water sources available to the planning area. Due to the high transportation cost, the only surface water supply source considered was raw water from the Brazos Basin. Evaluations were performed in the following chapters to determine what form of Brazos Basin water would be utilized to develop the final implementation plan. The forms available consists of the following raw water supply options:

- Option 1: Purchase treated Brazos River water from WHCSWSC.
- Option 2: Purchase raw water from the GCWA out of the GCWA's Canal "A" which originates from the Brazos River.
- Option 3: Purchase raw water from the Brazos River Authority directly out of the Brazos River which runs through the planning area.

As shown above, all of the available options result in utilizing raw water that originates in the Brazos Basin. The WHCSWSC proposes using raw water from the Brazos Basin.

Brazos Basin (Brazos River Authority)

The Brazos River Basin is the second largest river basin in the State with a total drainage area of 45,573 square miles. The basin is over 600 miles long and varies in width from 110 miles around Waco to only about 1 mile at its mouth at the Gulf of Mexico. The quality of water in the Brazos River Basin varies considerably along the extent of the basin. Presently, excluding the water available from the Galveston County Water Authority Canals, the Brazos Basin has approximately 80-100 MGD of uncommitted water available for long term contract. The Brazos River Authority, also, has the following planned future water resources projects within the Brazos Basin which could significantly increase the water available for long term contract.

The following is a summary of possible low cost projects that will produce available future yield within the Brazos Basin:

	Project	Estimated Yield (MGD)
1.	Allens Creek Reservoir (Future)	107
2.	Lake Besque (Planned 1991)	16
3.	South Bend Lake (Future)	98
4.	Caldwell Lake (Future)	87
5.	Whitney Lake (Future)	82
6.	Increased Yield Due to System Operations	107
	Total Future Yield Available	497

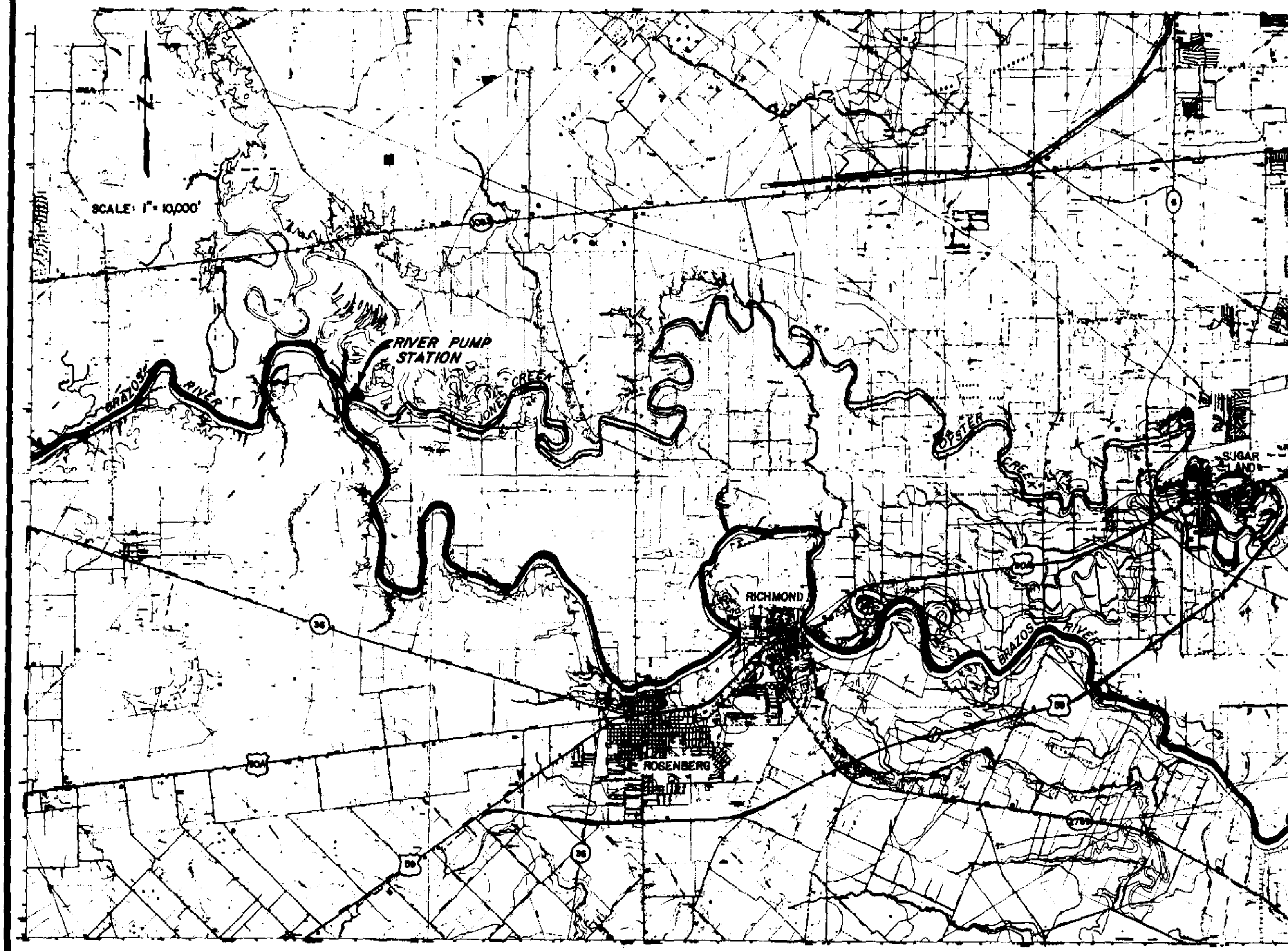
As shown above, the total uncommitted water could provide 80-100 MGD of raw water to the planning area, which far exceeds the projected demand of 20.5 MGD.

Brazos Basin (Galveston County Water Authority)

The GCWA canal system, also known as the BRA Canals "A" and "B", have been utilized to provide raw water to farmers and municipal users in Fort Bend, Brazoria Counties and Galveston County for many years. Canal "A", which is closest to the planning area, is located just northeast of the Brazos River approximately 12 miles north of the planning area.

Canal "A" begins at a pump station, known as the River Pump Station, south of Fulshear, Texas (see Figure 30). Originally constructed in 1908, the pump station has undergone a number of modifications and improvements to bring it to its current capacity of 242,000 gallons per minute (GPM). The pump station discharges into Jones Creek, which drains into Oyster Creek. Approximately 20 miles east of the pump station, Oyster Creek forms a series of lakes. The level of water in these lakes is controlled by a series of three dams. Just east of Dam No. 3, the most downstream dam near River Bend Country Club and Dulles Avenue, a second pump station lifts water from Oyster Creek into a channelized section flowing from that point south to the Galveston County Water Authority 12 MGD treatment plant near Texas City and beyond.

According to the GCWA General Manager and data released in recent studies, GCWA has approximately 60 MGD of raw water available for sale, which exceeds the projected 20.5 MGD demand within the planning area.



BASE MAP OBTAINED FROM F.B.C.W.C. & I.D. NO. 2 AND CITY OF SUGARLAND REGIONAL WATER SUPPLY AND PLANNING STUDY.

REGIONAL WATER SUPPLY STUDY
CITIES OF ROSENBERG AND RICHMOND

TRI-COUNTY CANAL

DEC DANNENBAUM ENGINEERING CORPORATION

FIGURE No. 30

DATE: MARCH 1989

JOB NO. 2454 - 01

Brazos Basin (Richmond Irrigation Canal Owned by HL&P)

Another potential source of Brazos River water researched was raw water owned by HL&P that is transported through the Richmond Irrigation Canal. The canal is used to transport raw water from the Brazos River between Rosenberg and Richmond to the intersection of Dry Creek and Meninite Road where it splits, transporting HL&P water southeast to Smithers Lake, and south to irrigated cropland in the area. According to HL&P officials there are no available water rights associated with this canal; however, the canal has additional capacity to be utilized for transporting future BRA water rights to the southern portion of the planning area where substantial development is projected. This form of Brazos River water was therefore not utilized in evaluating water sources; however, the Richmond Irrigation Canal was evaluated as a facility to transport raw water when developing the final implementation plan.

Raw Water Quality

The raw water from the Brazos River System which would be used to supply the planning area compares favorably with other regional water sources such as Lake Conroe or the Trinity River. Table 5.1 gives a summary comparison of Brazos River System water to these other supplies.

TABLE 5.1

COMPARISON OF REGIONAL SURFACE WATER QUALITY1/

Parameter (Units)	Brazos River	Lake Conroe2/ (San Jacinto River)	Benbrook Lake2/ (Trinity River)
Turbidity (ntu)	16 - 111	N.A.3/	N.A.3/
Alkalinity (mg/l @ $CaCO_3$)	78 - 250	39 - 140	110-160
pH (units)	7.9 - 8.9	6.4 - 8.4	6.9 - 8.6
Fluoride (mg/l)	0.28 - 0.34	0.1 - 0.2	0.2 - 0.4
Calcium Hardness (mg/l @ $CaCO_3$)	128 - 140	37 - 85	97-155
Hardness (mg/l @ $CaCO_3$)	148 - 180	46 - 100	130-180
Zinc (mg/l)	N.A.3/	0.01 - 0.03	N.A.3/
Iron (mg/l)	2.7 - 3.8	0.01 - 8.3	0.01 - 0.79

**Reproduced from G.C.W.A. Investigation of Potable Water Complaints in Dickinson, Texas by Malcolm Pirnie, May 1986.

1/ Source of Data: GCWA Monthly Reports, 1983 - 1985.
2/ Source of Data: U.S.G.S. Water Resources Data 1982.
3/ NA: Not Analyzed.

Raw water quality conditions of the Brazos River itself have been monitored over the past 20 years by the USGS at its gauging station near Richmond, Texas. Table 5.2, taken from data prepared by the USGS, gives a description of water quality conditions in the Brazos River along with statistical and recurrence intervals for each criteria. Of importance with respect to raw water supply and treatment are the amount of dissolved solids, chlorides and sulfates monitored in the raw water. In 95% of the samples taken the total dissolved solids were less than or equal to 730.0 milligrams per liter (mg/l), chlorides were equal to or less than 240.0 mg/l and sulfates were equal to or less than 130.5 mg/l. Other criteria related to water quality of the Brazos River can also be seen in this table.

Raw water taken from the Brazos River System is characteristically high in color, with variable turbidity, high organic content, high iron and seasonally high algae content. The high algae and organic content of the raw water results in the potential for taste and odor problems to develop during treatment and distribution.

Raw Water Availability and Cost

As shown previously the Brazos Basin has existing and projected available supplies that far exceed the projected needs of 20 MGD in the planning area. The cost of Brazos River water varies from between $0.24-$0.30/1000 gallons from the BRA to $0.11/1000 gallons from the GCWA.

TABLE 5.2

STATISTICAL SUMMARY OF SELECTED WATER-QUALITY DATA

STATION NUMBER: 08114000 STATION NAME: BRAZOS RIVER AT RICHMOND, TEX.

LATITUDE: 293456 LONGITUDE: 0954527 COUNTY: FORT BEND DRAINAGE AREA: 45007.00 SQUARE MILES

SUMMARY OF SELECTED WATER QUALITY DATA COLLECTED AT PERIODIC INTERVALS FROM OCT 1967 TO AUG 1986

WATER-QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS				PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	95	75	MEDIAN 50	25	5
TEMPERATURE (DEG C)	300	33.50	3.50	20.35	30.50	26.00	20.00	15.00	8.00
STREAMFLOW, INSTANTANEOUS (CFS)	244	98100.00	120.00	10510.12	44979.96	12250.00	4969.00	1777.50	742.00
TURBIDITY (FTU)	55	390.00	0.40	140.97	556.00	200.00	74.00	20.00	2.54
COLOR (PLATINUMCOBALT UNITS)	61	130.00	5.00	45.70	158.00	50.00	25.00	10.00	5.00
SPECIFIC CONDUCTANCE (UMHOS)	315	1900.00	220.00	753.58	1298.00	936.00	725.00	519.00	334.40
OXYGEN, DISSOLVED (MG/L)	120	14.30	5.40	8.77	11.40	9.30	8.60	7.50	6.70
OXYGEN, DISSOLVED (PERCENT SATURATION)	119	160.00	66.00	93.17	119.00	104.00	97.00	91.00	76.00
OXYGEN DEMAND, BIOCHEMICAL, 5 DAY (MG/L)	117	8.10	0.10	2.33	4.80	2.80	2.10	1.40	0.50
OXYGEN DEMAND, CHEMICAL (LOW LEVEL) (MG/	12	43.00	7.00	17.67	43.00	18.75	16.50	11.25	7.00
PH (UNITS)	302	8.60	6.20	7.73	8.30	8.00	7.80	7.50	7.10
ALKALINITY FIELD (MG/L AS CACO3)	293	248.00	75.00	136.29	190.00	153.50	135.00	115.00	89.00
CARBONATE FET-FLD (MG/L AS CO3)	251	9.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00
SOLIDS, RESIDUE AT 105 DEG. C, SUSPENDED	62	2260.00	15.00	384.74	1636.50	539.50	136.50	41.25	20.15
SOLIDS, VOLATILE, SUSPENDED (MG/L)	57	2220.00	0.00	103.09	332.40	103.50	50.00	16.50	0.00
NITROGEN, ORGANIC TOTAL (MG/L AS N)	94	7.20	-0.03	0.85	1.75	1.10	0.75	0.45	0.13
NITROGEN, ORGANIC DISSOLVED (MG/L AS N)	12	1.20	0.37	0.70	1.20	0.87	0.65	0.52	0.37
NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	42	0.18	0.00	0.05	0.14	0.08	0.05	0.03	0.00
NITROGEN, AMMONIA TOTAL (MG/L AS N)	103	1.10	0.00	0.06	0.22	0.08	0.05	0.02	0.00
NITROGEN, NITRITE DISSOLVED (MG/L AS N)	6	0.03	0.00	0.01	0.03	0.01	0.00	0.00	0.00
NITROGEN, NITRITE TOTAL (MG/L AS N)	39	0.25	0.00	0.02	0.13	0.02	0.01	0.00	0.00
NITROGEN, NITRATE DISSOLVED (MG/L AS N)	2	0.94	0.44						
NITROGEN, NITRATE TOTAL (MG/L AS N)	172	2.20	0.00	0.52	1.34	0.80	0.50	0.20	0.00
NITROGEN, AMMONIA + ORGANIC DIS. (MG/L AS	12	1.30	0.45	0.77	1.30	0.95	0.73	0.68	0.45
NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L A	75	7.30	0.01	1.09	1.95	1.20	0.93	0.72	0.46
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	76	1.50	0.00	0.40	1.10	0.62	0.41	0.02	0.00
NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	42	1.30	0.00	0.43	1.18	0.72	0.46	0.00	0.00
PHOSPHORUS, TOTAL (MG/L AS P)	111	0.95	0.03	0.24	0.66	0.31	0.19	0.11	0.07
PHOSPHORUS, DISSOLVED (MG/L AS P)	42	0.25	0.00	0.10	0.18	0.13	0.06	0.07	0.03
CARBON, ORGANIC TOTAL (MG/L AS C)	54	44.00	2.70	9.64	13.50	12.00	9.25	5.35	3.10
CARBON, ORGANIC DISSOLVED (MG/L AS C)	4	25.00	4.20						
CARBON, ORGANIC SUSPENDED TOTAL (MG/L AS	4	1.30	0.40						
HARDNESS (MG/L AS CACO3)	293	470.00	88.00	203.01	293.00	240.00	200.00	160.00	110.00
HARDNESS, NONCARBONATE (MG/L CACO3)	293	300.00	0.00	67.23	140.00	91.00	59.00	33.50	16.70
CALCIUM DISSOLVED (MG/L AS CA)	290	110.00	28.00	61.73	86.00	72.00	62.00	50.00	36.00
MAGNESIUM, DISSOLVED (MG/L AS MG)	290	71.00	3.20	11.67	20.00	15.25	12.00	7.77	4.45
SODIUM, DISSOLVED (MG/L AS NA)	130	240.00	9.50	77.54	169.00	110.00	69.50	40.00	16.05
SODIUM ADSORPTION RATIO	289	23.00	0.50	2.31	4.00	3.00	2.00	1.25	0.70
POTASSIUM, DISSOLVED (MG/L AS K)	142	7.50	1.80	4.59	5.89	5.10	4.50	4.10	3.40
CHLORIDE, DISSOLVED (MG/L AS CL)	295	370.00	11.00	111.01	240.00	150.00	96.00	53.00	22.00
SULFATE DISSOLVED (MG/L AS SO4)	294	220.00	13.00	71.40	130.50	92.00	67.00	46.00	21.50
FLUORIDE, DISSOLVED (MG/L AS F)	230	0.60	0.00	0.26	0.50	0.30	0.30	0.20	0.15
SILICA, DISSOLVED (MG/L AS SIO2)	294	40.00	0.30	8.19	11.00	9.30	8.40	6.97	3.63
COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML	42	7300.00	20.00	1107.00	6714.95	1175.00	535.00	137.50	42.50

TABLE 5.2 (Cont'd)

STATISTICAL SUMMARY OF SELECTED WATER-QUALITY DATA IN THE UPPER TRINITY RIVER BASIN, TEXAS

STATION NUMBER: 08114000 STATION NAME: BRAZOS RIVER AT RICHMOND, TEX.

LATITUDE: 293456 LONGITUDE: 0954527 COUNTY: FORT BEND DRAINAGE AREA: 45007.00 SQUARE MILES

SUMMARY OF SELECTED WATER QUALITY DATA COLLECTED AT PERIODIC INTERVALS FROM OCT 1957 TO AUG 1986

	DESCRIPTIVE STATISTICS				PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
WATER-QUALITY CONSTITUENT	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	95	75	MEDIAN 50	25	5
STREPTOCOCCI FECAL, KF AGAR (COLS. PER 1	42	9100.00	20.00	1374.35	8149.97	1100.00	240.00	130.00	32.60
PHENOLS (UG/L)	12	21.00	0.00	2.92	21.00	2.75	0.00	0.00	0.00
METHYLENE BLUE ACTIVE SUBSTANCE (MG/L)	16	0.05	0.00	0.01	0.05	0.01	0.00	0.00	0.00
SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED	42	915.00	135.00	495.50	906.95	674.25	466.00	314.75	159.75
SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (	290	1100.00	123.00	424.95	730.00	550.00	406.50	289.75	170.00
SED. SUSP. SIEVE DIAM. % FINER THAN .062	155	100.00	10.00	83.71	99.00	97.00	91.00	84.00	69.80
SEDIMENT, SUSPENDED (MG/L)	159	7360.00	12.00	1333.20	4320.00	1630.00	350.00	173.00	20.00
SEDIMENT, DISCHARGE, SUSPENDED (T/DAY)	159	500000.00	23.00	90910.31	495979.91	63400.00	12500.00	2010.00	55.00

CHAPTER 6 - EXISTING SYSTEM ANALYSIS

ROSENBERG

General

The City of Rosenberg uses groundwater to meet municipal water demands. Groundwater is presently produced by five wells located at four plant sites within the City limits (see Figure 32). Well ages range from approximately 1 year to 45 years, and well production ranges from approximately 300 to 2200 gallons per minute (GPM).

Water storage is provided by ground and elevated storage tanks, and water distribution and pressurization is accomplished by a combination of distribution pumps and elevated storage tanks. Conventional groundwater chlorination facilities at each plant disinfect the groundwater before it enters the storage tanks. System operation is accomplished by conventional water level and pressure switches, supplemented by daily plant inspections by City personnel. A brief description of each plant and a summary table follow.

Plant No. 1

Plant No. 1 is located at 2118 Avenue G, near the City of Rosenberg business district. Well facilities include a 350 GPM well onsite, and a 300 GPM well several blocks offsite. The wells discharge to a 150,000 gallon onsite elevated storage tank (there are no distribution pumps or ground storage tanks). Water treatment consists of onsite chlorination and water softening systems.

Plant No. 2

Plant No. 2 is located at 1415 Alamo, southeast of the business district, near Travis School. Groundwater is produced onsite by a 1200 GPM well, which discharges to a 1,000,000 gallon ground storage tank. Two 1200 GPM distribution pumps, and a 200,000 gallon elevated storage tank provide distribution and pressurization capabilities. Water treatment consists of an onsite chlorination system.

Plant No. 3

Plant No. 3 is located at 1024 Greenwald, approximately 2 miles southwest of the business district. Groundwater is produced onsite by a 1700 GPM well, which discharges to a 1,000,000 gallon ground storage tank. Two 1000 GPM distribution pumps, and a 500,000 gallon elevated storage tank (located several blocks away at 214 Ruby Street) provide distribution and pressurization capabilities. Water treatment consists of an onsite chlorination system.

Plant No. 4

Plant No. 4 is located at 3720 Airport Avenue, approximately 2 miles southeast of the business district. Groundwater is produced by a 2200 GPM well which discharges into a 1,000,000 gallon elevated storage tank (there are no distribution pumps or ground storage tanks). Water treatment consists of an onsite chlorination system.

The existing City of Rosenberg water plant locations are shown on Figure 31, and a facilities inventory is included in Appendix 3.

EXISTING SYSTEM ANALYSIS

RICHMOND

General

The City of Richmond uses groundwater to meet municipal water demands. Groundwater is presently produced by four wells located at three plant sites within the City limits (see Figure 32). Well ages range from approximately 10 years to 40 years, and well production ranges from approximately 125 gallons per minute (GPM) to 1325 GPM.

Water storage is provided by ground and elevated storage tanks, and water distribution and pressurization is accomplished by a combination of distribution pumps and elevated storage tanks. Conventional groundwater chlorination facilities at each plant disinfect the groundwater before it enters the storage tanks. System operation is accomplished by conventional water level and pressure switches, supplemented by daily plant inspections by City personnel. A brief description of each plant and a summary table follow.

Plant No. 1

Plant No. 1 is located at 100 South Fifth Street, just west of the Richmond City Hall in the business district. Well facilities include a 125 GPM well and an 800 GPM well which discharges to a 355,000 gallon ground storage tank. Two 775 GPM distribution pumps, and a 135,000 gallon elevated storage tank provide distribution and pressurization capabilities. Water treatment consists of an onsite chlorination system.

Plant No. 2

Plant No. 2 is located at 1405 Winston Drive, approximately 1 mile south of the business district, near Travis School. Groundwater is produced by a 425 GPM well, which discharges to a 109,000 gallon ground storage tank. A 400 GPM pump provides distribution and pressurization capabilities. Water treatment consists of an onsite chlorination system.

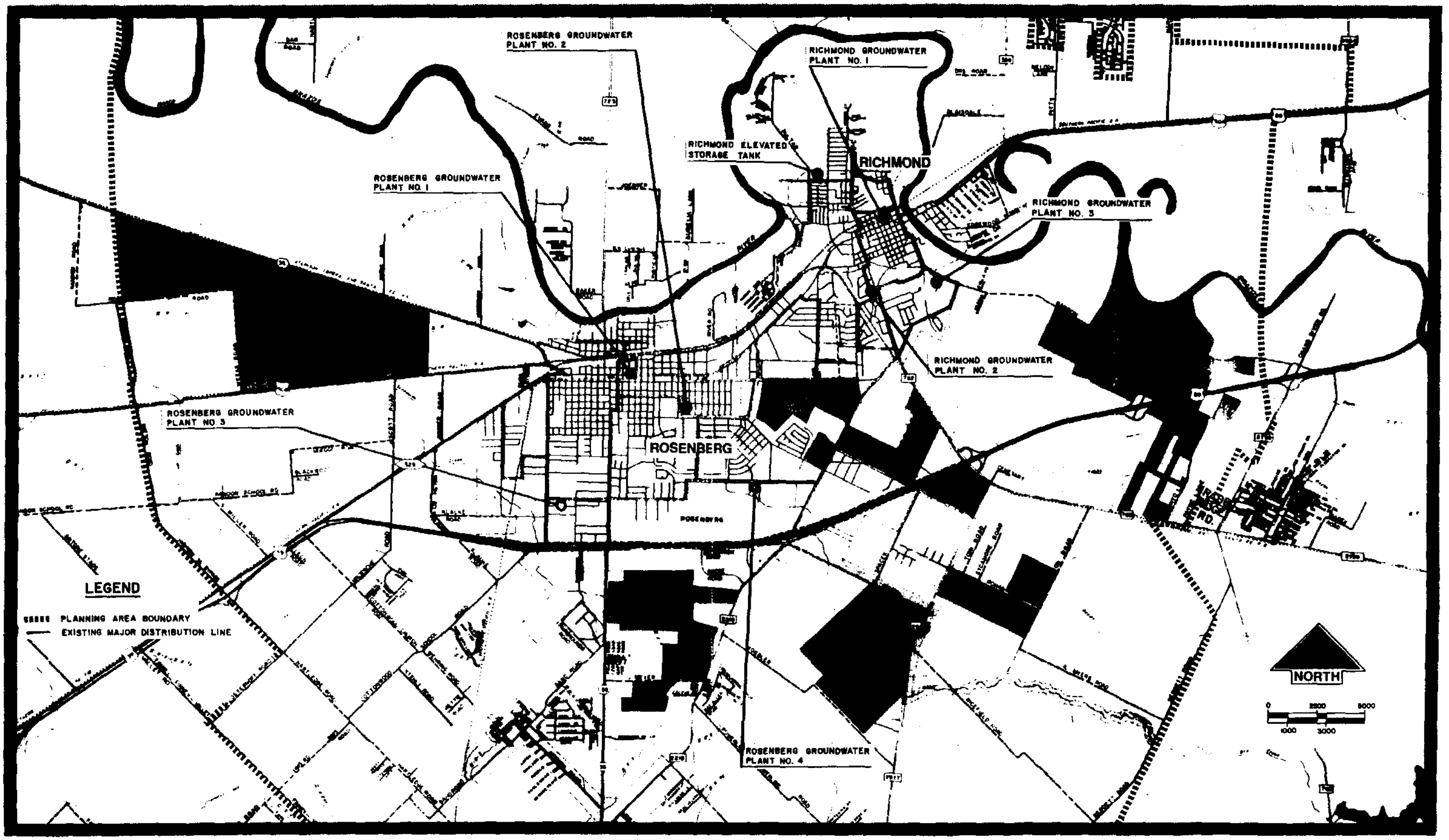
Plant No. 3

Plant No. 3 is located at 1606 Ranson Road, approximately 1 mile southeast of the business district. Groundwater is produced onsite by a 1325 GPM well, which discharges to a 500,000 gallon ground storage tank. Two 750 GPM distribution pumps, and a 350,000 gallon elevated storage tank provide distribution and pressurization capabilities. Water treatment consists of an onsite chlorination system. This plant is also equipped with a standby diesel generator.

Brazos Terrace Elevated Storage Tank

A 350,000 gallon remote elevated storage tank (Brazos Terrace) is located approximately 1 mile northwest of the business district.

The existing Richmond water plants are shown on Figure 31, and a facilities inventory is included in Appendix IV.



EXISTING MUNICIPAL WATER SUPPLY FACILITIES

FIGURE NO. 31

CHAPTER 7.0 - INITIAL EVALUATION OF SURFACE WATER SUPPLY ALTERNATIVES

General

Four surface water supply alternatives were developed for initial evaluation. Differences between the alternatives include plant locations, raw water sources, number of plants, and transmission systems.

Capital costs were determined for each alternative and were included among the criteria for final plan selection. Capital cost development for comparing the alternatives was based on the following assumptions:

- Costs would be developed for the ultimate plant facilities and transmission lines.
- Facility requirements would be based on supplying 2030 average daily surface water requirements (20.5 MGD) demand.
- Transmission lines would supply low pressure water to storage/pumping facilities which would feed the distribution systems. Storage/pumping facility locations were assumed at existing Water Plants No. 3 and 4 in Rosenberg, and at Water Plant No. 3 in Richmond.
- Treatment plants located south of US Highway 59 would provide high pressure service to areas south of the highway.

- Capital costs for each alternative included raw water conveyance, eighteen day termination/storage volume, treatment plant, and transmission lines. Costs for storage/pumping facilities and distribution systems were not developed since they would be similar for all alternatives.

<u>Alternative No. 1 - West Harris County Plant</u>

Alternative No. 1 consists of purchasing 20.5 MGD of water plant treatment capacity originating in the West Harris County Surface Water Supply Corporation's (WHCSWSC) proposed treatment plant. The WHCSWSC plant is proposed to supply water to a service area of approximately 443 square miles (283,500 acres) primarily in western Harris County. The WHCSWSC plant is proposed to be located in the vicinity of F.M. 723 at F.M. 1093 (see Figure 32), and will treat Brazos River water conveyed from the GCWA canal and the proposed Allens Creek Reservoir. This plant will allow the service area to meet surface water conversion requirements mandated by the Harris Galveston County Subsidence District.

Alternative No. 1 consists of a 20.5 million gallon per day (MGD) surface water treatment plant (the capacity of the WHCSWSC plant would be increased by 20.5 MGD), a 36" transmission line running south along FM 723 to US Highway 90 in Rosenberg, an 18" transmission line to Rosenberg Water Plant No. 3, a 36" transmission line to Rosenberg Water Plant No. 4, and a 24" transmission line to Richmond Water Plant No. 3.

The estimated total capital cost for the facilities are summarized in Table 7.1 which follows.

Alternative No. 2 - Oyster Creek Plant

This alternative consists of a 20.5 MGD surface water treatment plant located near Oyster Creek north of Pecan Grove, a 36" transmission line running south along Shiner Road, south along FM 359, and west along US Highway 90 to Richmond and then to Richmond Water Plant No. 3, a 30" transmission line to Rosenberg Water Plant No. 4, and an 18" transmission line to Rosenberg Water Plant No. 3 (see Figure 32).

The total estimated capital costs for the facilities are summarized in Table 7.1 which follows.

Alternative No. 3 - Rosenberg Area Plant

This alternative consists of a 20.5 MGD surface water treatment plant located in the vicinity of Seabourne Creek south of Rosenberg, a 36" transmission line running north along S.H. 36 to Rosenberg, an 18" transmission line to Rosenberg Water Plant No. 3, a 30" transmission line to Rosenberg Water Plant No. 4, and a 24" transmission line to Richmond Water Plant No. 3 (see Figure 32).

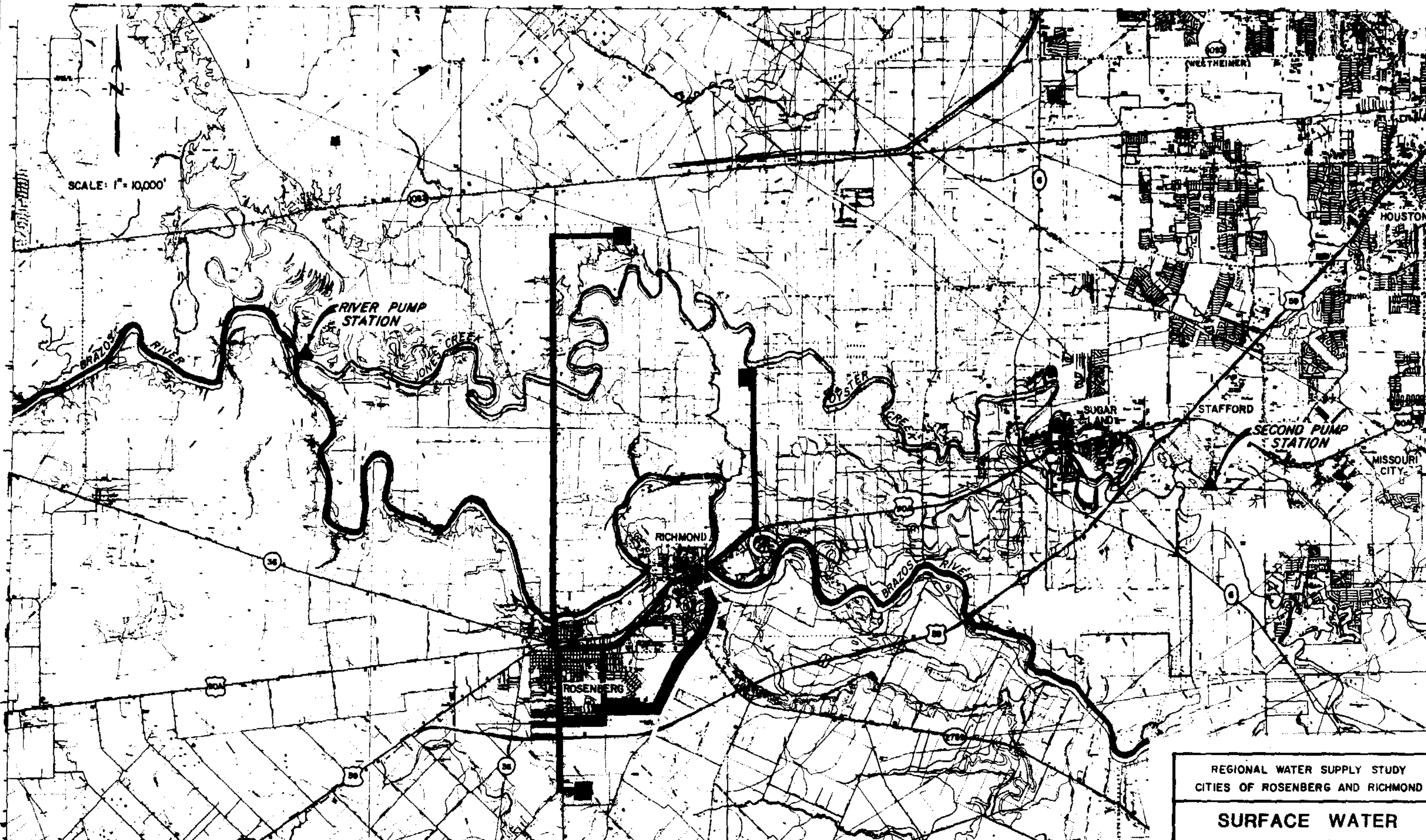
The estimated total capital costs for the facilities are summarized in Table 7.1 which follows.

Alternative No. 4 - Rosenberg Area Plant (Using HL&P Canal)

Houston Lighting and Power Company (HL&P) owns a pumping station/canal system which pumps water from the Brazos River into a canal system which supplies water to Smithers Lake and to Rice Farmers south of the Rosenberg/Richmond area (see Chapter 5.0). HL&P personnel have indicated that the system could be improved to convey the required volume of raw water to a treatment plant along the canal.

Alternative No. 4 consists of a 20.5 MGD surface water treatment plant located along the H.L. & P. canal southeast of Rosenberg, a 36" transmission line running north along FM 2218 to Rosenberg, a 30" transmission line to Rosenberg Water Plant No. 4, an 18" transmission line to Rosenberg Water Plant No. 3, and a 24" transmission line to Richmond Water Plant No. 3 (see Figure 32).

The total estimated capital costs for the facilities are summarized in Table 7.1 which follows.



ALTERNATIVE NO. 1: W.H.C.S.W.S.C. PLANT
ALTERNATIVE NO. 2: OYSTER CREEK PLANT
ALTERNATIVE NO. 3: ROSENBERG PLANT
ALTERNATIVE NO. 4: ROSENBERG PLANT ON H.L.&P. CANAL

BASE MAP OBTAINED FROM F.B.C.W.C. & I.D. NO 2 AND CITY OF SUGARLAND REGIONAL WATER SUPPLY AND PLANNING STUDY.

REGIONAL WATER SUPPLY STUDY
CITIES OF ROSENBERG AND RICHMOND

SURFACE WATER SUPPLY ALTERNATIVES

DEC DANNENBAUM ENGINEERING CORPORATION

FIGURE No 32

DATE: MARCH 1989

JOB NO. 2454-01

TABLE 7.1

ESTIMATED CAPITAL COSTS
FOR ALTERNATIVE ULTIMATE SYSTEMS

	Alt. No. 1	Alt. No. 2	Alt. No. 3	Alt. No. 4
Surface Water Treatment Plant Facilities	$17,050,000	$17,050,000	$17,050,000	$17,050,000
Raw Water Conveyance	11,500,000	830,000	2,270,000	1,080,000
Termination Storage	9,660,000	9,660,000	9,660,000	9,660,000
Transmission Lines	14,140,000	8,560,000	5,640,000	5,900,000
TOTAL	$52,350,000	$36,100,000	$34,620,000	$33,690,000

Evaluation

The four alternatives were evaluated using the following criteria:

- o Capital Costs for the Ultimate System
- o Location and Compatibility with Termination/Storage
- o Recreational Reservoir Concept
- o Raw Water Source
- o Dependence on Outside Agencies

Alternative No.1 - West Harris County Plant

Alternative No. 1 was eliminated because:

- o Capital costs are too high.

- The proposed plant location and raw water source do not require a termination/storage facility in the Rosenberg/Richmond area, therefore, a recreational reservoir would not be developed as part of the surface water supply system reducing the net benefit to the community.
- The plant, if constructed, would be built to meet timing and capacity requirements of areas beyond the Rosenberg/Richmond area.

Alternative No. 2 - Oyster Creek Plant

Alternative No. 2 was eliminated because:

- Capital costs are higher than other alternatives.
- The plant is not located central to the Rosenberg/Richmond area.

Alternative No. 3 and No. 4 - Rosenberg Area Plants

Alternatives No. 3 and 4 produced the lowest capital costs, and plant and recreational reservoir locations close to the Rosenberg/Richmond area. Alternative No. 4, a surface water treatment plant located near the HL&P canal southeast of Rosenberg, was selected for final evaluation because:

- Capital costs are lower than the other alternatives.
- The existing H.L.& P. Canal can be utilized for raw water supply.
- The recreational reservoir is central to the Rosenberg/Richmond area.

CHAPTER 8.0 - FACILITY PLAN UTILIZING SELECTED SURFACE WATER ALTERNATIVE

General

The selected alternative features a surface water treatment plant located near the HL&P canal southeast of Rosenberg. Transmission lines from the plant will supply low pressure water to storage/pumping facilities in Rosenberg and Richmond, which will supply and pressurize the distribution system north of U.S. Highway 59. The plant will supply direct high pressure water service to the areas south of US 59 to minimize reverse pumping.

Due to the length of the study period and the large difference between existing and projected ultimate water demands, a phased plant construction schedule is desirable. Phased construction allows reduced initial capital expenditures, reduces or eliminates periods of excess plant capacity, and allows flexibility to adapt to significant changes in future demands. A three phase construction schedule based on the following description was deemed appropriate for this study.

Phase I (initial plant construction) will build plant capacity equal to the water demand at that time. Subsequent increases in demand until the first plant expansion will be met by groundwater production. Phase II (First Plant Expansion) will build plant capacity equal to the water demand at that time, and subsequent increases in demand until the second plant expansion will be met by groundwater production. Phase III (second and final plant expansion) will again build plant capacity equal to the water demand at that time, and subsequent increases in demand will be met by groundwater production.

The schedule described above will result in conjunctive use of groundwater and surface water. The schedule eliminates periods of excess plant capacity and allows continued use of existing groundwater production facilities. The schedule will allow surface water production to meet the majority of the water demand by the final phases. The actual ratio of surface water versus groundwater will vary throughout the study period and will depend on the timing of initial plant construction and future expansions.

Raw Water Supply/Conveyance

The raw water supply utilized for the development of the final selected alternative will originate from existing and future raw water supplies out of the Brazos Basin. The final plan considers utilizing the existing Houston Lighting and Power Canal (Richmond Irrigation Canal) to transport raw water from the Brazos River, southeast of Rosenberg to the proposed recreational lake which is partially utilized for a termination storage facility to be discussed later. After coordination with H.L.&P. it was determined that the existing canal had sufficient capacity to deliver water for the interim phases without additional capital expense. However, it is projected that in the late phases certain road subsequent increases in demand until the second plant expansion will be met by groundwater production. Phase III (second and final plant expansion) will again build plant capacity equal to the water demand at that time, and subsequent increases in demand will be met by groundwater production.

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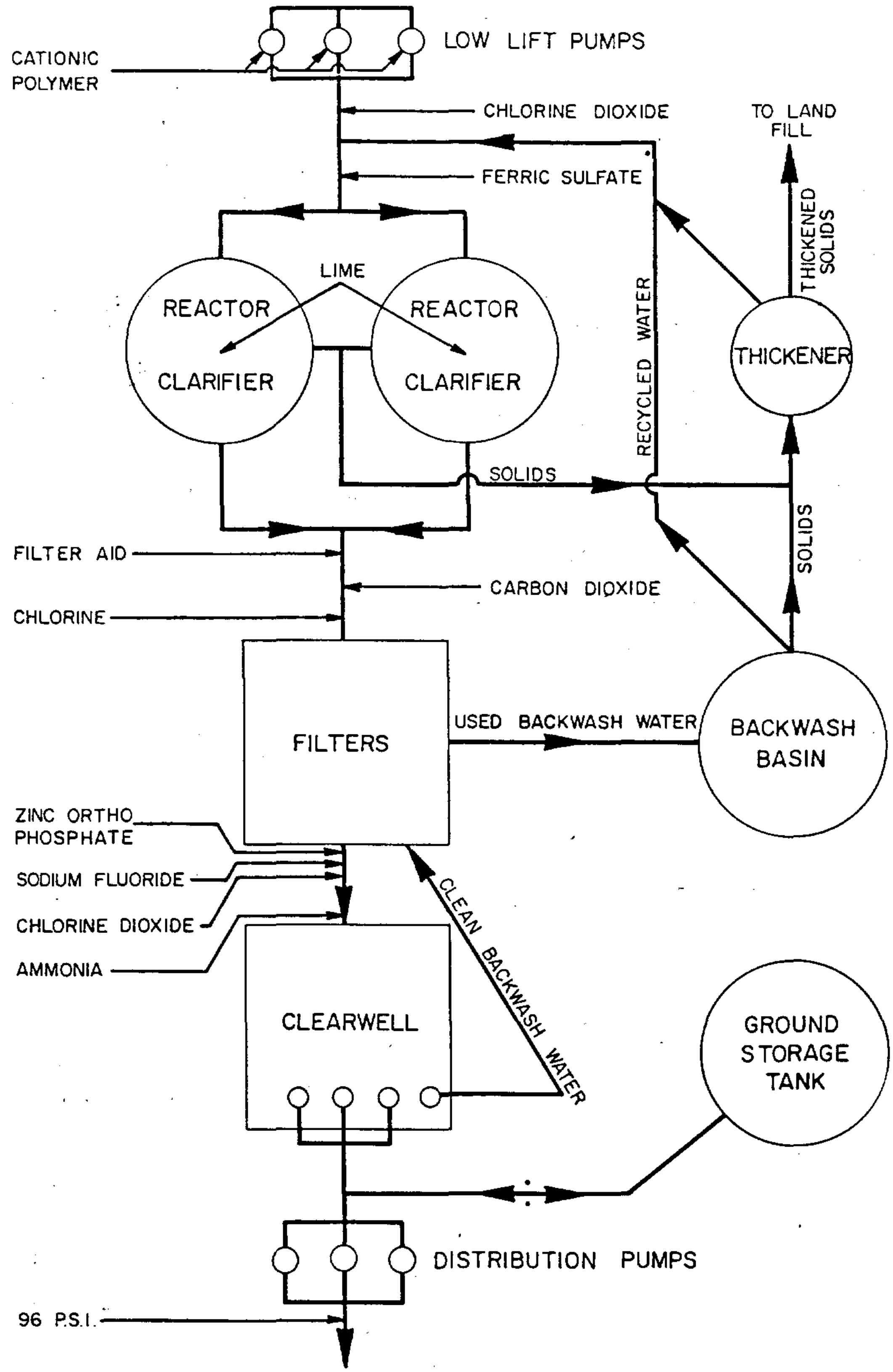
<u>Termination Storage</u>

The termination storage for this plan considers utilizing a portion of the proposed recreational lake (reservoir) water described in Chapter 9.0. This proposed storage will fulfill the requirements needed to maintain the desired raw water quality. The amount of stored raw water required is based on a desired water quality which would limit chloride concentration in the raw water to less than 240 mg/l. This concentration is below the EPA recommended level of 250 mg/l. Historic water quality data previously presented in Table 5.2 shows that this is possible 95% of the time. Under this assumption raw water would need to be stored for pumpage from a termination storage facility rather than directly from the Brazos River System 5% of the time during any one year. The termination storage requirement was calculated by using the ultimate surface water daily demand multiplied by the number of days required to satisfy the 5% limit. The requirement equates to a stored volume equal to 49.33 million cubic feet. Assuming a usable depth of 15 feet this volume would require a ultimate lake surface area of approximately 75 acres. The proposed recreational lake discussed in Chapter 9.0 contains approximately 125 surface acres resulting in a usable storage volume of 82.22 million cubic feet which is sufficient to supply the long term termination storage requirements. Assuming lake water usage for 18 consecutive days (5% of the year) the proposed surface water elevation of the lake would drop approximately 8 feet.

Surface Water Treatment Process

Raw water from the Brazos River System has been successfully treated in the past by industry and municipalities. The Galveston County Water Authority (GCWA) began treatment of Brazos River water in 1983 and is currently producing approximately 12 MGD of finished water. The treatment process for the plant proposed in this plan is projected to be similar to the GCWA plant as described below. At the GCWA plant, low lift pumps raise the water from the inlet channel to a pair of reactor clarifiers. Cationic polymer is added as a coagulant which causes the particles suspended in the water to clump together and settle out, clearing the water. Chlorine dioxide is added to destroy algae, taste and odor. Lime is added for pH adjustment and water softening. Reactor clarifiers are used to clarify the raw water with flocculation, clarification and softening taking place in the same unit. Filter aid, chlorine and carbon dioxide are added prior to filtration. The filters consist of two feet of crushed anthracite coal, nine inches of sand and one foot of gravel. A clearwell holds the filtered water where post disinfection with chlorine dioxide takes place. Water from the clearwell also serves as backwash water for the filters. Transfer pumps, supply treated water to the ground storage facilities. Figure 33 shows a typical flow diagram for this treatment process using reactor clarifiers similar to the GCWA plant.



REGIONAL WATER SUPPLY STUDY - CITIES OF ROSENBERG & RICHMOND

WATER TREATMENT PLANT FLOW DIAGRAM

FIGURE NO. 33

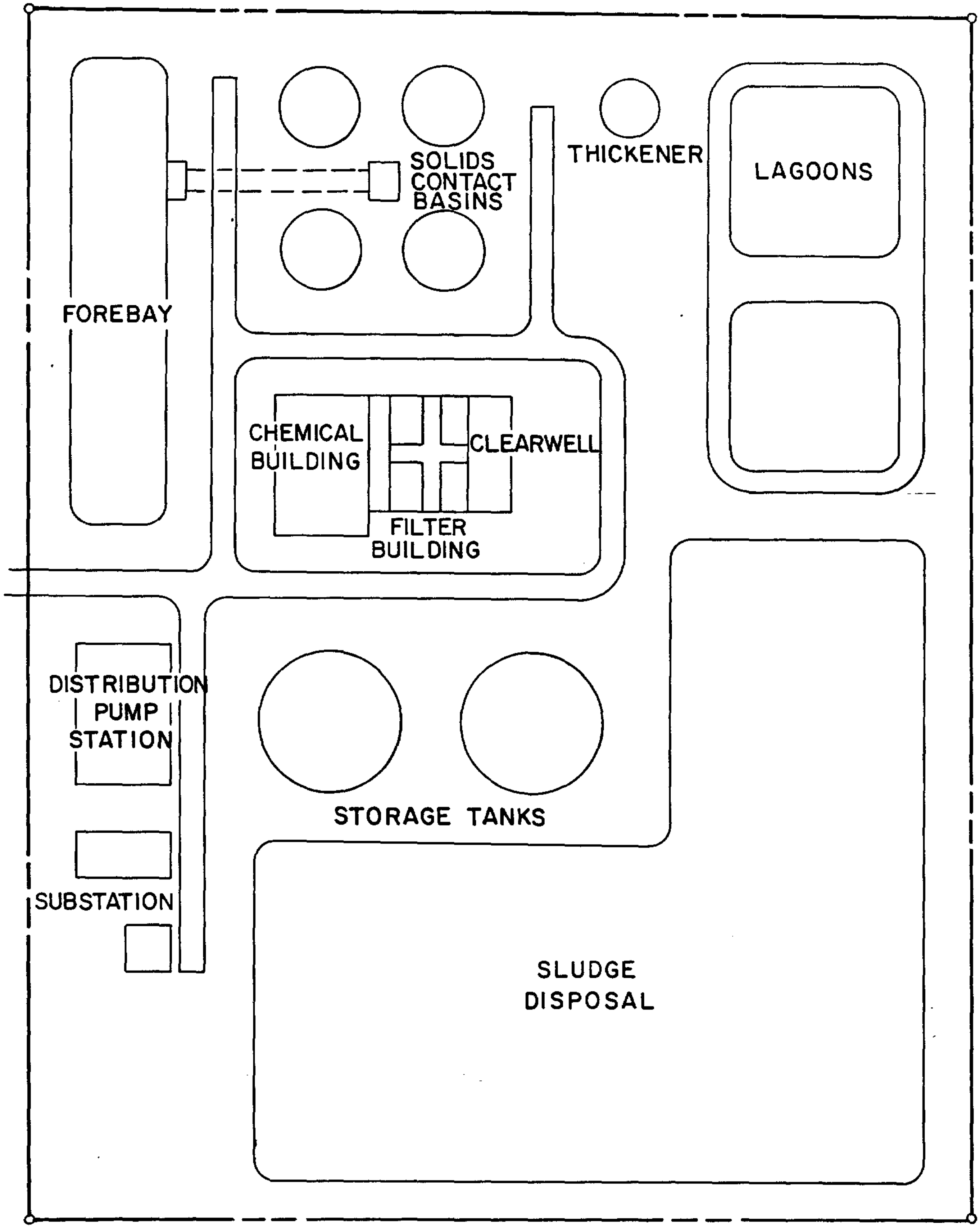
Treatment Plant Facilities

The ultimate surface water treatment plant will require approximately 35 acres of land (excluding termination/storage), and will produce 20.5 MGD average daily flow. The plant will be constructed in three phases, as discussed in Chapter 8.0. The phases and capacities are:

Phase	Phase Capacity	Plant Capacity	Year
I	10.2 MGD	10.2 MGD	2000
II	5.4 MGD	15.6 MGD	2010
III	4.9 MGD	20.5 MGD	2020

The onsite plant facilities comprising the solids contact treatment process include the forebay, low lift pump station, chemical building, and rapid mix units, reactor clarifiers, mixed media filters, clear well, ground storage tanks, and the distribution (treated water) pump station. Supporting facilisties include a filter backwash tank, laboratory/office, and an electrical substation, sludge facilities will include a sludge pump station, sludge thickeners, drying lagoons, and a sludge disposal site. A generic site layout is shown on Figure 34.

Offsite facilities will consist of the combined use termination/storage - recreation reservoir, and a raw water pump station with conveyance lines from the reservoir to the forebay. Supporting offsite facilities include the HL&P Co. Brazos River pump station and canal system discussed in previous chapters.



REGIONAL WATER SUPPLY STUDY - CITIES OF ROSENBERG & RICHMOND

GENERIC PLANT SITE LAYOUT

FIGURE NO. 34

Treated Water Storage/Pumping

Treated water is stored at the plant for use during peak demand periods. Ground storage tanks will provide 6 hour maximum daily demand capacity for the service area. Distribution pumping capacity will be tailored to handle the maximum daily surface water demands of the service area.

Transmission System

The transmission system will consist of two types of waterlines. Low pressure waterlines will transport treated water from the distribution pump station at the treatment plant to storage/pumping facilities in the Cities of Rosenberg and Richmond. The storage/pumping facilities will repressurize the water and feed it to the distribution system serving areas north of US 59. High pressure waterlines from the distribution pump station will provide direct service to areas south of US 59.

Computer Model

The hydraulic network analysis for the various conveyance and transmission systems was accomplished through the use of computer modeling using a program called KYPIPE "Steady State Pipe Network Analysis" by the University of

Kentucky. The program is based on the Hazen-Williams formula and provides pressure information, hydraulic grade line, head losses, pump heads, flow rates, velocities and system inflow and demand summaries for a variety of system configurations and components.

The various treated water conveyance and transmission systems were modeled as a series of junction nodes and pipe elements. User demands were taken out of the system at appropriate node locations. The system was supplied at a fixed grade node with a pump described by the useful horsepower needed to supply the demands of the system. A typical system contained approximately 10 pipes, 10 junction nodes and 1 fixed grade node. Treated water conveyance and transmission lines were located on base maps and were routed within existing street right-of-ways. Elevations of junction and fixed grade nodes were taken from USGS topographic quad maps, adjusted for depth of bury of lines, and input into the computer model. Demands were divided among junction nodes within each demand area to approximate service area water usage.

Network design criteria used in the various system models were as follows:

a. Design flow is average daily demand.

b. System pressures will not drop below 20 psi.

c. Velocities will not exceed 7 fps under maximum daily flow.

d. Average "C" values will be 120.

Treated water conveyance and transmission systems were analyzed for various flow rate and pressure conditions which represent the water demands for a particular alternate or system routing. Output data was analyzed and compared to the established system operating criteria, improvements were made to the model as needed and the model was rerun. This procedure was repeated until all components of the system conformed to the established criteria.

In addition to the hydraulic analysis performed the computer model simulation allowed for checking of each system for disconnected lines, redundant lines, agreement of supply versus demand, and general physical layout. Line lengths and sizes determined using the computer model were taken directly from the output for use in preparing construction cost estimates.

Construction Schedule Selection

Capital costs and subsidence effects were examined for two plant construction schedules. Case 1 schedule is: Construction of a 7.6 MGD surface water treatment plant in 1995 to meet total average day 1995 water demands; an 8.0 MGD expansion of the plant in 2010 to meet total average day 2010 water demands (15.6 MGD); and a 4.9 MGD expansion of the plant in 2020 to meet total 2020 average day water demands (20.5 MGD). Case 1 has previously been shown graphically on Figures 9 through 14. Case 2 Schedule is: Construction of a 10.2 MGD surface water treatment plant in 2000 to meet total average day 2000 water demands; a 5.4 MGD expansion in 2010 to meet total average day 2010 water demands (15.6 MGD); and a 4.9 MGD expansion in 2020 to meet total 2020 average day water demands (20.5 MGD). Case 2 has previously been shown graphically on Figures 15 through 20.

For each case capital costs were developed for: surface water treatment and transmission facilities; distribution lines along US Highway 59 and to proposed municipal utility districts (MUDs); internal distribution system improvements; ground and elevated storage tanks, and distribution pumps as required by current Texas Department of Health rules; and groundwater wells to meet demands prior to surface water treatment plant construction and to meet increasing demands after plant construction.

Existing wells were assumed to have a forty year life at current production rates. After forty years, wells were assumed to be either replaced or taken out of service, as required by demand. New well requirements were based on meeting average and peak demands prior to surface water treatment plant construction and meeting increasing water demands after plant construction or expansion, as explained above.

MUDs were assumed to begin development in 1995 and as a result a distribution line to each MUD cluster was therefore assumed to be required in 1995. A dual service line to each MUD cluster was deemed desirable, therefore a second distribution line to each MUD cluster was assumed to be required five years after initial development. (The Fort Bend Partners Venture (the "FBPV") was assumed to begin development in 1990. The study indicated that an additional well will be required in the Richmond area; it was therefore assumed that a groundwater facility would be constructed in the FBPV development in 1990, and that distribution lines from Richmond would follow the schedule described above.)

Internal distribution system improvements were assumed to be a constant annual expenditure. Elevated storage tanks, when required, were assumed to be located in each MUD cluster.

A capital cost schedule for each case was developed based on a series of five year interval capital improvement programs. The capital improvements and costs for Case I (1995 Plant) are listed in Table 8.1, and the capital improvements and costs for Case 2 (2000 plant) are listed in Table 8.2

Although the total capital costs for the two cases are similar, differences between the cases include:

- o Case 2 allows deferring approximately $24 million in surface water treatment system capital costs for five years until 2000.
- o Due to the earlier conversion to surface water year 2030 maximum subsidence for Case 1 is predicted to be approximately 0.4 feet less than for Case 2.
- o Surface water provides an average of 69% of total average water demand after conversion throughout the study period for Case 1.
- o Surface water provides an average of 83% of total average water demand after conversion throughout the study period for Case 2.

Although the predicted subsidence is slightly greater for Case 2, the cost savings gained by deferring plant construction until 2000 were deemed significant enough to allow recommendation of Case 2, construction of a surface water treatment plant in 2000.

CAPITAL IMPROVEMENT PROGRAM

The main features of Case 2, as shown on Figure 35 and in Table 8.2 include:

1990-1995 Interval

- o Installation of booster pumps (as required to meet Texas Department of Health (TDH) rules), a control building, and a ground storage tank at Rosenberg Water Plant No. 4 (this plant will eventually receive low pressure water from the surface water treatment plant, and will repressurize and feed the Rosenberg Distribution System).
- o Installation of additional distribution pump capacity at Rosenberg Water Plant No. 3 as required to meet TDH rules (this plant will eventually receive low pressure water from the surface water treatment plant, and will repressurize and feed the Rosenberg Distribution System).
- o Construction of Richmond Water Plant No. 4 in the Fort Bend Partners Venture Development (this facility will serve the development until distribution lines are extended from the City of Richmond, and will help meet future Richmond area well and storage requirements).

1995-2000 Interval

- o Installation of wells at Rosenberg Water Plants No. 2 and 3 and Richmond Water Plant No. 3 (these wells are required to meet projected peak demands prior to surface water treatment plant construction, and will be used to supplement surface water supply thereafter).

- Construction of service lines to MUDs.

2000-2005 Interval
- Construction of a 10 MGD surface water treatment plant and transmission lines to pumping facilities in Rosenberg and Richmond.
- Construction of second service lines to MUDs.

2005-2010 Interval
- Construction of ground and elevated storage tanks in the Rosenberg and Richmond areas to meet TDH requirements.

2010-2015 Interval
- Construction of a 5 MGD expansion of the surface water treatment plant.
- Construction of elevated storage tanks in the Richmond and Rosenberg areas to meet TDH requirements.
- Construction of water distribution trunk lines along US Highway 59.

2020-2025 Interval
- Construction of a 5 MGD expansion of the surface water treatment plant.
- Construction of ground and elevated storage tanks in the Richmond area to meet TDH requirements.

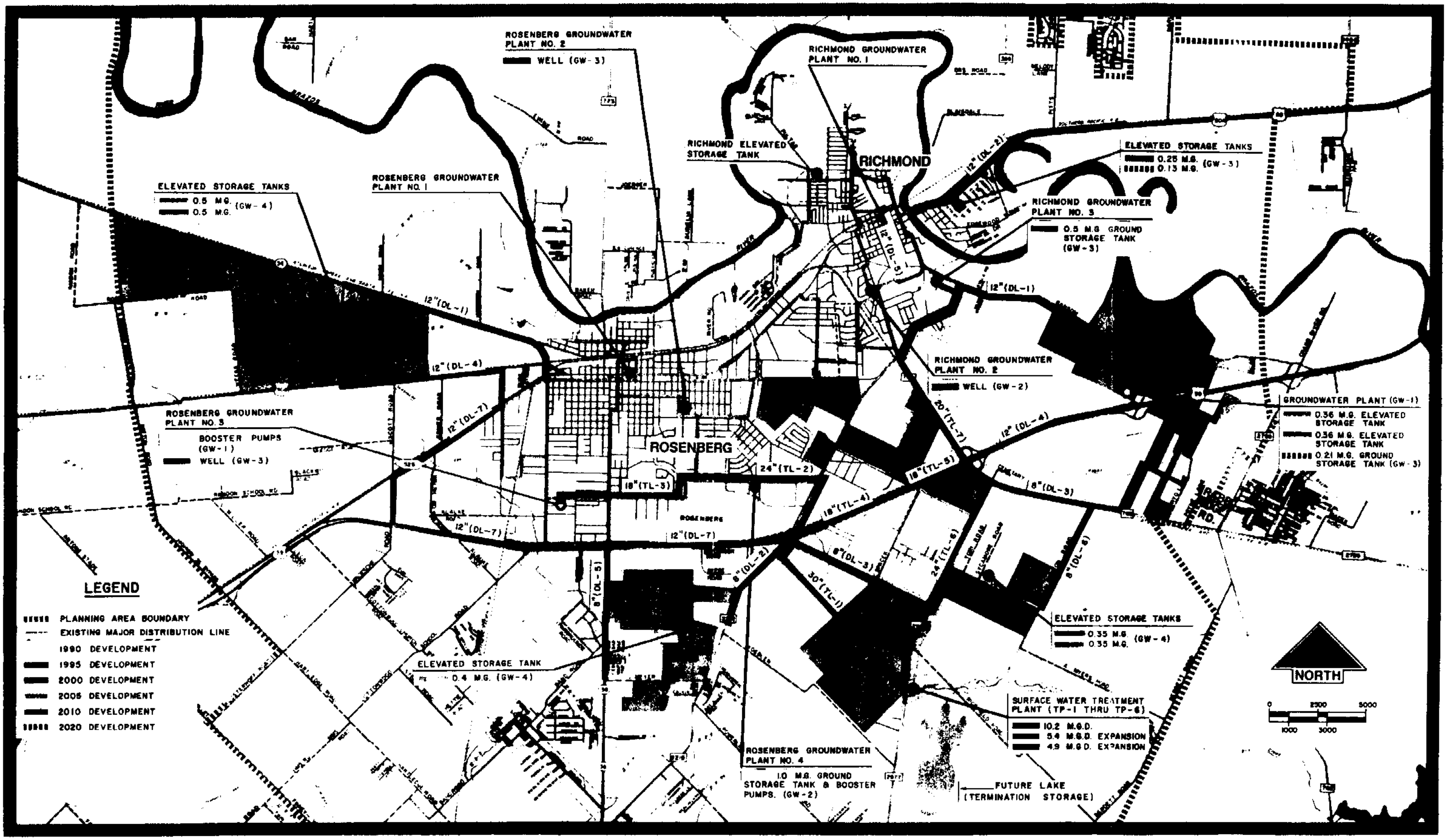
The Case 2 capital cost schedule shown in Table 8.2 was converted into capital improvement programs (CIPs) for the Cities of Rosenberg and Richmond. Additional assumptions used in developing each CIP include:

- Plant cost for each city is based on that city's surface water use as a percent of the total plant production.

- Right-of-way or easement acquisitions is 5% of total costs.

- Engineering is 10% of total costs.

The CIP programs developed for the Cities of Rosenberg and Richmond are shown in Appendices VI and VII, respectively. Also, please refer to Figure 35 for a graphic representation of the planned future facilities for Case 2.



FUTURE MUNICIPAL WATER SUPPLY FACILITIES

FIGURE NO. 35

TABLE 8.1

CASE 1 CAPITAL COST ESTIMATE

Interval	Rosenberg		Mutual		Richmond	
1990-1994	Booster Pumps @Plant 2 or 3,	$65,000			Water Plant #4@FBPV	$540,000
	1.0 MGD Ground Storage	900,000			Secondary System Imp's	325,000
	and Control Building	$965,000				$865,000
	w/Booster Pumps @ Plant 4					
1995-1999	12" Line to MUD 101-104	$450,000	7.6 MGD SW Plant	$12,535,000	12" Line along US 90	$555,000
	8" Line to MUD 59/63	120,000	Termination/Storage	5,835,000	12" Line to FBPV	310,000
	Secondary System Imp's	250,000	Raw Water Conveyance	1,080,000	Secondary System Imp's	125,000
		$820,000		$19,450,000		$990,000
			Transmission Lines	$5,565,000		
2000-2004	12" Line to MUD 101-104	$365,000	18" SW Trans Line	$1,640,000	0.25 MGD El.Stor. East	$290,000
	8" Line to MUD 59/63	195,000	to Plant 3		of River	
	8" Line to MUD 65/66/77/78	130,000	18" SW Interconnection	965,000	0.50 MGD Gr.Stor. @	405,000
	Secondary System Imp.	250,000	Along 59	$2,605,000	Plant #3	
		$940,000			8" Line to FBPV	175,000
					Secondary System Imp's	125,000
						$995,000
2005-2009	0.5 MG El.Stor.@MUD 101-104	$575,000			0.36 MG El.Stor. @	$415,000
	0.4 MG El.Stor.@MUD 59/63	460,000			FBPV	
	0.35 MG El.Storg.@MUD 65/66/ 77/78	405,000			Secondary System Imp's	125,000
	Secondary System Imp's	250,000				$540,000
		1,690,000				
2010-2014	0.5 MG El.Stor.@MUD 101-104	$575,000	8.0 MG SW Plant	$5,080,000	0.36 MG EL.Stor. @	$415,000
	0.35 MG El.Stor.@MUD 65/66/ 77/78	405,000	Expansion		FBPV	
	12" Line Along US 59/FM 529	615,000	Raw Water Conveyance	335,000	12" Line along US 59	360,000
	12" Line Along US 59	325,000		$5,415,000	Secondary System Imp's	125,000
	Secondary System Imp's	250,000				$900,000
		2,170,000				

TABLE 8.1 (Con't)

CASE 1 CAPITAL COST ESTIMATE

Interval	Rosenberg		Mutual		Richmond	
2020-2024			4.9 MGD SW Plant Expansion	$2,925,000	0.21 Gr. Stor. @ Plant 4	$170,000
			Termination/ Storage	2,495,000	0.13 El.Stor. @ East of River	150,000
				$5,420,000		$320,000
2025-2030	1500 GPM Well @ Plant #3	$290,000				
	1500 GPM Well @ Plant #4	290,000				
		$580,000				

TABLE 8.2

CASE 2 CAPITAL IMPROVEMENT SCHEDULE

Interval	Rosenberg		Mutual		Richmond	
1990-1994	Booster Pumps @Plant 2 or 3	$65,000			Water Plant #4@FBPV	$540,000
	1.0 MGD Ground Storage and	900,000			Secondary System Imp's	325,000
	Control Building with	$965,000				$865,000
	Booster Pumps @ Plant 4					
1995-1999	1500 GPM Well & Plant Mod's	$320,000			1200 GPM Well & Plant	$320,000
	at Plant 2				Mod's at Plant 2	
	1500 GPM Well & Plant Mod's	320,000			12" Line along US 90	555,000
	at Plant 3				12" Line to FBPV	310,000
	12" Line to MUD 101-104	450,000			Secondary System Imp's	125,000
	8" Line to MUD 59/63	120,000				1,310,000
	8" Line to MUD 65/66/77/78	185,000				
	Secondary System Imp's	250,000				
		$1,645,000				
2000-2004	12" Line to MUD 101-104	$365,000	10.2 MGD SW Plant	$14,875,000	0.25 MGD El.Stor. East	$290,000
	8" Line to MUD 59/63	195,000	Termination/Storage	5,845,000	of River	
	8" Line to MUD 65/66/77/78	130,000	Raw Water Conveyance	995,000	0.50 MGD Gr.Stor. @	405,000
	Secondary System Imp.	250,000		$21,715,000	Plant #3	
		$940,000	Transmission Lines	$8,170,000	8" Line to FBPV	175,000
					Secondary System Imp's	125,000
						$995,000
2005-2009	0.5 MG El.Stor.@MUD 101-104	$575,000			0.36 MG El.Stor. @	$415,000
	0.4 MG El.Stor.@MUD 59/63	460,000			FBPV	
	0.35 MG El.Storg.@MUD 65/66/	405,000			Secondary System Imp's	125,000
	77/78					
	Secondary System Imp's	250,000				$540,000
		1,690,000				

FINAL PLAN DEVELOPMENT COST

General

The development cost for the recommended facilities is broken down into individual project cost and allocated into 5-year increment as shown on the CIP in Appendix VI and VII. The development cost for this long range plan can be broken down into two types of costs, operating cost and capital cost. The capital cost is related to the development of the required facilities and are identified in the above mentioned CIP. The operating cost is the cost required to operate and maintain the water system on an ongoing basis. Operating cost generally includes the following: raw water cost to the BRA, raw water transportation cost to H.L.&P., utility salaries, electricity (power), maintenance supplies and parts, chemicals and other reoccurring costs associated with the water system. The following Table 8.3 lists on a yearly basis the projected annual cost associated with system operation and maintenance including the raw surface water cost associated with development of the recommended system. As mentioned earlier, this recommended plan includes both groundwater and surface water development and as a result Tables 8.3 and 8.4 have separate annual costs for both groundwater and surface water development where applicable. However, it is projected that the debt service required to fund the cost shown in Tables 8.3 and 8.4 will need to be incurred earlier if the water users within the planning area do not institute water conservation practices.

TABLE 8.3 (CONT'D)

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF ROSENBERG

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
				TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS			OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	W/O CONS.	W/CONS.			FUTURE BRA	CURRENT BRA	HL&P CANAL		(MG)		
2017	13.17	12.28	10.02	3853	$24,000	$731,000	$223,000	$1,772,000	1073	$751,000	$ 126,000
2018	13.53	12.60	10.02	3884	24,000	731,000	225,000	1,787,000	1172	820,000	1,618,000
2019	13.90	12.93	10.02	3915	24,000	731,000	227,000	1,801,000	1270	889,000	1,294,000
2020	14.26	13.25	13.25	4926	-	967,000	286,000	2,266,000	387	271,000	324,000
2021	14.62	13.57	13.25	4957	-	967,000	288,000	2,280,000	485	340,000	-
2022	14.98	13.90	13.25	4988	-	967,000	289,000	2,294,000	583	408,000	-
2023	15.34	14.22	13.25	5019	-	967,000	291,000	2,309,000	682	477,000	-
2024	15.70	14.54	13.25	5050	-	967,000	293,000	2,323,000	780	546,000	-
2025	16.06	14.87	13.25	5264	-	967,000	305,000	2,421,000	699	489,000	-
2026	16.42	15.19	13.25	5295	-	967,000	307,000	2,436,000	797	558,000	-
2027	16.78	15.51	13.25	5326	-	967,000	309,000	2,450,000	895	627,000	-
2028	17.14	15.83	13.25	5357	-	967,000	311,000	2,464,000	993	695,000	-
2029	17.50	16.16	13.25	5387	-	967,000	312,000	2,478,000	1091	764,000	-
2030	17.86	16.48	13.25	5418	-	967,000	314,000	2,492,000	1189	832,000	-

TABLE 8.4

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF RICHMOND

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
	W/O CONS.	W/CONS.		TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS: FUTURE BRA	RAW WATER COSTS: CURRENT BRA	RAW WATER COSTS: HL&P CANAL	OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	(MGD)	(MGD)							(MG)		
1990	2.20		-0-						869	$438,000	$ 81,000
1991	2.35	2.33	-0-						921	464,000	475,000
1992	2.50	2.46	-0-						972	490,000	33,000
1993	2.64	2.60	-0-						1027	518,000	335,000
1994	2.79	2.73	-0-						1079	544,000	119,000
1995	2.94	2.86	-0-						1130	570,000	1,306,000
1996	3.14	3.05	-0-						1205	607,000	1,066,000
1997	3.35	3.24	-0-		$ 7,000				1280	645,000	517,000
1998	3.55	3.42	-0-		7,000				1351	681,000	5,019,000
1999	3.76	3.61	-0-		7,000				1426	719,000	4,066,000
2000	3.96	3.80	3.80	1387	-	$277,000	$ 80,000	$ 638,000	114	57,000	1,741,000
2001	4.16	3.98	3.80	1387	-	277,000	80,000	638,000	185	93,000	13,000
2002	4.37	4.16	3.80	1387	-	277,000	80,000	638,000	256	129,000	106,000
2003	4.57	4.34	3.80	1387	-	277,000	80,000	638,000	327	165,000	-
2004	4.78	4.52	3.80	1387	-	277,000	80,000	638,000	398	201,000	-
2005	4.98	4.71	3.80	1387	-	277,000	80,000	638,000	474	239,000	27,000
2006	5.18	4.89	3.80	1387	-	277,000	80,000	638,000	545	275,000	133,000
2007	5.39	5.07	3.80	1387	10,000	277,000	80,000	638,000	616	310,000	502,000
2008	5.59	5.25	3.80	1387	10,000	277,000	80,000	638,000	687	346,000	567,000
2009	5.80	5.43	3.80	1387	10,000	277,000	80,000	638,000	758	382,000	475,000
2010	6.00	5.61	5.61	2048	-	410,000	119,000	942,000	169	85,000	442,000
2011	6.18	5.77	5.61	2048	-	410,000	119,000	942,000	232	117,000	54,000
2012	6.36	5.94	5.61	2048	-	410,000	119,000	942,000	299	151,000	459,000
2013	6.54	6.10	5.61	2048	-	410,000	119,000	942,000	362	182,000	-
2014	6.72	6.27	5.61	2048	-	410,000	119,000	942,000	429	216,000	-
2015	6.90	6.43	5.61	2048	-	410,000	119,000	942,000	493	248,000	-
2016	7.08	6.59	5.61	2048	-	410,000	119,000	942,000	556	280,000	119,000

TABLE 8.4 (CONT'D)

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF RICHMOND

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDITURES
				TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS			OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	W/O CONS.	W/CONS.			FUTURE BRA	CURRENT BRA	HL&P CANAL		(MG)		
2017	7.26	6.76	5.61	2048	$13,000	$410,000	$119,000	$ 942,000	623	$314,000	$ 64,000
2018	7.44	6.92	5.61	2058	13,000	410,000	119,000	947,000	675	340,000	821,000
2019	7.62	7.09	5.61	2073	13,000	410,000	120,000	954,000	728	367,000	657,000
2020	7.80	7.25	7.25	2705	-	529,000	157,000	1,244,000	159	80,000	180,000
2021	7.99	7.42	7.25	2720	-	529,000	158,000	1,251,000	211	106,000	32,000
2022	8.18	7.60	7.25	2736	-	529,000	159,000	1,259,000	266	134,000	272,000
2023	8.37	7.77	7.25	2752	-	529,000	160,000	1,266,000	318	160,000	-
2024	8.56	7.94	7.25	2767	-	529,000	160,000	1,273,000	369	186,000	-
2025	8.76	8.12	7.25	2783	-	529,000	161,000	1,280,000	424	214,000	-
2026	8.95	8.29	7.25	2798	-	529,000	162,000	1,287,000	477	240,000	-
2027	9.14	8.46	7.25	2814	-	529,000	163,000	1,294,000	529	267,000	-
2028	9.33	8.63	7.25	2829	-	529,000	164,000	1,301,000	582	293,000	-
2029	9.52	8.81	7.25	2845	-	529,000	165,000	1.309,000	634	320,000	-
2030	9.71	8.98	7.25	2860	-	529,000	166,000	1,316,000	687	346,000	-

Financial Analysis

The financial plan contemplates that the Citys' of Rosenberg and Richmond develop groundwater and surface water facilities as required to meet the water demands as projected. This plan asssumes that each City would sell sufficient revenue bonds to cover the development and expansion of each City's facilities. It has been assumed that the surface water facilities would be constructed and paid for on a pro rata basis with each City selling bonds to cover its share. At this time, it is contemplated that Rosenberg would construct the surface water facilities with Richmond participating in funding. The City of Rosenberg's financial advisor Moroney, Beissner and Co., Inc. created the projected debt service schedules for both Rosenberg and Richmond utilizing the yearly capital cost outlined previously in Tables 8.3 and 8.4. Please refer to Appendix VIII for detail projected debt service schedules. The projected debt service schedules are for capital cost associated with the development starting in the year 1990 and does not include any previous indebtness by Rosenberg or Richmond. The debt service schedules are based on an average bond life of 25 years assuming a coupon rate of 8% per annum. The bond issues have been prepared assuming a minimum bond issuance size of $1,000,000 and frequency of issuance as required by Table 8.3 or in three year intervals. This financial plan envisions the City of Rosenberg having nine (9) bond issuances with the first issuance being in 1990. The City of Richmond would have eight (8) bond issuances starting in 1990. Please refer to Appendix VIII for schedule details. This plan, also, assumes that each City levy sufficient water rates to cover required annual bond payments as well as cover annual operation and maintenance costs.

Projected Water Rate Analysis

This section of the report attempts to project the annual water rate for both Rosenberg and Richmond required to allow each City to operate as a self sustaining business and recover the total cost of providing services throughout the planning period. This analysis has not attempted to determine an average constant water rate required to maintain service, therefore, eliminating wide water rate fluctuations from year to year. However, it is recommended that further analysis be done to determine rate stability. This section should only be used to compare the projected break even cost to the customers versus existing break even cost. The following break even cash flow analysis in Table 8.4 includes existing debt service from Rosenberg as outlined by the City's Financial Director. The City of Richmond has no existing debt on its water system and as a result, Table 4.5 the break even cash flow analysis for Richmond, has no existing debt service included. Please refer to the following Tables 8.5 and 8.6 for details on Rosenberg and Richmond's cash flow analysis assuming each City levies a yearly rate sufficient to cover all costs with no anticipated surplus.

TABLE 8.5

CITY OF ROSENBERG
CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES AND REVENUES
(Breakeven) (1988 $)

Year	Existing Debt Service	Proposed Debt Service	*Raw Surface Water Cost	Total Operations and Maintenance	Total Expenditures	Cost of Water/1000 Gallons	Projected Water Demand With Conserv. (Sales) (MGD)
1990	$208,732	$ 43,000	-0-	$1,142,000	$1,393,732	$0.94	4.07
1991	189,032	111,000	-0-	1,179,000	1,479,032	0.97	4.20
1992	182,387	109,000	-0-	1,215,000	1,506,387	0.95	4.33
1993	174,344	112,000	-0-	1,254,000	1,540,344	0.94	4.47
1994	165,497	238,800	-0-	1,292,000	1,696,297	1.01	4.60
1995	159,669	435,600	-0-	1,328,000	1,923,269	1.11	4.73
1996	150,901	437,600	-0-	1,423,000	2,011,501	1.09	5.07
1997	142,304	1,051,200	12,000	1,519,000	2,724,504	1.38	5.41
1998	98,820	1,999,000	12,000	1,611,000	3,720,820	1.78	5.74
1999	93,770	1,996,800	12,000	1,707,000	3,809,570	1.72	6.08
2000	88,846	2,094,000	605,000	1,240,000	4,027,846	1.72	6.42
2001	83,512	2,243,000	605,000	1,341,000	4,272,512	1.73	6.78
2002	78,405	2,247,200	605,000	1,442,000	4,372,605	1.68	7.14
2003	58,393	2,242,000	605,000	1,543,000	4,448,393	1.63	7.50
2004	44,861	2,242,800	605,000	1,644,000	4,536,661	1.58	7.86
2005	16,879	2,327,600	605,000	1,745,000	4,694,479	1.56	8.22
2006	15,810	2,451,800	605,000	1,846,000	4,918,610	1.57	8.58
2007	-0-	2,448,000	623,000	1,947,000	5,018,000	1.54	8.94
2008	-0-	2,572,000	623,000	2,048,000	5,243,800	1.54	9.30
2009	-0-	2,795,000	623,000	2,150,000	5,568,000	1.58	9.66
2010	-0-	2,789,800	943,000	1,935,000	5,667,800	1.55	10.02
2011	-0-	2,720,400	943,000	2,024,000	5,687,400	1.51	10.34
2012	-0-	2,791,000	945,000	2,108,000	5,844,000	1.50	10.67
2013	-0-	2,786,600	947,000	2,191,000	5,924,600	1.48	10.99
2014	-0-	2,792,600	949,000	2,275,000	6,016,000	1.46	11.31
2015	-0-	2,457,400	951,000	2,357,000	5,765,400	1.36	11.64

TABLE 8.5 (CONT'D)

CITY OF ROSENBERG
CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES AND REVENUES
(Breakeven) (1988 $)

Year	Existing Debt Service	Proposed Debt Service	*Raw Surface Water Cost	Total Operations and Maintenance	Total Expenditures	Cost of Water/1000 Gallons	Projected Water Demand With Conserv. (Sales) (MGD)
2016	$ -0-	$2,538,200	$ 953,000	$2,441,000	$5,902,200	$1.38	11.76
2017	-0-	2,663,600	978,000	2,523,000	6,164,600	1.38	12.28
2018	-0-	1,108,400	980,000	2,607,000	4,695,400	1.02	12.60
2019	-0-	1,166,200	982,000	2,690,000	4,838,200	1.03	12.93
2020	-0-	1,271,200	1,253,000	2,537,000	5,061,120	1.05	13.25
2021	-0-	1,028,400	1,255,000	2,620,000	4,903,400	0.99	13.57
2022	-0-	1,020,800	1,256,000	2,702,000	4,978,800	0.98	13.90
2023	-0-	1,025,800	1,258,000	2,786,000	5,069,800	0.98	14.22
2024	-0-	1,022,200	1,260,000	2,869,000	5,151,200	0.97	14.54
2025	-0-	1,025,400	1,272,000	2,910,000	5,207,400	0.96	14.87
2026	-0-	824,600	1,274,000	2,994,000	5,092,600	0.92	15.19
2027	-0-	820,800	1,276,000	3,077,000	5,173,800	0.92	15.51
2028	-0-	824,200	1,278,000	3,159,000	5,261,200	0.91	15.83
2029	-0-	484,000	1,279,000	3,242,000	5,005,000	0.85	16.16
2030	-0-	487,400	1,281,000	3,324,000	5,092,400	0.85	16.48

*Includes uses of H.L. & P. Canal.

TABLE 8.6

CITY OF RICHMOND
CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES AND REVENUES
(Breakeven) (1988 $)

Year	Existing Debt Service	Proposed Debt Service	*Raw Surface Water Cost	Total Operations and Maintenance	Total Expenditures	Cost of Water/1000 Gallons	Projected Water Demand With Conserv. (Sales) (MGD)
1990	$ -0-	$ 42,600	-0-	$ 438,000	$ 480,600	$0.60	2.20
1991	-0-	110,200	-0-	464,000	574,200	0.68	2.30
1992	-0-	108,200	-0-	490,000	598,200	0.67	2.46
1993	-0-	106,200	-0-	518,000	624,200	0.66	2.60
1994	-0-	206,000	-0-	544,000	750,000	0.75	2.73
1995	-0-	355,400	-0-	570,000	925,400	0.89	2.86
1996	-0-	353,600	-0-	607,000	960,600	0.86	3.05
1997	-0-	740,400	7,000	645,000	1,392,400	1.18	3.24
1998	-0-	1,341,800	7,000	681,000	2,029,800	1.63	3.42
1999	-0-	1,346,600	7,000	719,000	2,072,600	1.57	3.61
2000	-0-	1,419,800	357,000	695,000	2,471,800	1.78	3.80
2001	-0-	1,536,000	357,000	731,000	2,624,000	1.81	3.98
2002	-0-	1,540,800	357,000	767,000	2,664,800	1.76	4.16
2003	-0-	1,542,400	357,000	803,000	2,702,400	1.71	4.34
2004	-0-	1,540,800	357,000	839,000	2,736,800	1.66	4.52
2005	-0-	1,591,200	357,000	877,000	2,825,200	1.64	4.71
2006	-0-	1,673,000	357,000	913,000	2,943,000	1.65	4.89
2007	-0-	1,668,200	360,000	948,000	2,976,200	1.61	5.07
2008	-0-	1,664,400	360,000	984,000	3,008,400	1.57	5.25
2009	-0-	1,719,600	360,000	1,020,000	3,099,600	1.57	5.43
2010	-0-	1,815,000	529,000	1,027,000	3,371,800	1.65	5.61
2011	-0-	1,708,600	529,000	1,059,000	3,296,600	1.57	5.77
2012	-0-	1,704,600	529,000	1,093,000	3,326,600	1.53	5.94
2013	-0-	1,705,000	529,000	1,124,000	3,358,000	1.51	6.10
2014	-0-	1,714,000	529,000	1,158,000	3,401,000	1.49	6.27
2015	-0-	1,455,400	529,000	1,190,000	3,174,400	1.35	6.43

TABLE 8.6 (CONT'D)

CITY OF RICHMOND
CASH FLOW ANALYSIS OF ANNUAL EXPENDITURES & REVENUES
(Breakeven) (1988 $)

Year	Existing Debt Service	Proposed Debt Service	*Raw Surface Water Cost	Total Operations and Maintenance	Total Expenditures	Cost of Water/1000 Gallons	Projected Water Demand With Conserv. (Sales) (MGD)
2016	$ -0-	$1,501,000	$ 529,000	$1,222,000	$3,252,000	$1.35	6.59
2017	-0-	1,564,800	542,000	1,256,000	3,362,800	1.36	6.76
2018	-0-	578,800	542,000	1,282,000	2,402,800	0.95	6.92
2019	-0-	620,600	543,000	1,321,000	2,484,600	0.96	7.09
2020	-0-	695,800	686,000	1,324,000	2,705,800	1.02	7.25
2021	-0-	500,000	687,000	1,357,000	2,544,000	0.94	7.42
2022	-0-	502,400	688,000	1,393,000	2,583,400	0.93	7.60
2023	-0-	493,200	689,000	1,426,000	2,608,200	0.92	7.77
2024	-0-	503,200	689,000	1,459,000	2,651,200	0.91	7.94
2025	-0-	500,800	690,000	1,494,000	2,614,800	0.88	8.12
2026	-0-	371,800	691,000	1,527,000	2,589,800	0.86	8.29
2027	-0-	376,200	692,000	1,561,000	2,629,200	0.85	8.46
2028	-0-	364,000	693,000	1,594,000	2,651,000	0.84	8.63
2029	-0-	371,400	694,000	1,629,000	2,694,400	0.84	8.81
2030	-0-	221,800	695,000	1,662,000	2,578,000	0.79	8.98

*Includes uses of H.L. & P. Canal.

CHAPTER 9.0 - RESERVOIR/PARK FACILITY PLAN

Plan Concept

The Rosenberg area is only approximately 25 miles from downtown Houston. Many of the area residents work in Houston's central business district. However, for the area to become more attractive to potential residential homebuyers and small industrial and manufacturing facilities, the area needs a facility that could be used as a focal point for developing a high-end use residential development.

The concept developed in this section of the report envisions expanding the surface water storage facility into a small (125 $\pm$ acres) lake capable of not only storing surface water for future potable water purposes, but also becoming a focal point for the development of a major public park with water-based activities, as well as a golf course facility integrating portions of the lake's waterfront for course development. The plan concept also outlines land that would be available for the development of large residential properties with possible golf course and lake frontage. Incorporation of flood control benefits was found to be unfeasible due to the additional volume above the surface water storage requirement required to store run-off. Also, the reservoir location near the canal results in minimum downstream flood control benefits. Please refer to Figures 36 and 37 for graphic representation of the development concept. Utilizing a needed municipal water supply facility for multi-purpose activities would benefit the future quality of life for the existing and future residents of the Rosenberg-Richmond area.

Definition of Plan

General

The plan envisions the development of a 125 acre multi-purpose lake south of Dry Creek and east of Minonite Road. The development would require approximately 566 acres with the 125 acre lake being the focal point for the joint municipal/private development. The above 566 acres included 41 acres for the ultimate surface water plant site.

Municipal Park

The development would contain a 116 acre municipal park northwest of the lake between Minonite Road and Dry Creek. The park would contain baseball and soccer complexs, public pavillion area, volleyball and beach area along the lake shoreline, 12,000 linear feet of jogging trails, public picnic areas overlooking the lake, large fishing pier with a small boat dock for fishing and boat ramp for launching of small boats and easy access to approximately 17,000 linear feet of shoreline for bank fishing, open to the general public. The park is projected to be developed in three phases with Phase I consisting of 50 acres, Phase II of 27 acres and Phase III of 39 acres. Please refer to Exhibit 36 for phasing schematics. This projected phased development will allow the City to maximize the amount of funding from the Texas Parks and Wildlife Department.

Private Golf Course

The area southeast of the lake would be sold or leased to a private golf course developer. The plan envisions the development of an 18 hole golf course utilizing approximately 137 acres.

Residential Development

This part of the plan envisions the development of a high-end residential development by a private developer totalling approximately 147 acres. The residential development would surround the golf course with a large number of lots having golf course as well as lake frontage. The development would be totally funded by a private developer.

The following plan for the development of the above-mentioned reservoir-associated projects is not meant to be considered a feasibility study of the economics of developing such projects. The reservoir/park facility plan has been produced to demonstrate the benefits from oversizing the reservoir (termination storage) to accommodate other possible projects that would enhance the overall community as well as increase the tax base of the City of Rosenberg. The estimated cost of oversizing the reservoir is approximately $5.4 million The reservoir would be developed and paid for out of revenues obtained from treated water sales to customers in the study planning area. The cost for developing the park project associated with the reservoir would be funded by grants from the Texas Parks and Wildlife and from land donations. The private golf course and residential development would be totally funded by private developers.

Plan Phasing

General

The development of the reservoir/park facility plan described in this section assumes that the reservoir (termination storage facility) is developed beginning in 1990. This assumption results in the reservoir being completed approximately six years before it is required for surface water conversion. Please refer to able 9.1 for a conceptual development schedule for this concept.

TABLE 9.1

CONCEPTUAL DEVELOPMENT SCHEDULE
RESERVOIR/PARK FACILITY

Task	Date
General	
Organize Non-Profit Organization/ Negotiate Land Donation	Jan. 1990 - Nov. 1990
Reservoir	
Design	Jan. 1991 - Jan. 1992
Approval and Bidding	Jan. 1992 - April 1992
Reservoir Construction	May 1992 - July 1993
Municipal Park (Phase I)	
Prepare/File T.P.& W. Grant Application	Sept. 1990 - Nov. 1990
Review & Approval of Phase I Grant/ T.P.& W. Funding	Nov. 1990 - Feb. 1990
Design (Phase I)	March 1991 - Jan. 1992
Approval and Bidding (Phase I)	Jan. 1992 - April 1992
Phase I Construction	May 1992 - May 1993
Municipal Park (Phase II)	
Prepare/File T.P.& W. Grant Application	Feb. 1993 - July 1993
Review & Approval of Phase II Grant/ T.P.& W. Funding	Aug. 1993 - Feb. 1994
Design (Phase II)	Feb. 1994 - Aug. 1994
Approval and Bidding (Phase II)	Aug. 1994 - Oct. 1994
Phase II Construction	Oct. 1994 - Feb. 1995
Municipal Park (Phase III)	
Prepare/File T.P.& W. Grant Application	Oct. 1994 - Dec. 1994
Review & Approval of Phase III Grant/ T.P.& W. Funding	Dec. 1994 - Feb. 1995
Design (Phase III)	Feb. 1995 - Aug. 1995
Approval and Bidding (Phase III)	Aug. 1995 - Oct. 1995
Phase III Construction	Nov. 1995 - May 1996

Municipal Park

The municipal park is projected to be developed in three phases as mentioned previously and shown graphically on Exhibit 36. It is projected that the Phase I grant application be filed with the Texas Parks and Wildlife Department in September, 1990 resulting in Phase I being completed by May, 1993. As shown previously in Table 9.1 the three phased park project would be totally developed by May of 1996.

The maximum amount of 50% matching grant funds available from the T.P. & W. is $750,000.00 for any one project. As a result of this criteria, the park is projected to be developed in three phases utilizing the value of the donated land as the City's 50% matching share resulting in the City developing the entire park project with grant funds and not City funds.

Private Golf Course/Residential Development

The phasing and economical viability of the private golf course and residential development projects are beyond the scope of this study. The projects are shown graphically on Exhibit 37 to reflect possible private development projects which could be a direct result of the City developing an oversized reservoir (termination storage facility for long term surface water needs.

Capital Cost

General

The capital costs reflected in this section of the report are conceptual in nature and are based on 1988 dollars.

Reservoir

The capital cost of the termination storage portion of the reservoir (approximately 75 acres) is projected to be funded through water rates as outlined in Section 8.0 of this report. The estimated cost to oversize the reservoir to 125 acres is approximately $5.4 million. It is projected that this added cost could be funded from a combination of users fees collected from the adjacent proposed residential and golf course developments as well as from ad valorem taxes. The justification for the use of ad valorem taxes to fund a portion of the oversizing is based on the increased tax base from the residential and golf course developments that are a direct result of the development of the reservoir. Please refer to the financial analysis section of this report for details.

Municipal Park

Phase I

The capital cost excluding land cost for Phase I is projected to be $749,000 for developing park facilities on 50 acres. Refer to the following Table 9.2 for details.

TABLE 9.2

CAPITAL COST FOR PARK DEVELOPMENT
PHASE I (+ 50 ACRES)

No.	Description	Capital Cost
1.	Roadway (24' Asphalt with Roadside Ditches)	$239,950.00
2.	Concrete Parking	38,000.00
3.	Jogging Trail (3500 L.F.)	35,000.00
4.	Baseball Complex (2)	50,000.00
5.	Fishing Pier/Boat Dock	15,000.00
6.	Beach Area	10,000.00

No.	Description	Capital Cost
7.	Shelter/Restroom Facility	20,000.00
8.	Utilities (Water/Sanitary)	53,700.00
9.	Pedestrian Bridge	5,000.00
10.	Playground Cluster (1)	10,000.00
11.	Picnic Table Area/Grills (4)	12,000.00
12.	Landscaping	160,000.00
13.	Engineering/Contingencies	100,350.00
	TOTAL PHASE I COST	$749,000.00

Phase II

The capital cost excluding land cost for Phase II is projected to be $400,000 for developing park facilities on 27 acres. Refer to the following Table 9.3 for details.

TABLE 9.3

CAPITAL COST FOR PARK DEVELOPMENT
PHASE II (+ 27 ACRES)

No.	Description	Capital Cost
1.	Roadway (24' Asphalt with Roadside Ditches)	$60,000.00
2.	Concrete Parking	32,000.00
3.	Jogging Trail (3800 L.F.)	38,000.00
4.	Soccer Complex (3)	45,000.00
5.	Fishing Pier/Boat Dock	15,000.00
6.	Boat Ramp	15,000.00
7.	Beach Area	10,000.00
8.	Playground Cluster (1)	10,000.00
9.	Utilities	10,000.00
10.	Picnic Table Area/Grills (4)	12,000.00
11.	Landscaping	93,000.00
12.	Engineering/Contingencies	60,000.00
	TOTAL PHASE II COST	$400,000.00

Phase III

The capital cost excluding land cost for Phase III is projected to be $583,000.00 for developing park facilities on 39 acres. Refer to the following Table 9.4 for details.

TABLE 9.4

CAPITAL COST FOR PARK DEVELOPMENT
PHASE III (+ 39 ACRES)

No.	Description	Capital Cost
1.	Roadway (24' Asphalt with Roadside Ditches)	$91,200.00
2.	Concrete Parking	60,000.00
3.	Jogging Trail (5000 L.F.)	50,000.00
4.	Baseball Complex (2)	50,000.00
5.	Soccer Complex (2)	30,000.00
6.	Volleyball Complex	5,000.00
7.	Shelter/Restroom Facility	20,000.00
8.	Utilities	37,700.00
9.	Playground Cluster (1)	10,000.00
10.	Picnic Table Area/Grills (4)	12,000.00
11.	Landscaping	135,000.00
12.	Engineering/Contingencies	80,000.00
	TOTAL PHASE III COST	$580,000.00

Financial Analysis

General

As mentioned previously, this study is based on the land for the park facility being donated with the value of the land being used as the 50% matching funds for Texas Parks and Wildlife grants. A large portion of the reservoir (75 acres) is projected to be funded by revenue bonds backed by water revenues. The remaining 50 acres is expected to be funded through user fees and ad valorem taxes. The private golf course and residential developments costs are expected to be funded by private developers and as result are not addressed in detail in this report.

Reservoir

The total 125 acre reservoir is projected to cost approximately $13.8 million with 8.4 million being paid for through the issuance of water revenue bonds backed by the Cities water revenues. The remaining $5.4 million is proposed to be funded through a combination of user fees placed on the acreage encompassed in the surrounding private golf course and residential development acreage as well as ad valorem taxes.

It is estimated the proposed adjacent 147 acre residential development could yield on average of three houses per acre at an average value of $175,000 per house. Upon build out, this would result in an increased assessed valuation to the City of approximately $75 million resulting in a yearly increase of ad valorem taxes of approximately $563,000 assuming a tax rate of $0.75/$100 assessed valuation. If you applied the entire increased tax dollars toward repayment of the reservoir oversizing, then the cost of $5.4 million to oversize the reservoir would be retired in less than ten years. This time frame would be further reduced if you included the increased revenue from the increased assessed valuation and sales taxes collected as a result of the private golf course development. Other revenue sources that could be used to generate funds to repay the reservoir oversizing include park user fees as well as fishing and boat dock user fees.

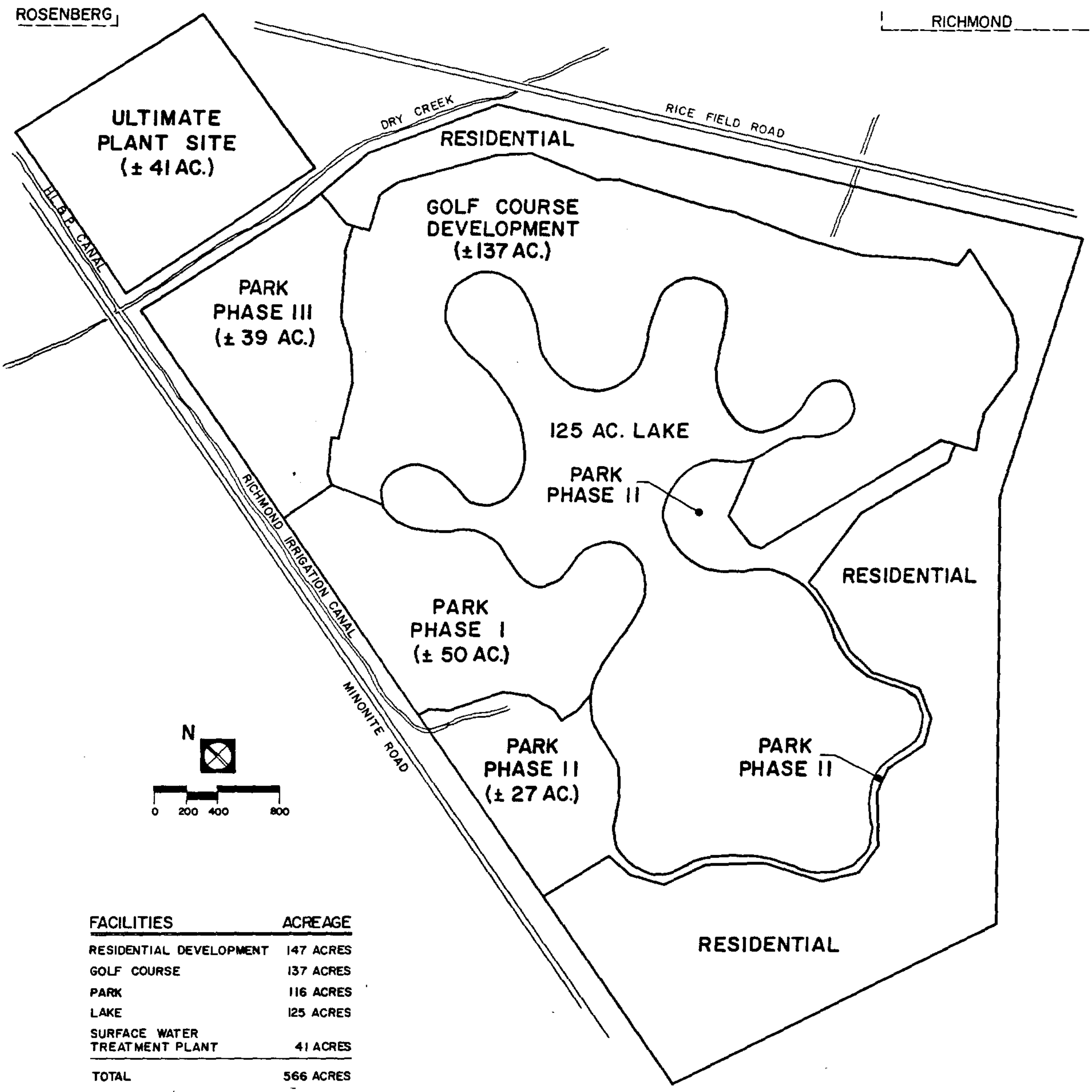
The above mentioned methods of funding the reservoir oversizing are mentioned in this study for consideration only. Further economic evaluation and research will need to be performed before the method of funding the oversizing can be finalized which is presently beyond the scope of this study.

Municipal Park

As mentioned previously the municipal park is proposed to be developed in three phases as shown:

Phase I -	± 50 Acres
Phase II -	± 27 Acres
Phase III -	± 39 Acres

This study proposes that the City of Rosenberg either alone or in conjunction with the City of Richmond and/or Fort Bend County sponsor and apply for 50% matching grant funds from the Local Parks and Open Space Fund administered by the Texas Parks and Wildlife Department. The value of the proposed donated land could be used for the City's share of the 50% matching funds. Assuming the value of the donated land could be appraised at approximately $15,000/acre, then the City could obtain sufficient funds from the Texas Parks and Wildlife Department to fund the development of all three phases without utilizing any City or County funds. However, it must be pointed out that this assumption is based on the land for park development being donated. Also, the City would not be allowed to take possession of the land before grant approval without forteiting the opportunity for the City to use the value of the land for its 50% matching share. By utilizing this method of financing, the City would be required to develop the park in the above mentioned phases to assure that no individual grant request exceeds $750,000.00 which is presently the maximum limit on any one project. To take full benefit of the donated land, this study proposes that the City organize a non-profit corporation to be used as a land holding company until each grant can be submitted.



FACILITIES	ACREAGE
RESIDENTIAL DEVELOPMENT	147 ACRES
GOLF COURSE	137 ACRES
PARK	116 ACRES
LAKE	125 ACRES
SURFACE WATER TREATMENT PLANT	41 ACRES
TOTAL	566 ACRES

REGIONAL WATER SUPPLY STUDY - CITIES OF ROSENBERG & RICHMOND

SCHEMATIC LAND PLAN

FIGURE NO. 36

FACILITIES	ACREAGE
Residential Development	147 Acres
Golf Course	137 Acres
Park	116 Acres
Lake	125 Acres
Surface Water Treatment Plant	41 Acres
Total	566 Acres

CONCEPTUAL MASTER PLAN

ROSENBERG SURFACE WATER CONVERSION STUDY

FIGURE 37

CHAPTER 10 - CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The Rosenberg/Richmond area will experience substantial growth in the next 40 years. Population is expected to increase from the present 42,421 to approximately 176,000 in 2030. Municipal water demand is expected to increase from the present 6.2 MGD to approximately 25.4 MGD in 2030.

2. The existing groundwater production facilities will not be adequate to serve future demands.

3. Total dependence on groundwater in the Rosenberg/Richmond area is projected to cause approximately 7-8 feet of subsidence by 2030, exclusive of additional subsidence caused by groundwater withdrawal by other regional groundwater users.

4. Developing surface water treatment facilities to supply approximately, 83% of the water demand will reduce projected subsidence by up to 5 feet. A comprehensive water conservation plan can reduce water demand by up to ten percent.

5. The Brazos River Authority can make Brazos River water available at between $0.25-$0.39 per thousand gallons. The H.L. & P. Co. pump station and canal system can provide Brazos River water at approximately $0.05 per thousand gallons.

6. A surface water treatment plant located at the confluence of the Richmond Irrigation canal and Dry Creek can provide low pressure treated water to storage/pumping facilities in Rosenberg and Richmond. The storage/pumping facilities will then provide high pressure service to areas north of US 59. The treatment plant can provide direct high pressure service to areas south of US 59.

7. Due to occasional periods of high chloride content in the Brazos River, an 18 day raw water storage facility is required near the treatment plant. The Rosenberg/Richmond area would benefit from a joint-use storage/recreational facility.

8. Surface water supply facilities and additional supplemental groundwater supply facilities would result in user costs varying between $0.94/1000 gallons in 1990 to $1.78/1000 gallons in 2000 eventually reducing to $0.85/1000 gallons in year 2030.

Recommendations

1. Implement the water conservation plan.

2. Research the possibility of developing an regional administration for surface water treatment facilities planning, construction; and operation.

3. Negotiate a water supply contract with the Brazos River Authority and a raw water transportation contract with Houston Lighting and Power Company for the right to use the Richmond Irrigation Canal.

4. Negotiate land purchase contracts and/or land donations for the treatment plant and storage/recreational facility sites including the park site.

5. Set-Up a non-profit organization to accept land donations until such time as Texas Parks and Wildlife grants are organized.

6. File for Texas Parks and Wildlife grant for Phase I of park.

APPENDIX NO. I

CITY OF ROSENBERG

WATER CONSERVATION PLAN

DANNENBAUM ENGINEERING CORPORATION
Consulting Engineers
3100 WEST ALABAMA
HOUSTON, TEXAS 77098
(713) 622-8011

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I-1.0 INTRODUCTION

The City of Rosenberg will supply treated surface water to a service area of approximately 100 square miles (64,000 acres). The Cities of Richmond and Pleak, and twelve existing political subdivisions are included in the service area and will be supplied water on a wholesale basis. A Water Conservation Plan will be an integral part of the supply system design, operation, and administration.

The Texas Revised Civil Statutes grant home rule cities the authority to establish and enforce water conservation measures within their service areas. The City of Rosenberg will therefore establish a comprehensive Water Conservation Plan with:

Non-regulatory measures including -

- o Public education and information programs
- o Leak detection and repair programs
- o Recycle/reuse programs

and Regulatory measures including -

- o Water-saving landscaping requirements
- o Water-saving plumbing codes
- o Universal metering and meter testing/repair program

- o Water-conserving rate structure
- o Drought Contingency Plan

The Statutes also grant home rule cities the authority to require wholesale customers to establish and enforce water conservation measures within their service areas. The City of Rosenberg will therefore require all wholesale customers to establish and enforce similar plans.

Voluntary water conservation programs can produce demand reductions of approximately five percent to ten percent, and stringent water conservation programs can produce demand reductions of approximately ten percent to fifteen percent. The Water Conservation Plan must be broad-based, uniformly applied among affected users, and continuously monitored and enforced to be effective. The above-listed measures, which are discussed in detail in the following sections, are expected to reduce water demand by approximately ten percent.

The benefits of reduced water demand include:

- o Increased ability of existing water (and wastewater) facilities and supplies to serve existing and future demand;
- o Capital and debt service cost savings resulting from delayed construction of new facilities;
- o Capital cost savings resulting from decreased facility capacity requirements;
- o Cost savings resulting from reduced debt service requirements;

- Cost savings resulting from reduced operation and maintenance costs;
- Qualification for loan assistance from State agencies;
- Qualification for bond sales.

The expected water demand reductions are included in the water demand projections developed in this study.

CITY OF ROSENBERG
I-2.0 UTILITY EVALUATION

o	Service Area	11 Sq. Mi.
o	Population	26,131
o	Connections	4893 Residential 764 Commercial 3 Industrial
o	Average Groundwater Production for Last 2 Years	878 MG/Yr.
o	Average Monthly Groundwater Production for Last 2 Years	73 MG/Mo.
o	Peak Daily Use	2.9 MGD
o	Peak/Average Use Ratio (Average Daily Summer Use/Annual Average Daily Use)	1.3
o	Percent of Water Customers Served by City of Rosenberg Wastewater Treatment Plants	100%
o	Percent of Wastewater Flows Originating from Sources Other Than Water Consumers (Excluding Infiltration and Inflow)	0%
o	Average Daily Flow at Wastewater Treatment Plants (Total)	2.6 MGD
o	Peak Daily Flow at Wastewater Treatment Plants (Total)	3.7 MGD

- Estimated Percent of Wastewater Flows by Category: (Not including infiltration and inflow)

Residential and Commercial	75%
Industrial and Manufacturing	3%
Public and Government	22%

- Safe Annual Yield of Groundwater Supply — 2867 MG/Yr.

- Peak Daily System Capacity — 7.8 MGD

- Percent of Water Supply Connections Metered:

Residential	100%
Commercial	100%
Industrial	100%
Public/Government	0%

- Average Annual Water/Wastewater Revenue — $2,650,748

- Previous 12 Month Groundwater Sales (Gallons):

	Residential	Commercial	Industrial	Total
May '87	58,399,100	17,619,400	31,900	76,050,400
June '87	43,007,100	14,439,700	35,700	57,482,500
July '87	45,121,900	15,806,900	23,900	60,952,700
August '87	48,110,600	15,929,400	24,600	64,064,600
September '87	58,847,000	19,588,700	66,100	78,501,800
October '87	42,032,300	17,322,200	36,600	59,391,100
November '87	44,785,200	13,692,200	42,100	58,519,500
December '87	40,656,200	15,326,700	29,700	56,012,600
January '88	43,584,800	13,885,600	22,900	57,493,300
February '88	35,281,900	11,969,900	25,600	47,277,400
March '88	39,145,700	15,236,800	24,600	54,407,100
April '88	42,823,000	14,405,200	29,500	57,257,700
Total	541,794,800	185,222,700	393,200	727,410,700

- Water Rate Structure:

Residential	Commercial/Industrial First 2000 Gallons Meter Size	Minimum Charge
$6.25 up to 2000 Gallons		
$1.60/1000 Gallons: 2000 Gallons to 5000 Gallons	3/4"	$6.25
$1.65/1000 Gallons: 5000 Gallons to 10,000 Gallons	1"	$18.75
$1.75/1000 Gallons: Over 10,000 Gallons	1-1/2"-2"	$31.25
	3"	$43.75
No Billing Cap	4"	$68.75
	6"	$87.50
	Over 2000 Gallons	
	$1.60/1000 Gallons	
	No Billing Cap	

- Wastewater Rate Structure:

Residential	Commercial/Industrial
$5.50 up to 2000 Gallons	$5.50 up to 2000 Gallons
$1.40/1000 Gallons: 2000 Gallons to 5000 Gallons	$1.60/1000 Gallons over 2000 Gallons
$1.50/1000 Gallons: 5000 Gallons to 10,000 Gallons	No Billing Cap
$1.60/1000 Gallons: 10,000 Gallons to 12,000 Gallons	
Maximum Billing Cap = 12,000 Gallons	

I-3.0 WATER CONSERVATION PLAN

3.10 NON-REGULATORY MEASURES

Public Education and Information

Water conservation efforts by the public at home and at work will make an important contribution to the reduction in water demand. Proper conservation practices will be promoted by:

- o Introducing proposed conservation/drought contingency plan with newsletter to wholesale and retail customers.
- o Semi-annual distribution of educational materials to all retail and wholesale customers. The distribution will coincide with the peak summer and winter demand cycles. Suggested conservation measures (Exhibit I-A) and an index of material available from the Texas Water Development Board (Exhibit I-B) will comprise the information package.
- o Press releases coinciding with the distribution of the educational materials.
- o Distribution of educational materials to new customers.
- o Holding public meetings with various speakers addressing water conservation.

Leak Detection and Repair

Leaks in customer's lines (beyond the meter) are common sources of lost water. A sudden increase in a customer's water usage is probably due to a leak in the line. The City of Rosenberg's billing computer is programmed to flag customers whose water usage increases suddenly. City personnel are then sent to the customer to investigate, repairs are made, if required, and water conservation pamphlets are left with the customer. The City will continue to monitor customer water usage, and future wholesale customers will be required to implement similar programs to minimize losses due to leaks in customer's lines.

Major leaks are usually identified by rapidly falling storage tank levels, decreased system pressure, or wet grounds. City personnel monitor storage tank water levels and system pressure at each water plant at least twice daily, and wet grounds are usually detected by City personnel or citizens. The City will promote leak detection and repair by requiring future wholesale customers to implement facility monitoring and inspection programs.

The effectiveness of a leak detection program is increased by universal metering of water users. If all water users are metered, the volume of water lost in the system can be determined. Excessive water losses will become evident, and additional leak detection methods, such as sonic leak detection, can be utilized. The City will purchase sonic leak detection equipment and will make it available to wholesale customers for use within their service areas. Universal metering of customers is discussed in the Regulatory Measures section.

Recycle/Reuse Program

Water demand can be reduced by using recycled water. Examples include recycling industrial process or cooling water, and using wastewater treatment plant effluent for agricultural or recreational land irrigation.

The City has no water users practicing industrial or recreational recycling at this time. All large volume industrial, agricultural, and recreational customers will be encouraged to recycle water where possible.

3.20 REGULATORY MEASURES

Water-Saving Landscape Program

Water conservation through creative landscaping (Xeriscape) can result in lawn watering water use reductions of up to 50 percent. Lawn watering can account for up to 50 percent of a single family residence's yearly water use; therefore, Xeriscape can make a significant contribution to water conservation efforts. The City will require Xeriscape practices in new developments in all service areas, and will provide existing and new customers with the information shown in Exhibit I-E.

Water-Saving Plumbing Fixtures

The City of Rosenberg Building Code (Southern Standard Building Code) contains no provisions for water-saving plumbing fixtures. The City will adopt Appendix J of the 1985 Edition of the Southern Standard Building Code, which contains water-saving fixture requirements. The City will amend Appendix J to include a requirement of swimming pool recirculating equipment for new installations.

Existing customers will be encouraged to retrofit with water-saving fixtures. The public education program will inform customers of the advantages of water-saving fixtures, and the types and availability of fixtures. The excess-use rate structure (discussed later) will further encourage installation of the fixtures.

<u>Universal Metering and Meter Testing/Repair Program</u>

A yearly water audit (comparison of water produced versus water billed or metered) can provide useful information about the condition of the system. The City and its wholesale customers will conduct a yearly water audit.

The water audit is especially useful if all sources of water use are metered. The City currently meters all customers; however, City facilities, including swimming pools, are not metered. The City will adopt a program which requires meter installation for all customers and users, including City facilities. Wholesale customers will also be required to meter all of their individual users.

Faulty meters decrease the accuracy of the water audit by providing erroneous indications of water use. The City currently attempts to replace meters on a 10-year cycle (large meters currently receive low replacement priority). The City will revise the program to include yearly testing of large (greater than one inch) meters. The repair/ replacement of large meters will have an important impact on the accuracy of the yearly water audit, and since faulty meters read low, the increased revenues from billings will help offset the costs of meter testing and repair. The City will require wholesale customers to implement a similar program within their service areas.

Street cleaning and water main flushing are additional causes of water audit inaccuracies. The City currently attempts to flush mains on a 90-day cycle. This program will continue; however, meters will be installed on the hydrants during flushing, and water use will be monitored. The City has one street sweeper operating at this time, and water used for street cleaning will be monitored. The City will require wholesale customers to implement similar programs within their service areas.

Water-Conserving Rate Structure

Most of the water demand in the area is from residential customers. The City water rate structure includes a step rate feature for residential customers. After the base volume is exceeded, the water rate increases in steps as water use increases. The City will incorporate an excess-use limit into the rate structure for single family residential customers. An excess-use limit will be established for each customer, and an excess-use fee will be assessed when the limit is exceeded.

The step rate and excess use fee features will encourage water conservation practices by residential customers. The City will require wholesale customers to adopt similar features for residential users in their service areas.

Drought Contingency Plan

The Drought Contingency Plan is discussed in Section I-4.0.

3.30 IMPLEMENTATION AND ENFORCEMENT

Non-regulatory water conservation measures will be implemented by the City through press releases and distribution of educational materials. Regulatory water conservation measures will be implemented by enacting City ordinances, or developing programs within City Departments, as applicable.

The regulatory water conservation measures will be enforced by the following methods (Drought Contingency Plan enforcement is discussed in Section I-4.0):

- Building permits for new construction will not be issued unless plans call for installation of meters, water conserving fixtures, and Xeriscape. Building permits for remodeling that includes plumbing improvements will not be issued unless water conserving fixtures are specified.
- Service taps will not be made, and building inspectors will not issue Certificates of Occupancy if meters and water conserving fixtures have not been installed.
- Customer service will be disconnected if water bills are not paid. Excess-use fees and a step rate structure will provide indirect enforcement by providing cost incentives to reduce water use. Wholesale customers will be required to adopt, implement, and enforce similar measures.

3.40 ANNUAL REPORT

The City of Rosenberg will file an Annual Report with the Texas Water Development Board. The report will assess the status, progress, and effectiveness of the Water Conservation Plan and will include:

- Educational information which has been issued or made available.
- Press releases.
- Public comments.
- Water audit.

- Excess-use fees levied.
- Meter repair/replacement program summary.
- Summary of connections.
- Water conservation ordinances and policies in effect.

I-4.0 DROUGHT CONTINGENCY PLAN

4.10 GENERAL

The Drought Contingency Plan for the City of Rosenberg consists of two parts: trigger conditions and contingency measures. The trigger conditions which follow will be used as guides in determining drought levels, and may be mitigated by factors such as season and weather. The assessment of drought trigger conditions will be made by the Director of Public Works; drought contingency measures will be implemented and terminated by the City Council. Enforcement of drought contingency measures will be similar to other City ordinances.

Wholesale customers will be required to establish similar Drought Contingency Plans for their service areas. Drought trigger condition assessments, and contingency measure implementation will be conducted by each wholesale customer; however, the City of Rosenberg will have the authority to invoke drought contingency measures within wholesale customer service areas, if deemed necessary.

4.20 TRIGGER CONDITIONS

Mild Drought:

- o Daily water use averaged over three consecutive days reaches 80% of firm production capacity.

Moderate Drought:

- o Daily water use averaged over three consecutive days reaches 90% of firm production capacity.
- o Raw water storage volume is decreasing.
- o Treated water storage volume is decreasing. Distribution system pressure is below level acceptable to operators and/or customers.

Severe Drought:

- o Daily water use averaged over three consecutive days reaches 100% of firm production capacity.
- o Replenishment of raw water reservoirs has stopped. Failure of a system component would create a health or safety hazard.

4.30 DROUGHT CONTINGENCY MEASURES

Mild Drought

- o Public notices indicating that a mild drought trigger condition is imminent or has been reached.
- o Request for voluntary restrictions on water use including limiting landscape watering to morning and evening hours, and limiting vehicle and sidewalk/driveway washing.

Moderate Drought

- o Public notices indicating that a moderate drought trigger condition is imminent or has been reached.

- o Mandatory restriction of landscape and recreational facility watering to a street address/day of week system. Specific address and time information will be provided when finalizing plan.
- o Mandatory restriction of landscape and recreational facility watering to early morning and late evening hours.
- o Prohibition of residential vehicle, sidewalk and driveway cleaning.
- o Prohibition of street cleaning.
- o Prohibition of hydrant flushing.
- o Voluntary restriction of commercial sidewalk and driveway cleaning.
- o Voluntary restriction of non-essential nursery watering.

<u>Severe Drought</u>

- o Public notices indicating that a severe drought trigger condition is imminent or has been reached.
- o Prohibition of all landscape watering by nurseries, recreational facilities, residential and commercial users.
- o Prohibition of all vehicle, sidewalk and driveway cleaning.
- o Prohibition of street cleaning.
- o Prohibition of hydrant flushing.

Public notices will include press releases, noties posted at public works or water utilities buildings, post offices and selected supermarkets. Notices will contain drought level and contingency measure information, and sources of additional information. Termination notification will be accomplished through press releases and removal of posted notices.

EXHIBITS

EXHIBIT I-A

WATER CONSERVATION SUGGESTIONS

A. Bathroom

1. Take showers instead of baths. Showers usually use less water than baths.

2. Install a low-flow shower head which restricts the quantity of flow at 60 psi to no more than 3.0 gallons per minute.

3. Take short showers and turn the water off while soaping.

4. Don't use hot water when cold will do. Water and energy can be saved by washing hands with soap and cold water. Hot water should be added only when hands are especially dirty.

5. Reduce the level of the water in the bath tub by several inches.

6. Turn the water off when brushing teeth or washing hands until it is needed for rinsing.

7. Shampoo hair during showers or baths. This practice uses less water than showering or bathing separately.

8. Hold hot water in the basin when shaving instead of letting the faucet run.

9. Test toilets for leaks: add a few drops of food coloring to the water in the tank (the toilet should not be flushed); if the coloring appears in the bowl in a few minutes, the fixture needs adjustment or repair.

10. Install a toilet tank displacement device. A one-gallon plastic milk bottle filled with stones or water, recapped, and placed in the toilet tank will reduce the amount of water in the tank, yet will provide enough water for flushing. Bricks are not recommended since they eventually crumble and damage the working mechanism. Displacement devices should not be used with new, low-volume flush toilets.

11. Install faucet aerators to reduce water consumption.

12. Don't use the toilet to dispose of cleansing tissues, cigarette butts, or other trash. This wastes water and places an unnecessary load on the sewage treatment plant or septic tank.

13. Install low-volume flush toilets that use 3.5 gallons or less per flush.

B. **Kitchen**

1. Use a pan of water (or place a stopper in the sink) for rinsing cooking implements during cooking rather than using the water faucet for rinsing.

2. Run the dishwasher only with a full load. This practice will save water, detergent, and electricity.

3. Don't use the garbage disposal for just a few scraps.

4. Keep a container of drinking water in the refrigerator. Running water from the tap until it is cool wastes water.

5. Clean vegetables in a pan rather than under the faucet.

6. Use as little water as possible and use a cover when cooking in pots. This method saves water, and food is more nutritious since vitamins and minerals are not poured down the drain with the extra cooking water.

7. Use a pan of water for rinsing instead of the faucet when hand washing dishes.

8. Small kitchen savings, such as not making too much coffee, are important.

C. **Laundry**

1. Wash only full loads in automatic washing machines (32 to 59 gallons are required per load).

2. Use a lower water level setting for light loads.

3. Cold water washing will save energy and conserve hot water.

D. **Appliances and Plumbing**

1. Check water requirements when purchasing new appliances that use water. Some use less water than others.

2. Check all waterline connections and faucets for leaks. Water leaks waste water and increase water bills.

3. Stop drips by replacing faucet washers. A slow drip can waste up to 170 gallons of water each day.

4. Check for water leakage between the water meter and the house; turn off all indoor and outdoor faucets and check the water meter; if the meter continues to run, the line is leaking.

5. Insulate all hot water pipes to avoid the delays (and wasted water) experienced while waiting for the water to "run hot."

6. Be sure the water heater thermostat is not set too high. High settings waste water and energy because the water often has to be cooled with cold water before it can be used.

7. Use a moisture meter to determine when house plants need water. Most plants are over-watered.

E. <u>Outdoor Use</u>

1. Water lawns in the morning or evening during summer months. Some of the water used during hot weather will evaporate before it reaches the grass.

2. A sprinkler that produces large drops of water, rather than a fine mist, will reduce evaporation.

3. Turn soaker hoses so the holes are on the bottom to avoid evaporation.

4. Water slowly for better absorption, and never water in high winds.

5. Don't water streets, sidewalks, or driveways.

6. Condition the soil with compost before planting grass or flower beds; this will allow water to soak in rather than run off.

7. Fertilize lawns at least twice a year for root stimulation. Grass with a good root system requires less water.

8. Water grass only when it's needed. If the grass has turned a dull grey-green, or if footprints remain visible, the grass needs water.

9. Don't water too frequently. Too much water can overload the soil and promote plant disease by keeping air from the roots.

10. Don't over-water. The soil can absorb only so much moisture and the rest simply runs off. One-and-a-half inches of water applied once a week will keep most Texas grasses healthy.

11. Operate automatic sprinkler systems around 6:00 A.M. when the demand on the water supply is lowest.

12. Don't scalp lawns when mowing during hot weather (taller grass holds moisture better). Grass should be cut fairly often, so that only 1/2 to 3/4 inch is trimmed off.

13. Use a watering can or a hand held hose for small areas of the lawn that need more frequent watering (areas near walks or driveways).

14. Choose varieties of grass, shrubbery, and plants which are adapted to the climate and the yard.

15. Consider decorating areas of the yard with rocks, gravel, wood chips, or other materials which require no water.

16. Use a bucket of soapy water for washing vehicles. Use the hose only for wetting and rinsing the vehicle.

EXHIBIT I-B

TEXAS WATER DEVELOPMENT BOARD
WATER CONSERVATION LITERATURE

Single copies of all of the following publications and materials can be obtained at no charge. The * indicates those publications that are available free to political subdivisions in small quantities. Larger quantities can be obtained through special arrangement or at the cost of printing. To make a request, write: CONSERVATION, Texas Water Development Board, Capitol Station, Austin, Texas 78711-3231.

Agricultural Conservation Literature

Title	Published By	Description	Length
Agricultural Water Conservation in Texas*	TWDB	Pamphlet with Tear-out	8 pages
Have Your Irrigation System Evaluated Free*	TWDB	Pamphlet	4 pages
LEPA Irrigation*	TWDB	Pamphlet	6 pages
Drip Irrigation*	TWDB	Pamphlet	6 pages
Plastic Ruler*	TWDB	6" x 1-1/4"	---
Furrow Dikes*	HPUWCD #1	Pamphlet	4 pages
Soil Moisture Monitoring*	HPUWCD #1	Pamphlet	4 pages
Center Pivot Irrigation Systems L-2219*	TAEX	Pamphlet	4 pages
Surge Flow Irrigation L-2220*	TAEX	Pamphlet	4 pages
Surge Irrigation	SCS	Pamphlet	6 pages
Coloring Poster for Children*	TWDB	Coloring Poster	1 page
Water Conservation Coloring Book* (No. 1)	TWDB	Booklet	4 pages

Municipal Conservation Literature

Title	Published By	Description	Length
Water: Half-A-Hundred Ways To Save It*	TWDB	Pamphlet	8 pages
Water Saving Ideas For Business and Industry*	TWDB	Pamphlet	8 pages
How To Save Water Outside The Home*	TWDB	Pamphlet	8 pages
How To Save Water Inside The Home*	TWDB	Pamphlet	8 pages
Toilet Tank Leak Detector Tablets*	TWDB	2 Tablets	---
Municipal and Commercial Water Conservation Services	TWDB	Pamphlet with Tear-out	8 pages
A Homeowner's Guide to Water Use and Water Conservation	TWDB	Booklet	22 pages
Guidelines for Municipal Water Conservation and Drought Contingency Planning and Program Development	TWDB	Loose-leaf	36 pages
How to Xeriscape	NXC	Pamphlet	10 pages
Texas Sesquicentennial Native Plant Landscape	TDA/TWDB	Pamphlet	8 pages
Municipal Water Conservation Workshop Notebook (See Attachment "A" for a Description of Contents)	TWDB	Notebook	6 sections
Water Conservation Coloring Book* (No. 2)	TWDB	Booklet	4 pages

EXHIBIT I-C

Contents of the Municipal Water Conservation Workshop Notebook

The notebook is distributed to participants at Board-sponsored Municipal Water Conservation workshops. In addition, single copies of the notebook can be provided to cities and utilities. Single copies of selected materials from the notebook can also be provided.

Title	Published By	Description	Length
Section 1: The Need for Conservation			
Texas Water Resources and Conservation	TWDB	Paper	38 pages
Section 2: Water Conservation Techniques			
Efficient Use of Water in the Garden and Landscape (B-1496)	TAEX	Booklet	20 pages
Xeriscape	City of Austin	Booklet	20 pages
Water Pressure Reducing Valves	Watts Regulator	Booklet	21 pages
Texas Native Tree and Plant Directory, 1986	TDA	Book	162 pages
Sources of Leak Detection Equipment and Services	TWDB	List	21 pages
Sources of Water Saving Devices	TWDB		
Locating and Reducing Unaccounted For Water Through The Use Of The Water Audit and Leak Detection	TWDB	Guidebook	30 pages
Water Rate Design Emphasizing Conservation Rate Structures	TWDB	Guidebook	30 pages
Model Water Ordinances	TWDB	Guidebook	25 pages
The Authority of Cities, Water Utilities, and Water Districts To Regulate And Enforce Water Conservation Measures	TWDB	Guidebook	25 pages

Title	Published By	Description	Length
Section 3: Alternate Sources			
The Cost of Conventional Water Supply Development And Treatment	TWDB	Paper	9 pages
Potential For Utilization Of Brackish Groundwater	TWDB	Paper	21 pages
Guidelines For Water Reuse EPA-600/8-80-036	EPA	Book	105 pages
Section 4: Workshop Exercise			
Example Problem	TWDB	Loose-leaf	15 pages
Section 5: Plan Elements			
Guidelines For Municipal Water Conservation and Drought Contingency Planning And Program Development	TWDB	Loose-leaf	36 pages
Section 6: Plan Development			
Water Conservation and Drought Contingency Plan Development Procedures	TWDB	Loose-leaf	58 pages

EXHIBIT I-D

LIST OF PUBLICATIONS AND AUDIOVISUAL MATERIALS AVAILABLE OR LOAN FROM TEXAS WATER DEVELOPMENT BOARD (TWDB) (a)

Publications

Title	Published By	Description	Length
Water Audit and Leak Detection Guidebook	California Dept. of Water Resources	Book	142 pages
Example Brochures and Promotional Material	Complied by TWDB	Ringbinder	32 pages
Regional Teachers Guide Supplements	California Dept. of Water Resources	Books	Nos. 1 - 7

Audiovisual Materials

The Alternative is Conservation	Water Films	16mm Film VCR/VHS Format	28 minutes
Water Follies	American Water Works Association (AWWA)	16mm Film VCR/VHS Format	7.5 minutes
Orangutans (Public Service Announcement)	AWWA VCR/VHS Format	16mm Film VCR/VHS Format	30 seconds
Gooney Birds (Public Service Announcement)	AWWA VCR/VHS Format	16mm Film VCR/VHS Format	30 seconds
Tanks (Public Service Announcement)	AWWA VCR/VHS Format	16mm Film VCR/VHS Format	30 seconds
Spot Announcements	Lower Colorado River Authority	Audio Cassette	30 seconds

(a) The films, video cassettes, and publications are provided for review purposes only. Permission to use any of this material for print or broadcast must be obtained from the producer or publisher of the material.

Texas Water Resources and Planning Literature

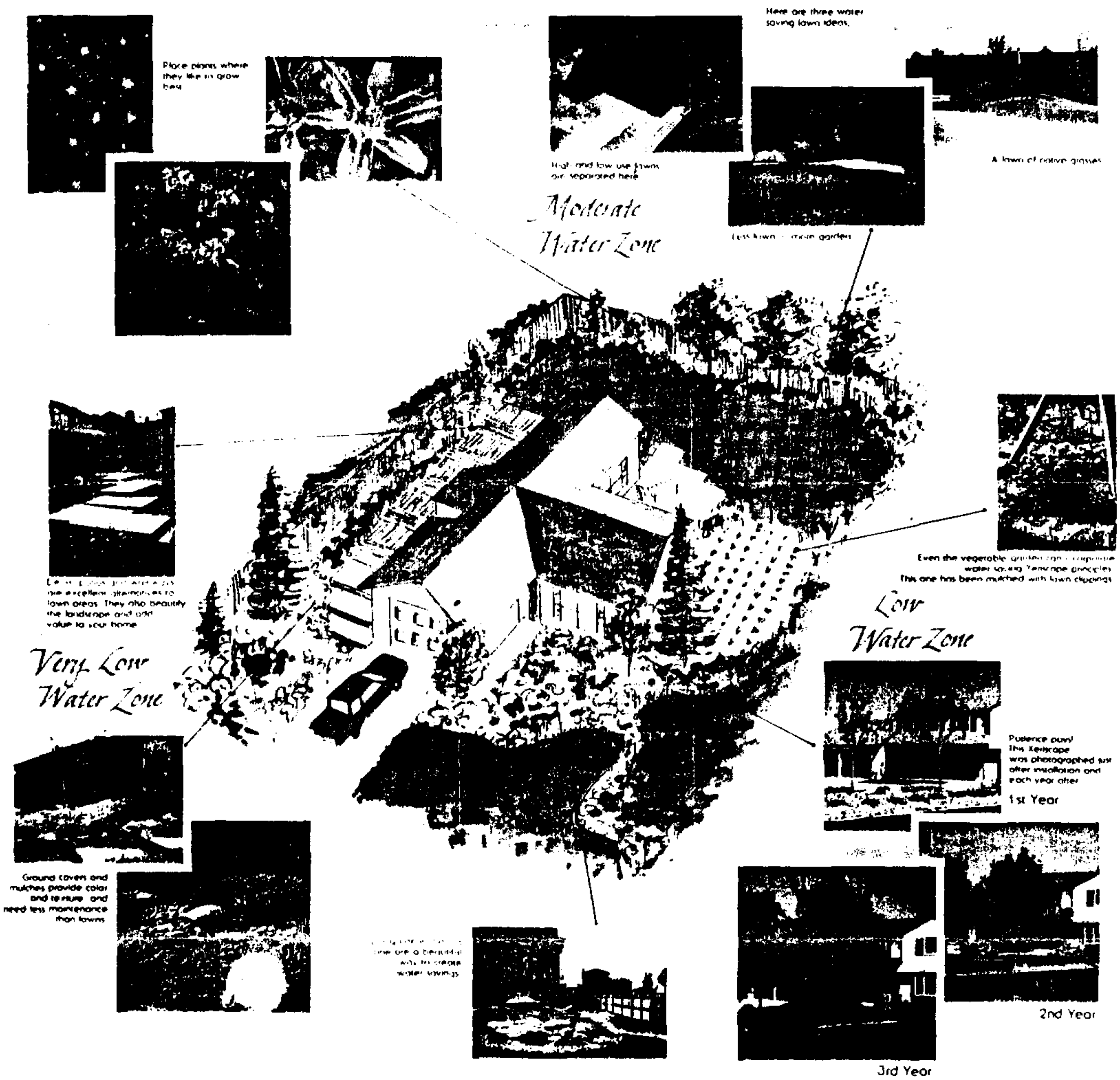
Title	Published By	Description	Length
TWDB Report 294 - Surveys Of Irrigation In Texas	TWDB	Book	243 pages
Summary of Water for Texas (C-20)	TDWR	Pamphlet	8 pages
Water Planning In Texas	TDWR	Booklet	27 pages
Texas Water Development Board (Funding Programs)	TWDB	Pamphlet	4 pages
Water For Texas (GP-4-1)	TDWR	Books	
Volume 1 (Comprehensive Plan)	(Available for purchase only from the Texas Water Commission, P.O. Box 13087, Austin, Texas 78711)		72 pages
Volume 2 (Technical Appendix)			530 pages
Texas Water Facts	TDWR	Booklet	12 pages

Abbreviations:

HPUWCD #1	High Plains Underground Water Conservation District No. 1
NXC	National Xeriscape Council, Inc.
SCS	USDA - Soil Conservation Service
TAEX	Texas Agricultural Extension Service
TDA	Texas Department of Agriculture
TDWR	Texas Department of Water Resources
TWDB	Texas Water Development Board

EXHIBIT I-E

XERISCAPE AT HOME



P L A N N I N G YOUR X E R I S C A P E

When planning your Xeriscape, the first things to consider are:

- What do you need from your landscape?
- How much time do you want to spend in your landscape, for pleasure and for maintenance?

Answers to these questions and those that follow help you get the most from your landscape planning efforts, and turn your dreams into reality.

- What kind of back yard activities do you enjoy: garden parties, sunning, games?
- Do you have children or pets, what are their needs?
- Do you need storage for tools, firewood, recreational vehicles, or other items?
- What image or style do you want — formal, traditional, natural?
- Would you like to have specific plants in your landscape.
- Are you interested in growing a vegetable garden?
- Does your property have views to preserve or to screen?
- What kind of qualities already exist in your landscape: slopes, existing plants, structures, rocks?
- Is the drainage in your yard adequate?
- Are there other questions that you need to answer?

Zoning the Landscape:

Xeriscapes take advantage of microclimate conditions. Microclimates are affected by moisture, sun, shade, air movement, heat.
For example, reflected light from south and west facing structures creates high temperatures which increases the loss of water from nearby plantings. Shade trees and groundcovers strategically planted in these exposures reduce temperatures in summer, yet allow sunlight to enter in the winter. Similarly, water-loving plants can be grown in a microclimate where irrigation and other water run off is captured in drainage swales, on north facing slopes or in areas surrounding gutter basins. Several microclimates exist within every landscape. As plants grow and provide shade or screen, microclimates will change accordingly.

Creating Microclimate Zones:

The following are guidelines for the creation of three Xeriscape microclimates. Each zone is based upon the amount of water applied. All of the examples incorporate the seven Xeriscape fundamentals reviewed above.

Very Low Water Zone:

This is the lowest water zone in a Xeriscape, providing the greatest savings relative to traditional landscapes. Irrigation is needed during the establishment of new plantings. Once established, the plants in this zone require little, if any, additional water. Plants in the low water zone need to be selected carefully for minimal water use.

Low Water Zone:

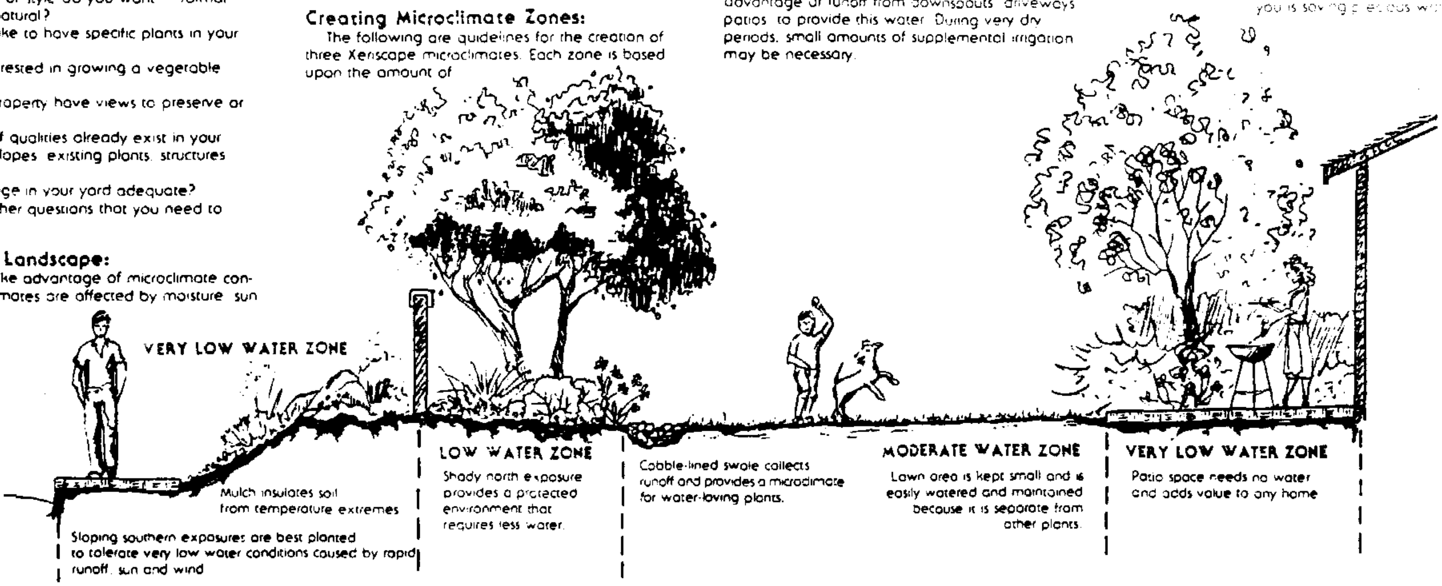
Plants growing in this zone require more water than is available from natural precipitation. Take advantage of runoff from downspouts, driveways, patios, to provide this water. During very dry periods, small amounts of supplemental irrigation may be necessary.

Moderate Water Zone:

Even though this zone uses the most water, it still demands less than traditional landscapes. This zone is kept small in size to limit water need. This moderate water use zone may be considered a mini-oasis and is best located near entry ways or areas of high use.

Long Term Beauty and Savings with Xeriscape!

By following the guidelines and tips in this brochure, you too can proudly create your own water saving Xeriscape. Help your neighbors, friends and family start their own Xeriscapes. Trade plants and ideas. Most of all, sit back and enjoy the thought that all of the beauty around you is saving precious water.



For additional information on water conservation methods, contact:

CITY OF AUSTIN
RESOURCE MANAGEMENT DEPARTMENT
3000 IH-35S
Austin, Texas 78704
(512) 462-6265

APPENDIX NO. II
GROUNDWATER/SUBSIDENCE STUDY

SUB-CONSULTANT
BAC-GROUND
3216 Georgetown
Houston, Texas 77005

BAC-GROUND

GROUNDWATER CONSULTING SUPPORT
3216 Georgetown, Houston, Texas, USA 77005-2906
(713) 668-6874

GROUNDWATER STUDY OF THE ROSENBERG, TEXAS AREA

1.0 GENERAL

The general approach used in this project was to use a numerical groundwater flow model to predict drawdowns, given three pumping scenarios from the study area. The subsidence contribution from the given pumping was estimated from an empirical formulation (Gabrysch, 1981). In addition, there is contribution from outside the study area that was estimated. Total subsidence calculations were adjusted correspondingly. Model details follow.

2.0 GROUNDWATER MODEL OF ROSENBERG, TX AREA

2.1. MODFLOW Model

The model used in this study was MODFLOW (McDonald and Harbaugh, 1984). MODFLOW is a finite-difference groundwater flow model that yields drawdowns as a function of discretized time and space. This model consists of several modules which are briefly discussed below.

2.1.1 BASIC Module

This module principally contains the number of grids, boundary conditions, initial conditions, and stress periods. The number of grids, together with the size of the grids (BCF Module), were determined based on the size of the study area, number of aquifers, and computer hardware capabilities. The rectangular grids were extended outside of the study area to minimize model edge effects. The final grid configuration, Figure 1, was 42 columns by 37 rows by 2 layers (3108 grid cells representing the Chicot and Evangeline aquifers). The clays within and in between the aquifers were represented implicitly by a leakance factor.

All grid cells in the model were deemed active with recharge occuring at the northern boundary (toward the aquifer outcrops) and discharge occuring at the southern boundary (toward the Texas Gulf Coast). A steady-state run was made to determine the initial heads and the recharge rates. The initial heads were selected such that the drawdown at steady-state with no pumping was zero. A groundwater gradient of about 3.E-4 ft/ft (about 1.6 ft/mile) was estimated.

Time discretization was based on the detail of the population forecasts, which determines the detail of the pumpage data. The table below shows the relationship between the length of the stress periods and the stress period number used in each of the three cases.

YEAR	----- STRESS PERIOD # ----		
	CASE 1	CASE 2	CASE 3
1990	0	0	0
1995	1	1	1
2000	2	2	2
2005			
2010	3	3	3
2015			
2020	4	4	4
2025	5	5	
2030	6	6	5

2.1.2 BCF Module

This module principally contains the grid cell sizes and the aquifer parameters. The grid cells were selected to be equal in the center of the study area (2000 ft by 2000 ft). This was based on the level of detail of the input data and to provide sufficient output detail. This dimension of grid cells is about the size of the smallest MUD district within the study area. Moving away from the center of the site the grid cells increase in size by a factor of 1.2 from one grid cell to the next adjacent grid cell. The cell size increase was implemented to increase areal coverage away from the center of the study area to avoid model edge effects. The factor of 1.2 is adequate to achieve this goal and at the same time it is small enough to minimize numerical errors. The total grid size is 107,664 ft by 97,664 ft or, about 20.4 miles by 18.5 miles. The grid is centered in the City of Rosenberg, TX, as shown in Figure 1.

Aquifer parameters include transmissivity, storativity, and leakance. Since this model was not calibrated, previous calibrated studies were referenced. The Carr et al. (1985) report was used to extract the aquifer parameters needed. Since our study area was small compared to the Carr et al. (1985) report study areas, most of the aquifer parameters were considered constant within the Rosenberg study area. The storativity in layer 1 (Chicot aquifer) was divided into three zones (0.1, 0.05, and 0.005). Leakance was selected to be the geometric mean of the given range of vertical hydraulic conductivity (9.2E-5 to 4.6E-3 ft/day) divided by the range in aquifer thicknesses at the study site (500 to 700 ft). This is illustrated by:

Leakance = Vert. Hydr. Cond./Thickness
= SQRT((9.2E-5 * 365 / 700) * (4.6E-3 * 365 / 500))
= 0.0004 per year.

The selected aquifer parameters are presented below.

Layer #	Transmissivity	Storativity	Leakance
1 (Chicot)	9000 sq ft/day	0.1 to 0.005	0.0004 /yr
2 (Evangeline)	8500 sq ft/day	0.0005	

2.1.3 RCH Module

The recharge module contains the assumed rate of recharge/discharge of 2 inches/year. This rate was selected as that required to produce a steady-state gradient of about 3.E-4 ft/ft across the grid cells in the absence of pumping.

2.1.4 WEL Module

This package is the driving module for the model. The well pumping rates are specified at each new stress period. Each case assumes that there is pumping in the Chicot and Evangeline aquifers. Existing wells in outlying areas are assumed pumping from the Chicot aquifer, existing city wells are assumed pumping from the Chicot and Evangeline aquifers, and all future wells are assumed pumping from the Evangeline aquifer. Distribution of the pumping rates was developed by Dannenbaum Engineering Corporation based on population/demand estimates. Assumed well locations for each case studied are shown on Figures 2 through 4.

2.1.5 Other Modules

Other modules include the SIP and OUT packages. The SIP (Strongly Implicit Package) module controls the numerical solution selected and associated parameters. The most significant parameter in this module is the head change criterion for convergence which was selected as 0.01 ft.

The OUTput control module controls the various printing options. A binary output file of the drawdown was selected so that it can be read by another program for calculating subsidence and for plotting purposes.

3.0 SUBSIDENCE MODEL

Subsidence was estimated by using an empirical relationship based on research conducted in the Houston area by Gabrysch (1981). This method involves the determination of specific unit compactions for the study area. The specific unit compaction is defined as the subsidence divided by the drawdown divided by the clay thickness at that point, and it is essentially a normalizing factor for subsidence. Gabrysch generated specific unit compaction and clay thickness maps for the Houston-Galveston area. Average values for the Rosenberg study area were obtained from Carr et al. (1985). Calculation procedures are presented below.

SUB = (SUC1 * CT1 * DD1) + (SUC2 * CT2 * DD2)

where,

SUB = Subsidence, in feet

SUC = Specific Unit Compaction for layers 1 and 2, per feet
SUC1= 1.0E-4 per feet (for Chicot Aquifer)
SUC2= 1.8E-5 per feet (for Evangeline Aquifer)

CT = Clay Thickness in layers 1 and 2, in feet
CT1 = 200 feet (for Chicot Aquifer)
CT2 = 600 feet (for Evangeline Aquifer)

DD = Drawdown in layers 1 and 2 (from MODFLOW), in feet

Subsidence was calculated using the above relationship. The critical head is assumed to have occured before 1990 throughout the study area, therefore subsidence is immediate. Lastly, subsidence occurs only when the water levels are going down, with zero additional subsidence occuring when the water levels rebound. This method of calculating subsidence is an approximation designed to give an estimate of the additional subsidence due to pumping from only the study area as defined in this report.

4.0 SUBSIDENCE FROM OUTSIDE STUDY AREA

It is recognized that there is a significant subsidence contribution from outside the study area. The intent of this study was not to calculate the absolute subsidence within the study area, but to estimate the amount of subsidence that is contributed from the study area. Outside contributions depend on other factors which are beyond the scope of this study. In order to estimate the total subsidence, the study subsidence values can be assumed to contribute 75% of the total subsidence, and the subsidence values can be adjusted accordingly.

5.0 RESULTS

Drawdown and subsidence results are summarized below. Drawdowns in Cases 1 and 2 were quite similar, and reflect the assumed conversion to surface water as the primary source of municipal water supply in 1995 and 2000, respectively. Case 3 represents an extreme condition of continued use of groundwater as the only source of municipal water supply. Notice that the subsidence results reflect the same pattern as the drawdown results.

	Range of Drawdowns (ft) at the End of the Year 2030		
	Case 1	Case 2	Case 3
Chicot Aquifer	19 -43	22 -49	53-147
Evangeline Aquifer	87-122	106-142	416-530

	Range of Subsidence (ft) at the End of the Year 2030		
	Case 1	Case 2	Case 3
Total Adjusted Subsidence	1.4-2.1	1.8-2.5	5.7-7.9

6.0 REFERENCES

Carr, J. E., W. R. Meyer, W. M. Sandeen, and I. R. McLane, "Digital Models for Simulation of Ground-Water Hydrology of the Chicot and Evangeline Aquifers Along the Gulf Coast of Texas", **TEXAS DEPARTMENT OF WATER RESOURCES**, Report 289, Austin, Texas, 1985.

Gabrysch, R. K., and C. W. Bonnet, "Land Surface Subsidence in the Houston-Galveston Region, Texas", **TEXAS WATER DEVELOPMENT BOARD**, Report 188, Austin, Texas, 1975.

Gabrysch, R. K., Personal Communication, 1981.

McDonald, M. G., and A. W. Harbaugh, **A MODULAR THREE-DIMENSIONAL FINITE-DIFFERENCE GROUND-WATER FLOW MODEL**, U.S. Department of the Interior, U.S. Geological Survey, National Center, Reston, VA, 1984.

Meyer, W. R., and J. E. Carr, "A Digital Model for Simulation of Ground-Water Hydrology in the Houston Area, Texas", **TEXAS DEPARTMENT OF WATER RESOURCES**, U.S. Geological Survey, Austin, Texas, 1979.

CASE 1 - YEAR 2030

DRAWDOWN IN CHICOT AQUIFER

CASE 1

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	21.5	21.8	22.2	22.6	23.1	23.5	23.9	24.3	24.8	25.3	25.7	26.3	26.8	27.4	28.0
2	19.6	19.9	20.3	20.7	21.2	21.6	22.0	22.5	22.9	23.4	23.9	24.4	25.0	25.5	26.2
3	19.9	20.1	20.5	21.0	21.5	21.9	22.3	22.8	23.2	23.7	24.2	24.7	25.3	25.9	26.5
4	20.0	20.3	20.7	21.1	21.6	22.1	22.5	22.9	23.3	23.8	24.3	24.9	25.5	26.1	26.7
5	19.9	20.2	20.6	21.1	21.6	22.0	22.4	22.9	23.3	23.8	24.3	24.9	25.5	26.1	26.7
6	19.8	20.0	20.4	20.9	21.4	21.8	22.3	22.7	23.2	23.7	24.2	24.8	25.4	26.0	26.6
7	19.4	19.7	20.1	20.6	21.1	21.5	22.0	22.4	22.9	23.4	23.9	24.5	25.1	25.8	26.4
8	20.1	20.3	20.7	21.2	21.7	22.2	22.6	23.0	23.5	24.0	24.6	25.2	25.8	26.6	27.1
9	19.7	20.0	20.4	20.9	21.3	21.8	22.2	22.7	23.1	23.7	24.2	24.8	25.4	26.1	26.8
10	19.4	19.6	20.0	20.5	21.0	21.5	21.9	22.3	22.8	23.3	23.8	24.4	25.1	25.7	26.4
11	20.0	20.3	20.7	21.2	21.6	22.1	22.5	23.0	23.4	23.9	24.5	25.1	25.7	26.3	27.0
12	19.7	20.0	20.4	20.8	21.3	21.8	22.2	22.6	23.1	23.6	24.1	24.7	25.3	26.0	26.7
13	20.4	20.6	21.0	21.5	22.0	22.4	22.9	23.3	23.8	24.3	24.8	25.3	25.9	26.6	27.3
14	20.1	20.3	20.7	21.2	21.7	22.1	22.6	23.0	23.4	23.9	24.4	25.0	25.6	26.2	26.8
15	19.8	20.0	20.4	20.9	21.4	21.8	22.2	22.7	23.1	23.6	24.1	24.6	25.2	25.8	26.4
16	20.5	20.7	21.1	21.6	22.1	22.5	22.9	23.3	23.8	24.3	24.8	25.3	25.9	26.5	27.1
17	20.2	20.5	20.9	21.3	21.8	22.2	22.6	23.0	23.5	24.0	24.5	25.0	25.5	26.1	26.7
18	19.9	20.2	20.6	21.0	21.5	21.9	22.4	22.8	23.2	23.7	24.2	24.7	25.2	25.8	26.4
19	20.7	20.9	21.3	21.8	22.2	22.7	23.1	23.5	23.9	24.4	24.9	25.4	25.9	26.5	27.1
20	20.4	20.7	21.1	21.5	22.0	22.4	22.8	23.2	23.7	24.1	24.6	25.1	25.6	26.2	26.8
21	20.2	20.4	20.8	21.3	21.7	22.2	22.6	23.0	23.4	23.9	24.3	24.8	25.4	25.9	26.5
22	21.0	21.2	21.6	22.0	22.5	22.9	23.3	23.7	24.2	24.6	25.1	25.6	26.1	26.7	27.3
23	20.7	21.0	21.4	21.8	22.3	22.7	23.1	23.5	23.9	24.4	24.9	25.4	25.9	26.4	27.0
24	20.5	20.8	21.2	21.6	22.1	22.5	22.9	23.3	23.7	24.2	24.6	25.1	25.7	26.2	26.8
25	21.4	21.6	22.0	22.4	22.9	23.3	23.7	24.1	24.5	25.0	25.4	25.9	26.5	27.0	27.6
26	21.2	21.4	21.8	22.2	22.7	23.1	23.5	23.9	24.3	24.8	25.3	25.8	26.3	26.9	27.4
27	21.0	21.3	21.6	22.1	22.5	23.0	23.4	23.7	24.2	24.6	25.1	25.6	26.1	26.7	27.2

29	21.7	22.0	22.3	22.8	23.2	23.6	24.0	24.4	24.9	25.3	25.8	26.3	26.8	27.4	27.9
30	21.6	21.8	22.2	22.6	23.1	23.5	23.9	24.3	24.7	25.2	25.7	26.2	26.7	27.2	27.7
31	22.5	22.7	23.1	23.5	24.0	24.4	24.8	25.2	25.6	26.0	26.5	27.0	27.5	28.1	28.6
32	22.4	22.7	23.0	23.5	23.9	24.3	24.7	25.1	25.5	26.0	26.4	26.9	27.5	28.0	28.5
33	22.5	22.8	23.1	23.6	24.0	24.4	24.8	25.2	25.6	26.0	26.5	27.0	27.5	28.1	28.8
34	22.6	23.0	23.4	23.8	24.3	24.7	25.1	25.4	25.9	26.3	26.7	27.2	27.7	28.3	28.8
35	23.2	23.5	23.9	24.3	24.7	25.1	25.5	25.9	26.3	26.7	27.2	27.6	28.1	28.6	29.1
36	22.9	23.1	23.5	23.9	24.4	24.8	25.1	25.5	25.9	26.3	26.8	27.3	27.7	28.2	28.8
37	22.7	23.0	23.3	23.7	24.2	24.6	25.0	25.4	25.8	26.2	26.7	27.2	27.7	28.2	28.7

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	28.7	29.3	30.0	30.7	31.4	32.1	32.8	33.5	34.1	34.8	35.4	36.0	36.6	37.2	37.7
2	26.8	27.5	28.2	28.9	29.6	30.3	31.0	31.6	32.3	32.9	33.5	34.1	34.7	35.3	35.9
3	27.2	27.8	28.5	29.2	30.0	30.6	31.3	32.0	32.6	33.3	33.9	34.5	35.1	35.6	36.2
4	27.3	28.0	28.7	29.4	30.2	30.9	31.[illegible]	32.2	32.9	33.5	34.1	34.7	35.3	35.8	36.3
5	27.4	28.1	28.8	29.5	30.2	30.9	31.6	32.3	33.0	33.6	34.2	34.7	35.3	35.8	36.3
6	27.3	28.0	28.7	29.4	30.1	30.8	31.5	32.2	32.9	33.6	34.1	34.6	35.1	35.6	36.1
7	27.1	27.7	28.4	29.2	29.9	30.6	31.2	32.0	32.8	33.8	34.0	34.3	34.8	35.3	35.8
8	27.8	28.4	29.2	29.9	30.6	31.2	31.9	32.6	33.3	34.0	34.5	34.9	35.4	35.9	36.4
9	27.4	28.2	28.9	29.7	30.3	30.9	31.5	32.2	32.8	33.4	34.0	34.5	35.0	35.5	36.0
10	27.1	27.8	28.7	29.8	30.1	30.6	31.1	31.7	32.3	32.9	33.5	34.0	34.6	35.1	35.6
11	27.8	28.5	29.2	30.0	30.6	31.1	31.7	32.3	32.9	33.5	34.1	34.6	35.2	35.7	36.2
12	27.5	28.1	28.7	29.4	30.1	30.7	31.3	31.9	32.5	33.1	33.6	34.2	34.7	35.3	35.8
13	28.0	28.6	29.3	30.0	30.6	31.2	31.8	32.5	33.0	33.6	34.2	34.8	35.3	35.9	36.4
14	27.5	28.2	28.8	29.5	30.2	30.8	31.4	32.0	32.6	33.2	33.8	34.4	34.9	35.5	36.0
15	27.1	27.7	28.4	29.1	29.8	30.4	31.0	31.6	32.2	32.8	33.4	34.0	34.6	35.1	35.7
16	27.7	28.4	29.0	29.7	30.4	31.0	31.6	32.2	32.8	33.4	34.0	34.6	35.2	35.7	36.3
17	27.4	28.0	28.7	29.3	30.0	30.6	31.3	31.9	32.5	33.1	33.7	34.2	34.8	35.4	35.9
18	27.0	27.7	28.3	29.0	29.6	30.3	30.9	31.5	32.1	32.7	33.3	33.9	34.4	35.0	35.5
19	27.7	28.3	29.0	29.6	30.3	30.9	31.5	32.2	32.8	33.3	33.9	34.5	35.1	35.6	[illegible]
20	27.4	28.0	28.7	29.3	30.0	30.6	31.2	31.8	32.4	33.0	33.6	34.1	34.7	35.3	35.8
21	27.1	27.8	28.4	29.0	29.7	30.3	30.9	31.5	32.1	32.7	33.2	33.8	34.4	34.9	35.4
22	27.9	28.5	29.1	29.8	30.4	31.0	31.6	32.2	32.8	33.3	33.9	34.5	35.0	35.6	36.1
23	27.6	28.3	28.9	29.5	30.1	30.7	31.3	31.9	32.4	33.0	33.6	34.1	34.7	35.2	35.7
24	27.4	28.0	28.6	29.2	29.8	30.4	31.0	31.6	32.1	32.7	33.3	33.8	34.4	34.9	35.4
25	28.2	28.8	29.4	30.0	30.6	31.1	31.7	32.3	32.8	33.4	34.0	34.5	35.1	35.6	36.1
26	28.0	28.6	29.2	29.7	30.3	30.9	31.4	32.0	32.5	33.1	33.7	34.2	34.7	35.3	35.7
27	27.8	28.4	28.9	29.5	30.1	30.6	31.2	31.7	32.3	32.8	33.4	33.9	34.4	34.9	35.4
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

29	28.4	29.0	29.5	30.0	30.6	31.1	31.7	32.2	32.7	33.3	33.8	34.3	34.8	35.3	35.8
30	28.3	28.8	29.3	29.8	30.4	30.9	31.4	31.9	32.5	33.0	33.5	34.0	34.5	35.0	35.4
31	29.1	29.6	30.1	30.6	31.1	31.6	32.2	32.7	33.2	33.7	34.3	34.8	35.2	35.7	36.1
32	29.0	29.5	30.0	30.5	31.0	31.5	32.0	32.5	33.1	33.6	34.1	34.5	35.0	35.4	35.8
33	29.1	29.6	30.0	30.5	31.0	31.5	32.0	32.5	33.1	33.6	34.0	34.5	34.9	35.3	35.7
34	29.3	29.8	30.2	30.7	31.3	31.8	32.3	32.8	33.3	33.7	34.2	34.6	35.0	35.4	35.8
35	29.6	30.2	30.7	31.2	31.8	32.3	32.8	33.2	33.7	34.1	34.5	34.9	35.3	35.7	36.1
36	29.3	29.8	30.4	31.0	31.7	32.4	32.6	33.0	33.3	33.7	34.1	34.5	34.8	35.2	35.5
37	29.2	29.7	30.2	30.8	31.3	31.8	32.2	32.7	33.1	33.5	33.8	34.2	34.6	34.9	35.3

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	31	32	33	34	35	36	37	38	39	40	41	42
1	38.3	38.8	39.3	39.8	40.3	40.7	41.2	41.6	42.1	42.6	42.9	43.2
2	36.4	36.9	37.5	38.0	38.4	38.8	39.3	39.7	40.2	40.6	41.0	41.2
3	36.7	37.3	37.8	38.3	38.7	39.1	39.5	40.0	40.4	40.8	41.2	41.5
4	36.9	37.4	37.9	38.4	38.8	39.2	39.6	40.0	40.5	40.9	41.3	41.5
5	36.8	37.4	37.8	38.3	38.7	39.1	39.5	39.9	40.4	40.8	41.2	41.4
6	36.7	37.2	37.6	38.1	38.5	38.9	39.3	39.7	40.1	40.5	40.9	41.1
7	36.3	36.8	37.3	37.7	38.2	38.5	38.9	39.3	39.7	40.2	40.5	40.7
8	36.9	37.4	37.9	38.3	38.7	39.1	39.5	39.9	40.3	40.7	41.1	41.3
9	36.5	37.0	37.5	37.9	38.3	38.7	39.1	39.5	39.9	40.3	40.7	40.9
10	36.1	36.6	37.1	37.5	37.9	38.3	38.7	39.1	39.5	39.9	40.2	40.5
11	36.7	37.2	37.7	38.1	38.5	38.9	39.3	39.7	40.1	40.5	40.8	41.0
12	36.3	36.8	37.3	37.7	38.1	38.5	38.9	39.2	39.7	40.0	40.4	40.6
13	37.0	37.4	37.9	38.3	38.7	39.1	39.4	39.8	40.2	40.6	41.0	41.2
14	36.6	37.1	37.5	37.9	38.3	38.7	39.0	39.4	39.8	40.2	40.6	40.8
15	36.2	36.7	37.1	37.5	37.9	38.3	38.6	39.0	39.4	39.8	40.1	40.4
16	36.8	37.3	37.7	38.1	38.5	38.9	39.2	39.6	40.0	40.4	40.7	40.9
17	36.4	36.9	37.3	37.8	38.1	38.5	38.8	39.2	39.6	40.0	40.3	40.5
18	36.0	36.5	37.0	37.4	37.7	38.1	38.4	38.8	39.2	39.6	39.9	40.1
19	36.7	37.1	37.6	38.0	38.4	38.7	39.0	39.4	39.8	40.2	40.5	40.7
20	36.3	36.8	37.2	37.6	38.0	38.3	38.7	39.0	39.4	39.8	40.1	40.3
21	35.9	36.4	36.8	37.2	37.6	37.9	38.3	38.6	39.0	39.4	39.7	39.9
22	36.6	37.0	37.5	37.8	38.2	38.5	38.9	39.2	39.6	40.0	40.3	40.5
23	36.2	36.7	37.1	37.5	37.8	38.2	38.5	38.8	39.2	39.6	39.9	40.1
24	35.9	36.3	36.7	37.1	37.5	37.8	38.1	38.5	38.8	39.2	39.5	39.7
25	36.5	37.0	37.4	37.7	38.1	38.4	38.7	39.1	39.4	39.8	40.1	40.3
26	36.2	36.6	37.0	37.4	37.7	38.0	38.3	38.7	39.0	39.4	39.7	39.9
27	35.6	36.3	36.7	37.0	37.3	37.7	38.0	38.3	38.7	39.0	39.3	39.5

29	36.2	36.6	36.9	37.3	37.6	37.9	38.2	38.5	38.9	39.2	39.5	39.7
30	35.8	36.2	36.6	36.9	37.3	37.5	37.8	38.2	38.5	38.8	39.1	39.3
31	36.5	36.9	37.2	37.6	37.9	38.2	38.5	38.8	39.1	39.4	39.7	39.9
32	36.2	36.6	37.0	37.3	37.6	37.9	38.2	38.5	38.8	39.1	39.4	39.5
33	36.1	36.5	36.8	37.1	37.4	37.7	38.0	38.3	38.6	38.9	39.2	39.3
34	36.2	36.5	36.8	37.1	37.4	37.7	38.0	38.3	38.6	38.9	39.1	39.3
35	36.4	36.7	37.0	37.3	37.6	37.9	38.1	38.4	38.7	39.0	39.3	39.5
36	35.9	36.2	36.5	36.8	37.0	37.3	37.6	37.8	38.1	38.4	38.7	38.8
37	35.6	35.9	36.2	36.5	36.7	37.0	37.2	37.5	37.8	38.1	38.3	38.5

CASE 1 - YEAR 2030

DRAWDOWN IN EVANGELINE AQUIFER

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	90.0	90.3	90.8	91.3	91.9	92.4	92.9	93.4	94.0	94.5	95.1	95.8	96.5	97.2	97.9
2	89.7	90.0	90.5	91.0	91.6	92.2	92.7	93.2	93.7	94.3	94.9	95.5	96.2	96.9	97.7
3	90.1	90.4	90.9	91.4	92.0	92.6	93.1	93.6	94.1	94.7	95.3	96.0	96.7	97.4	98.2
4	90.2	90.5	91.0	91.6	92.2	92.7	93.2	93.8	94.3	94.9	95.5	96.2	96.9	97.7	98.5
5	90.1	90.5	91.0	91.5	92.1	92.7	93.2	93.7	94.3	94.9	95.5	96.2	96.9	97.7	98.5
6	89.9	90.2	90.7	91.3	91.9	92.5	93.0	93.5	94.1	94.7	95.3	96.0	96.7	97.5	98.3
7	89.5	89.9	90.4	90.9	91.5	92.1	92.6	93.2	93.7	94.3	95.0	95.7	96.4	97.1	98.0
8	90.1	90.4	90.9	91.5	92.1	92.7	93.2	93.7	94.3	94.9	95.6	96.2	97.0	97.7	98.6
9	89.6	90.0	90.5	91.1	91.7	92.2	92.8	93.3	93.9	94.5	95.1	95.8	96.6	97.3	98.1
10	90.2	90.5	91.0	91.6	92.2	92.8	93.4	93.9	94.5	95.1	95.7	96.4	97.2	97.9	98.7
11	89.7	90.1	90.6	91.2	91.8	92.4	92.9	93.4	94.0	94.6	95.3	96.0	96.7	97.5	98.3
12	90.3	90.6	91.1	91.7	92.3	92.9	93.5	94.0	94.6	95.2	95.9	96.6	97.3	98.1	98.9
13	89.5	90.1	90.7	91.3	91.9	92.5	93.0	93.6	94.1	94.8	95.4	96.2	96.9	97.7	98.5
14	89.3	89.7	90.2	90.8	91.4	92.0	92.5	93.1	93.7	94.3	95.0	95.7	96.5	97.3	98.1
15	89.8	90.2	90.7	91.3	91.9	92.5	93.1	93.6	94.2	94.9	95.6	96.3	97.1	97.9	98.7
16	89.4	89.7	90.2	90.8	91.4	92.0	92.6	93.1	93.7	94.4	95.1	95.9	96.7	97.5	98.4
17	89.9	90.2	90.7	91.3	91.9	92.5	93.1	93.6	94.2	94.9	95.6	96.4	97.2	98.1	99.0
18	89.3	89.7	90.2	90.8	91.4	92.0	92.5	93.1	93.7	94.4	95.1	95.9	96.8	97.8	98.7
19	89.8	90.2	90.7	91.2	91.8	92.4	93.0	93.6	94.2	94.9	95.6	96.4	97.4	98.4	99.5
20	89.3	89.6	90.1	90.7	91.3	91.9	92.4	93.0	93.6	94.3	95.1	95.9	96.8	97.9	99.2
21	89.8	90.1	90.6	91.1	91.7	92.3	92.9	93.4	94.0	94.7	95.4	96.3	97.2	98.3	99.7
22	89.3	89.6	90.0	90.6	91.2	91.7	92.3	92.8	93.4	94.0	94.8	95.6	96.5	97.5	98.7
23	88.7	89.0	89.5	90.0	90.6	91.1	91.6	92.2	92.7	93.4	94.0	94.8	95.6	96.6	97.6
24	89.2	89.5	89.9	90.4	91.0	91.5	92.0	92.5	93.0	93.6	94.3	95.0	95.7	96.6	97.4
25	88.6	88.9	89.3	89.8	90.4	90.9	91.4	91.8	92.3	92.9	93.5	94.1	94.8	95.6	96.3
26	89.1	89.3	89.8	90.3	90.8	91.2	91.7	92.1	92.6	93.2	93.7	94.3	94.9	95.6	96.2
27	88.5	88.8	89.2	89.7	90.1	90.6	91.0	91.5	91.9	92.4	92.9	93.5	94.0	94.6	95.2
28	[illegible]	89.2	89.6	90.1	90.5	91.0	91.4	91.8	92.2	92.6	93.1	93.6	94.1	94.7	95.2

29	88.4	88.7	89.0	89.5	89.9	90.3	90.7	91.1	91.5	91.9	92.3	92.8	93.3	93.8	94.2
30	88.9	89.1	89.5	89.9	90.3	90.7	91.0	91.4	91.8	92.2	92.6	93.0	93.4	93.9	94.3
31	88.3	88.5	88.9	89.3	89.7	90.1	90.4	90.7	91.1	91.5	91.8	92.2	92.6	93.1	93.5
32	88.8	89.0	89.4	89.7	90.1	90.5	90.8	91.1	91.4	91.8	92.1	92.5	92.9	93.3	93.6
33	88.4	88.6	88.9	89.3	89.6	90.0	90.3	90.6	90.9	91.2	91.5	91.9	92.2	92.6	92.9
34	88.2	88.4	88.6	89.0	89.3	89.6	89.9	90.2	90.5	90.8	91.1	91.4	91.7	92.0	92.3
35	88.1	88.2	88.5	88.8	89.1	89.4	89.7	89.9	90.2	90.5	90.8	91.0	91.3	91.6	91.9
36	88.2	88.4	88.6	88.9	89.2	89.5	89.7	89.9	90.2	90.4	90.7	91.0	91.2	91.5	91.8
37	87.1	87.3	87.5	87.8	88.1	88.3	88.6	88.8	89.0	89.3	89.5	89.8	90.0	90.3	90.6

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	98.7	99.4	100.3	101.1	101.9	102.8	103.6	104.4	105.2	105.9	106.5	107.1	107.5	107.8	108.0
2	98.5	99.3	100.2	101.0	101.9	102.9	103.8	104.7	105.7	106.5	107.4	108.1	108.6	108.9	108.9
3	99.0	99.9	100.8	101.7	102.7	103.7	104.8	105.9	107.1	108.4	109.6	110.8	111.7	111.7	111.4
4	99.3	100.2	101.1	102.1	103.1	104.2	105.4	106.7	108.1	109.7	111.7	114.2	118.0	115.4	113.9
5	99.3	100.2	101.2	102.2	103.2	104.4	105.6	106.9	108.4	110.0	111.7	113.4	114.9	115.1	114.7
6	99.1	100.0	101.0	102.0	103.1	104.2	105.5	106.8	108.2	109.8	111.5	113.2	114.8	115.8	115.9
7	98.6	99.7	100.7	101.7	102.7	103.9	105.1	106.4	107.8	109.4	111.1	113.1	115.2	117.4	117.4
8	99.4	100.3	101.2	102.2	103.3	104.4	105.6	106.9	108.3	109.8	111.6	113.7	116.6	122.0	119.9
9	99.0	99.9	100.8	101.8	102.8	103.9	105.1	106.3	107.6	109.1	110.7	112.5	114.6	116.8	117.0
10	99.6	100.5	101.4	102.3	103.3	104.4	105.5	106.6	107.9	109.2	110.6	112.1	113.6	114.8	115.2
11	99.2	100.0	100.9	101.9	102.8	103.8	104.9	106.0	107.1	108.3	109.5	110.7	111.8	112.6	113.0
12	99.7	100.6	101.5	102.4	103.3	104.3	105.2	106.3	107.3	108.4	109.4	110.4	111.3	112.0	112.3
13	99.3	100.2	101.1	101.9	102.8	103.7	104.6	105.6	106.5	107.5	108.4	109.3	110.1	110.7	111.0
14	98.9	99.8	100.6	101.5	102.3	103.2	104.0	104.9	105.8	106.6	107.5	108.3	109.1	109.7	110.1
15	99.6	100.4	101.3	102.1	102.9	103.7	104.5	105.3	106.0	106.8	107.7	108.5	109.2	110.0	110.5
16	99.2	100.1	100.9	101.7	102.5	103.2	104.0	104.6	105.4	106.1	106.9	107.7	108.5	109.4	110.3
17	100.0	100.9	101.7	102.5	103.2	103.9	104.5	105.1	105.7	106.3	107.0	107.9	108.8	110.0	111.4
18	99.8	100.7	101.5	102.3	103.0	103.6	104.1	104.5	105.0	105.5	106.1	106.9	107.9	109.3	111.7
19	100.6	101.7	102.5	103.1	103.8	104.5	104.7	104.9	105.2	105.6	106.2	106.8	107.7	108.8	110.2
20	100.6	102.1	102.5	103.0	103.8	104.7	104.5	104.4	104.4	104.7	105.1	105.6	106.2	107.0	107.7
21	101.5	104.8	103.4	103.6	104.7	107.2	105.2	104.6	104.5	104.6	104.9	105.2	105.7	106.2	106.6
22	100.1	101.6	101.9	102.3	103.0	103.9	103.6	103.3	103.3	103.4	103.6	103.9	104.2	104.5	104.8
23	98.6	99.6	100.2	100.8	101.3	101.8	101.9	101.9	102.0	102.1	102.3	102.5	102.7	103.0	103.1
24	98.3	99.1	99.7	100.2	100.7	101.1	101.3	101.5	101.6	101.8	101.9	102.1	102.3	102.5	102.6
25	97.0	97.7	98.3	98.8	99.3	99.6	99.9	100.1	100.3	100.5	100.6	100.8	101.0	101.1	101.2
26	96.8	97.4	98.0	98.5	98.9	99.2	99.5	99.8	100.0	100.2	100.4	100.5	100.7	100.8	100.9
27	95.7	96.3	96.8	97.2	97.6	98.0	98.3	98.5	98.8	99.0	99.1	99.3	99.5	99.6	99.6
28	[illegible]	96.2	[illegible]	97.1	97.4	97.8	98.1	[illegible]	98.6	98.8	99.0	99.1	[illegible]	99.4	99.5

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 5 IN STRESS PERIOD 6

	31	32	33	34	35	36	37	38	39	40	41	42
1	108.0	108.0	107.9	107.7	107.5	107.3	107.0	106.6	106.2	105.8	105.4	105.1
2	108.9	108.7	108.4	108.1	107.8	107.4	107.1	106.6	106.1	105.6	105.1	104.8
3	111.0	110.5	110.0	109.5	109.0	108.4	107.9	107.3	106.7	106.1	105.5	105.2
4	112.9	112.1	111.3	110.6	109.8	109.2	108.5	107.8	107.0	106.3	105.7	105.3
5	114.1	113.2	112.2	111.3	110.4	109.5	108.7	107.9	107.0	106.2	105.6	105.1
6	115.4	114.3	112.9	111.7	110.6	109.6	108.7	107.7	106.8	106.0	105.3	104.8
7	117.3	115.2	113.3	111.7	110.4	109.3	108.4	107.4	106.4	105.5	104.8	104.3
8	122.1	116.9	114.1	112.3	111.0	109.9	108.9	107.9	106.9	106.0	105.3	104.8
9	117.0	115.0	113.1	111.6	110.4	109.3	108.3	107.3	106.4	105.5	104.7	104.2
10	115.0	114.0	112.8	111.6	110.6	109.6	108.7	107.7	106.8	105.9	105.1	104.6
11	112.9	112.3	111.5	110.6	109.7	108.8	108.0	107.0	106.1	105.2	104.5	104.0
12	112.3	111.9	111.3	110.6	109.8	109.0	108.2	107.3	106.4	105.5	104.8	104.4
13	111.1	110.8	110.3	109.6	108.9	108.2	107.4	106.6	105.7	104.8	104.1	103.7
14	110.2	109.9	109.4	108.8	108.1	107.4	106.6	105.8	104.9	104.1	103.4	103.0
15	110.7	110.4	109.8	109.0	108.3	107.5	106.8	106.0	105.1	104.3	103.7	103.2
16	110.7	110.2	109.3	108.4	107.5	106.7	105.9	105.1	104.3	103.5	102.9	102.5
17	112.8	111.4	109.9	108.7	107.7	106.8	106.0	105.2	104.5	103.7	103.1	102.7
18	116.8	111.6	109.2	107.8	106.7	105.9	105.1	104.3	103.6	102.9	102.3	101.9
19	111.5	110.1	108.6	107.5	106.6	105.8	105.1	104.4	103.7	103.0	102.5	102.1
20	108.2	107.7	106.8	106.0	105.3	104.6	104.0	103.3	102.7	102.1	101.6	101.3
21	106.8	106.5	106.1	105.5	104.9	104.4	103.9	103.3	102.7	102.2	101.7	101.4
22	104.8	104.7	104.4	104.0	103.6	103.2	102.7	102.3	101.8	101.3	100.9	100.6
23	103.2	103.1	102.9	102.6	102.3	102.0	101.6	101.2	100.8	100.4	100.0	99.7
24	102.6	102.6	102.4	102.3	102.0	101.8	101.5	101.2	100.8	100.4	100.1	99.9
25	101.2	101.2	101.1	101.0	100.8	100.6	100.4	100.1	99.8	99.5	99.2	99.0
26	100.9	100.9	100.9	100.8	100.6	100.5	100.3	100.1	99.9	99.6	99.4	99.2
27	99.7	99.7	99.7	99.6	99.5	99.4	99.3	99.1	98.9	98.7	98.5	98.4

SUBSIDENCE IN TENTHS OF FEET -- CASE 1
STRESS PERIOD 1

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CASE 1 - YEAR 2030

SUBSIDENCE

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AAAAAAAAAA   5555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555   AAAAAAAAAA
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LATEST VERSION

12/20/88

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HHHHH  0 0 0    1    EEEE   N N N  BBBB
H   H  00  0    1    E      N  NN  B   B
H   H  0   0    1    E      N   N  B   B
H   H   000    111   EEEEE  N   N  BBBB

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      DD      DD  AA      AA       TT                       11
      DD      DD  AA      AA       TT                       11
      DD      DD  AA      AA       TT           ;;;;        11
      DD      DD  AA      AA       TT           ;;;;        11
      DD      DD  AAAAAAAAAA       TT           ;;;;        11
      DD      DD  AAAAAAAAAA       TT           ;;;;        11
....  DD      DD  AA      AA       TT             ;;        11
....  DD      DD  AA      AA       TT             ;;        11
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....  DDDDDDDD    AA      AA       TT           ;;        111111
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File _DUA1:[H01ENB.TEST]SUB1.DAT;1 (1636,173,0), last revised on 15-DEC-1988 15:05, is a 57 block sequential file owned by UIC [H01ENB]. The records are variable length with FORTRAN (FTN) carriage control. The longest record is 126 bytes.

Job SUB1 (1800) queued to SYS$PRINT on 16-DEC-1988 11:09 by user H01ENB, UIC [H01ENB], under account 245401 at priority 100, started on printer LTA9107 on 16-DEC-1988 11:09 from queue LTA9107.


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AAAAAAAAAA   5555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555   AAAAAAAAAA
AAAAAAAAAA   555555555555555555555555  Digital Equipment Corporation - VAX/VMS Version V4.7  555555555555555555555555   AAAAAAAAAA
AAAAAAAAAA   5555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555555   AAAAAAAAAA
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SUBSIDENCE IN TENTHS OF FEET -- CASE 1
STRESS PERIOD 2

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15	15	15	15	15	16	16	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19	19	19	19
15	15	15	15	15	16	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	19	19	19	19	19	19

30	114.4	114.8	115.1	115.4	115.6	115.8	116.0	116.1	116.2	116.3	116.4	116.4	116.4	116.4	116.4
31	113.3	113.6	113.9	114.2	114.4	114.6	114.8	115.0	115.1	115.2	115.2	115.3	115.3	115.3	115.3
32	113.2	113.6	113.9	114.1	114.3	114.5	114.7	114.9	115.0	115.1	115.2	115.2	115.3	115.3	115.3
33	112.3	112.6	112.9	113.1	113.3	113.5	113.7	113.9	114.0	114.1	114.2	114.3	114.3	114.3	114.4
34	111.5	111.7	112.0	112.2	112.4	112.6	112.8	113.0	113.1	113.2	113.3	113.4	113.5	113.5	113.6
35	110.8	111.1	111.3	111.6	111.8	112.0	112.1	112.3	112.4	112.6	112.7	112.8	112.8	112.9	112.9
36	110.5	110.8	111.0	111.2	111.4	111.6	111.8	111.9	112.1	112.2	112.3	112.4	112.5	112.6	112.6
37	109.2	109.4	109.6	109.8	110.0	110.2	110.4	110.5	110.7	110.8	110.9	111.0	111.1	111.2	111.3

CASE 2 - YEAR 2030

DRAWDOWN IN CHICOT AQUIFER

30	116.3	116.3	116.2	116.1	116.0	115.9	115.8	115.6	115.5	115.3	115.1	115.0
31	115.3	115.2	115.2	115.1	115.0	115.0	114.9	114.7	114.6	114.5	114.3	114.2
32	115.3	115.3	115.2	115.2	115.1	115.1	115.0	114.9	114.8	114.7	114.5	114.5
33	114.4	114.4	114.3	114.3	114.3	114.2	114.2	114.1	114.0	113.9	113.9	113.8
34	113.6	113.6	113.6	113.6	113.6	113.5	113.5	113.5	113.4	113.3	113.3	113.2
35	113.0	113.0	113.0	113.0	113.0	113.0	113.0	113.0	113.0	112.9	112.9	112.8
36	112.7	112.7	112.7	112.8	112.8	112.8	112.8	112.8	112.8	112.8	112.7	112.7
37	111.3	111.4	111.4	111.5	111.5	111.5	111.5	111.5	111.5	111.5	111.5	111.5

DRAWDOWN WILL BE SAVED ON UNIT 27 AT END OF TIME STEP 10, STRESS PERIOD 6

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 10 IN STRESS PERIOD 6

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	0.15759E+11	STORAGE =	0.36145E+09
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
WELLS =	0.00000E+00	WELLS =	0.00000E+00
RECHARGE =	0.78556E+10	RECHARGE =	0.19639E+09
TOTAL IN =	0.23615E+11	TOTAL IN =	0.55784E+09
OUT:		OUT:	
STORAGE =	0.34467E+09	STORAGE =	0.00000E+00
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
WELLS =	0.15421E+11	WELLS =	0.36203E+09
RECHARGE =	0.78556E+10	RECHARGE =	0.19639E+09
TOTAL OUT =	0.23621E+11	TOTAL OUT =	0.55842E+09
IN - OUT =	-0.63816E+07	IN - OUT =	-0.57914E+06
PERCENT DISCREPANCY =	-0.03	PERCENT DISCREPANCY =	-0.10

TIME SUMMARY AT END OF TIME STEP 10 IN STRESS PERIOD 6

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.233448E+08	389080.	6484.67	270.194	0.739752
STRESS PERIOD TIME	0.157780E+09	0.262980E+07	43830.0	1826.25	5.00000
TOTAL SIMULATION TIME	0.126230E+10	0.210384E+08	350640.	14610.0	40.0000

CASE 2

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	24.1	24.4	24.9	25.4	25.9	26.3	26.8	27.2	27.7	28.2	28.8	29.4	30.0	30.6	31.3
2	22.2	22.5	23.0	23.5	24.0	24.5	24.9	25.4	25.9	26.4	26.9	27.5	28.1	28.8	29.5
3	22.6	22.8	23.3	23.8	24.3	24.8	25.2	25.7	26.2	26.7	27.3	27.9	28.5	29.2	29.8
4	22.7	23.0	23.4	23.9	24.4	24.9	25.4	25.9	26.4	26.9	27.5	28.1	28.7	29.4	30.1
5	22.7	22.9	23.4	23.9	24.4	24.9	25.4	25.9	26.4	26.9	27.5	28.1	28.7	29.4	30.1
6	22.5	22.8	23.2	23.7	24.3	24.8	25.2	25.7	26.2	26.8	27.4	28.0	28.7	29.3	30.1
7	22.2	22.5	22.9	23.4	24.0	24.5	25.0	25.4	25.9	26.5	27.1	27.7	28.4	29.2	29.9
8	22.8	23.1	23.6	24.1	24.6	25.1	25.6	26.1	26.6	27.2	27.8	28.4	29.2	30.0	30.6
9	22.5	22.8	23.2	23.8	24.3	24.8	25.3	25.8	26.3	26.8	27.4	28.1	28.8	29.6	30.3
10	22.2	22.5	22.9	23.4	24.0	24.5	25.0	25.4	25.9	26.5	27.1	27.8	28.4	29.2	29.9
11	22.9	23.2	23.6	24.1	24.6	25.2	25.6	26.1	26.6	27.2	27.8	28.4	29.1	29.8	30.6
12	22.6	22.8	23.3	23.8	24.3	24.8	25.3	25.8	26.3	26.9	27.5	28.1	28.8	29.5	30.3
13	23.3	23.6	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5	28.1	28.8	29.4	30.1	30.9
14	23.0	23.3	23.7	24.2	24.7	25.3	25.7	26.2	26.7	27.2	27.8	28.4	29.1	29.8	30.5
15	22.7	23.0	23.4	23.9	24.5	25.0	25.4	25.9	26.4	26.9	27.5	28.1	28.8	29.4	30.1
16	23.4	23.7	24.2	24.7	25.2	25.7	26.2	26.6	27.1	27.7	28.2	28.8	29.4	30.1	30.8
17	23.2	23.5	23.9	24.4	24.9	25.4	25.9	26.4	26.9	27.4	27.9	28.5	29.2	29.8	30.5
18	23.0	23.2	23.7	24.2	24.7	25.2	25.7	26.1	26.6	27.1	27.7	28.3	28.9	29.5	30.2
19	23.7	24.0	24.4	25.0	25.5	26.0	26.4	26.9	27.4	27.9	28.4	29.0	29.6	30.2	30.9
20	23.5	23.8	24.2	24.7	25.2	25.7	26.2	26.6	27.1	27.6	28.2	28.8	29.4	30.0	30.7
21	23.3	23.6	24.0	24.5	25.0	25.5	26.0	26.4	26.9	27.4	28.0	28.5	29.1	29.8	30.4
22	24.1	24.4	24.8	25.3	25.8	26.3	26.8	27.2	27.7	28.2	28.7	29.3	29.9	30.5	31.2
23	23.9	24.2	24.7	25.1	25.7	26.1	26.6	27.0	27.5	28.0	28.6	29.1	29.7	30.3	31.0
24	23.8	24.1	24.5	25.0	25.5	26.0	26.4	26.9	27.3	27.8	28.4	28.9	29.5	30.2	30.8
25	24.6	24.9	25.3	25.8	26.3	26.8	27.3	27.7	28.2	28.7	29.2	29.8	30.4	31.0	31.7
26	24.5	24.8	25.2	25.7	26.2	26.7	27.1	27.6	28.0	28.5	29.1	29.6	30.2	30.9	31.5
27	24.4	24.6	25.1	25.6	26.1	26.5	27.0	27.4	27.9	28.4	29.0	29.5	30.1	30.8	31.4
28	25.2	25.5	26.0	26.4	26.9	27.4	27.9	28.3	28.8	29.3	29.8	30.4	31.0	31.6	32.3
29	25.2	25.4	25.9	26.3	26.8	27.3	27.8	28.2	28.7	29.2	29.7	30.3	30.9	31.5	32.1

SUBSIDENCE IN TENTHS OF FEET -- CASE 2
STRESS PERIOD 3

15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	19	19	19	19	19	19	19	20	20	20	20	20	20	20	20	20	20	20	20	20	20
15	15	15	15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	18	18	18	18	18	19	19	19	19	19	19	19	19	19	20	20	20	20	20	20	20	20	20	20
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15	15	16	16	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20
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15	15	16	16	16	16	17	17	17	17	18	18	18	19	19	19	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20
15	15	15	16	16	16	16	17	17	17	17	18	18	19	19	19	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20	20
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15	15	15	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17	17	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	19	19	19	19

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	32.0	32.8	33.6	34.4	35.2	35.9	36.7	37.5	38.2	38.9	39.6	40.3	41.0	41.7	42.3
2	30.2	30.9	31.7	32.5	33.3	34.1	34.9	35.6	36.4	37.1	37.8	38.5	39.2	39.8	40.5
3	30.6	31.3	32.1	32.9	33.7	34.5	35.3	36.0	36.8	37.5	38.2	38.9	39.5	40.2	40.8
4	30.8	31.5	32.3	33.1	34.0	34.7	35.5	36.3	37.0	37.7	38.4	39.1	39.8	40.4	41.0
5	30.9	31.6	32.4	33.2	34.0	34.8	35.6	36.4	37.1	37.9	38.5	39.2	39.8	40.4	41.0
6	30.8	31.5	32.3	33.2	34.0	34.7	35.5	36.3	37.1	37.9	38.5	39.1	39.7	40.3	40.9
7	30.6	31.3	32.1	33.0	33.8	34.5	35.3	36.1	37.0	38.1	38.4	38.8	39.4	40.0	40.6
8	31.3	32.1	32.9	33.7	34.5	35.2	36.0	36.7	37.5	38.3	38.9	39.4	40.0	40.6	41.2
9	31.0	31.8	32.7	33.6	34.3	34.9	35.6	36.4	37.1	37.8	38.4	39.0	39.6	40.2	40.9
10	30.7	31.5	32.5	33.7	34.0	34.6	35.3	36.0	36.7	37.3	38.0	38.6	39.2	39.9	40.5
11	31.4	32.2	33.0	33.9	34.6	35.2	35.9	36.6	37.2	37.9	38.6	39.2	39.8	40.5	41.1
12	31.2	31.8	32.6	33.4	34.1	34.8	35.5	36.2	36.8	37.5	38.2	38.8	39.5	40.1	40.7
13	31.7	32.4	33.1	33.9	34.7	35.4	36.1	36.8	37.4	38.1	38.8	39.4	40.1	40.7	41.4
14	31.2	32.0	32.7	33.5	34.3	35.0	35.7	36.4	37.1	37.7	38.4	39.1	39.7	40.4	41.0
15	30.9	31.6	32.3	33.1	33.9	34.6	35.3	36.0	36.7	37.4	38.0	38.7	39.4	40.0	40.6
16	31.5	32.2	33.0	33.8	34.5	35.2	36.0	36.7	37.3	38.0	38.7	39.3	40.0	40.6	41.3
17	31.2	31.9	32.7	33.4	34.2	34.9	35.6	36.3	37.0	37.7	38.3	39.0	39.7	40.3	40.9
18	30.9	31.6	32.3	33.1	33.8	34.6	35.3	36.0	36.7	37.3	38.0	38.7	39.3	40.0	40.6
19	31.6	32.3	33.0	33.8	34.5	35.3	36.0	36.6	37.3	38.0	38.7	39.3	40.0	40.6	41.3
20	31.3	32.0	32.8	33.5	34.2	35.0	35.7	36.3	37.0	37.7	38.3	39.0	39.7	40.3	40.9
21	31.1	31.8	32.5	33.3	34.0	34.7	35.4	36.0	36.7	37.4	38.0	38.7	39.3	40.0	40.6
22	31.9	32.6	33.3	34.0	34.7	35.4	36.1	36.8	37.4	38.1	38.7	39.4	40.0	40.7	41.3
23	31.7	32.4	33.1	33.8	34.5	35.1	35.8	36.5	37.1	37.8	38.4	39.1	39.7	40.4	41.0
24	31.5	32.2	32.9	33.6	34.2	34.9	35.6	36.2	36.9	37.5	38.2	38.8	39.4	40.1	40.6
25	32.3	33.0	33.7	34.3	35.0	35.7	36.3	37.0	37.6	38.2	38.9	39.5	40.2	40.8	41.3
26	32.2	32.9	33.5	34.1	34.8	35.4	36.1	36.7	37.3	38.0	38.6	39.2	39.9	40.5	41.0
27	32.0	32.7	33.3	33.9	34.6	35.2	35.8	36.5	37.1	37.7	38.3	39.0	39.6	40.2	40.7
28	32.9	33.5	34.1	34.7	35.4	36.0	36.6	37.2	37.9	38.5	39.1	39.7	40.3	40.9	41.4
29	32.7	33.3	33.9	34.5	35.2	35.8	36.4	37.0	37.6	38.2	38.9	39.5	40.1	40.6	41.1

SUBSIDENCE IN TENTHS OF FEET -- CASE 2
STRESS PERIOD 5

17	17	17	18	18	18	18	18	18	19	19	19	19	19	19	20	20	20	20	21	21	21	21	21	22	22	22	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23
17	17	17	17	17	18	18	18	18	18	18	19	19	19	19	19	20	20	20	20	20	21	21	21	21	21	22	22	22	22	22	22	22	22	22	23	23	23	23	23	23	23
17	17	17	17	18	18	18	18	18	18	19	19	19	19	19	20	20	20	20	21	21	21	21	21	22	22	22	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23
17	17	17	17	18	18	18	18	18	18	19	19	19	19	20	20	20	20	20	21	21	21	21	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	17	17	18	18	18	18	18	19	19	19	19	19	20	20	20	20	21	21	21	21	22	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	17	17	18	18	18	18	18	19	19	19	19	19	20	20	20	20	21	21	21	21	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
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17	17	17	18	18	18	18	18	19	19	19	19	20	20	20	20	21	21	21	21	22	22	22	22	23	23	23	23	24	23	24	23	23	23	23	23	23	23	23	23	23	23
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17	17	17	18	18	18	18	18	19	19	19	19	20	20	20	20	21	21	21	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	17	18	18	18	18	19	19	19	19	19	20	20	20	21	21	21	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	17	18	18	18	18	19	19	19	19	20	20	20	20	21	21	21	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	18	18	18	18	18	19	19	19	19	20	20	20	21	21	21	22	22	22	22	23	23	23	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23
17	17	18	18	18	18	18	19	19	19	19	20	20	20	21	21	21	22	22	22	23	23	23	23	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23	23
17	17	18	18	18	18	18	19	19	19	19	20	20	20	21	21	21	22	22	22	23	23	23	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23
17	17	18	18	18	18	19	19	19	19	20	20	20	21	21	21	22	22	23	23	23	23	23	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23
17	17	18	18	18	18	19	19	19	19	20	20	20	21	21	22	22	22	23	23	23	23	23	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23
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17	18	18	18	18	19	19	19	19	20	20	20	21	21	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
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17	17	18	18	18	18	19	19	19	19	20	20	21	21	22	23	23	23	23	24	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
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17	17	18	18	18	18	19	19	19	19	19	20	20	20	20	21	21	21	21	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
18	18	18	18	18	18	19	19	19	19	19	20	20	20	20	21	21	21	21	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
18	18	18	18	18	18	19	19	19	19	19	20	20	20	20	20	21	21	21	21	21	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
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18	18	18	18	18	18	18	18	19	19	19	19	19	19	19	20	20	20	20	20	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	22	22	22

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	31	32	33	34	35	36	37	38	39	40	41	42
1	43.0	43.6	44.7	44.8	45.4	45.9	46.4	47.0	47.5	48.1	48.5	48.8
2	41.1	41.8	42.4	43.0	43.5	44.0	44.5	45.0	45.6	46.1	46.6	46.9
3	41.5	42.1	42.7	43.3	43.8	44.3	44.8	45.3	45.9	46.4	46.8	47.1
4	41.7	42.3	42.9	43.4	44.0	44.4	44.9	45.4	45.9	46.4	46.9	47.2
5	41.7	42.3	42.9	43.4	43.9	44.4	44.8	45.3	45.8	46.3	46.8	47.1
6	41.5	42.1	42.7	43.2	43.7	44.2	44.6	45.1	45.6	46.1	46.5	46.8
7	41.2	41.8	42.4	42.9	43.4	43.8	44.3	44.8	45.3	45.8	46.2	46.4
8	41.8	42.4	43.0	43.5	44.0	44.4	44.9	45.4	45.9	46.3	46.8	47.0
9	41.5	42.1	42.6	43.1	43.6	44.0	44.5	45.0	45.4	45.9	46.3	46.6
10	41.1	41.7	42.2	42.7	43.2	43.6	44.1	44.6	45.0	45.5	45.9	46.2
11	41.7	42.3	42.8	43.4	43.8	44.3	44.7	45.2	45.6	46.1	46.5	46.8
12	41.3	41.9	42.5	43.0	43.4	43.9	44.3	44.8	45.2	45.7	46.1	46.4
13	42.0	42.6	43.1	43.6	44.1	44.5	44.9	45.4	45.8	46.3	46.7	47.0
14	41.6	42.2	42.7	43.2	43.7	44.1	44.5	45.0	45.5	45.9	46.3	46.6
15	41.3	41.8	42.4	42.8	43.3	43.7	44.1	44.6	45.1	45.5	45.9	46.2
16	41.9	42.5	43.0	43.5	43.9	44.3	44.8	45.2	45.7	46.1	46.5	46.8
17	41.5	42.1	42.6	43.1	43.6	44.0	44.4	44.8	45.3	45.7	46.1	46.4
18	41.2	41.7	42.3	42.7	43.2	43.6	44.0	44.4	44.9	45.3	45.7	46.0
19	41.9	42.4	42.9	43.4	43.8	44.2	44.6	45.1	45.5	45.9	46.3	46.6
20	41.5	42.0	42.6	43.0	43.5	43.9	44.3	44.7	45.1	45.6	45.9	46.2
21	41.2	41.7	42.2	42.7	43.1	43.5	43.9	44.3	44.7	45.2	45.5	45.8
22	41.8	42.4	42.9	43.3	43.7	44.1	44.5	44.9	45.4	45.8	46.1	46.4
23	41.5	42.0	42.5	43.0	43.4	43.8	44.1	44.6	45.0	45.4	45.8	46.0
24	41.2	41.7	42.2	42.6	43.0	43.4	43.8	44.2	44.6	45.0	45.4	45.6
25	41.9	42.4	42.8	43.3	43.7	44.0	44.4	44.8	45.2	45.6	46.0	46.2
26	41.6	42.0	42.5	42.9	43.3	43.7	44.1	44.5	44.9	45.3	45.6	45.8
27	41.2	41.7	42.2	42.6	43.0	43.3	43.7	44.1	44.5	44.9	45.2	45.4
28	41.9	42.4	42.8	43.2	43.6	44.0	44.3	44.7	45.1	45.5	45.8	46.0
29	41.6	42.1	42.5	42.9	43.3	43.6	44.0	44.4	44.7	45.1	45.4	45.7

30	67.1	68.0	69.4	71.1	72.8	74.4	76.0	77.6	79.3	81.1	83.1	85.2	87.3	89.5	91.8
31	68.9	69.8	71.2	72.9	74.6	76.3	77.8	79.4	81.1	82.9	84.8	86.8	88.9	91.1	93.3
32	69.8	70.7	72.1	73.8	75.5	77.1	78.7	80.2	81.9	83.6	85.5	87.5	89.6	91.7	94.0
33	70.9	71.8	73.3	74.9	76.6	78.2	79.8	81.3	82.9	84.6	86.5	88.4	90.5	92.7	95.0
34	72.2	73.1	74.6	76.2	77.9	79.5	81.1	82.6	84.2	85.9	87.7	89.6	91.6	93.7	95.9
35	73.7	74.6	76.0	77.7	79.4	81.0	82.5	84.0	85.6	87.3	89.1	91.1	93.0	95.1	97.3
36	74.2	75.1	76.5	78.2	79.9	81.5	83.1	84.6	86.2	88.0	89.8	91.8	93.8	95.8	98.0
37	74.6	75.5	76.9	78.6	80.3	82.0	83.6	85.1	86.8	88.7	90.7	92.8	94.8	97.0	99.1

CASE 2 - YEAR 2030

DRAWDOWN IN EVANGELINE AQUIFER

30	94.1	96.5	99.0	101.6	104.6	106.4	108.5	110.9	113.3	115.8	118.4	121.0	123.1	125.2	127.2
31	95.6	97.9	100.4	102.8	105.4	107.6	109.9	112.2	114.7	117.1	119.7	122.1	124.3	126.4	128.3
32	96.2	98.5	100.8	103.2	105.6	108.0	110.3	112.7	115.2	117.7	120.1	122.4	124.5	126.6	128.5
33	97.1	99.3	101.6	103.9	106.3	108.7	111.1	113.5	116.0	118.4	120.7	122.9	125.0	127.0	128.9
34	98.1	100.3	102.6	105.0	107.4	109.9	112.3	114.8	117.1	119.4	121.6	123.7	125.7	127.7	129.5
35	99.5	101.7	104.1	106.5	109.0	111.6	114.2	116.3	118.5	120.6	122.7	124.7	126.6	128.5	130.3
36	100.2	102.5	105.0	107.4	109.7	112.1	114.4	116.6	118.7	120.8	122.8	124.8	126.7	128.5	130.2
37	101.3	103.5	105.8	108.0	110.3	112.5	114.7	116.9	119.0	121.0	123.0	124.9	126.8	128.5	130.3

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	108.8	109.2	109.7	110.4	111.0	111.6	112.1	112.7	113.2	113.8	114.5	115.2	115.9	116.6	117.3
2	108.6	108.9	109.5	110.1	110.8	111.4	111.9	112.5	113.1	113.7	114.3	115.0	115.7	116.5	117.3
3	109.0	109.4	109.9	110.6	111.2	111.9	112.4	113.0	113.6	114.2	114.9	115.6	116.4	117.1	118.0
4	109.2	109.6	110.2	110.8	111.5	112.1	112.7	113.3	113.9	114.6	115.3	116.0	116.8	117.6	118.4
5	109.2	109.6	110.2	110.8	111.5	112.2	112.8	113.4	114.0	114.7	115.4	116.2	117.0	117.8	118.7
6	109.0	109.4	110.0	110.7	111.4	112.1	112.7	113.3	114.0	114.7	115.4	116.2	117.0	117.8	118.7
7	108.6	109.0	109.7	110.4	111.1	111.8	112.4	113.1	113.7	114.4	115.2	116.0	116.8	117.7	118.6
8	109.2	109.6	110.3	111.0	111.7	112.4	113.1	113.7	114.4	115.2	115.9	116.8	117.6	118.5	119.4
9	108.8	109.2	109.9	110.6	111.4	112.1	112.8	113.4	114.1	114.9	115.7	116.5	117.4	118.3	119.3
10	109.4	109.8	110.5	111.2	112.0	112.7	113.4	114.1	114.8	115.6	116.4	117.3	118.2	119.1	120.1
11	109.0	109.4	110.1	110.8	111.6	112.4	113.1	113.8	114.5	115.3	116.2	117.1	118.0	119.0	120.0
12	109.5	110.0	110.6	111.4	112.2	113.0	113.7	114.4	115.2	116.1	116.9	117.9	118.8	119.8	120.9
13	109.1	109.5	110.2	111.0	111.8	112.6	113.4	114.1	114.9	115.8	116.7	117.6	118.7	119.7	120.8
14	108.6	109.1	109.8	110.6	111.4	112.2	113.0	113.7	114.6	115.5	116.4	117.4	118.5	119.6	120.8
15	109.1	109.6	110.3	111.1	111.9	112.8	113.6	114.3	115.2	116.1	117.1	118.2	119.3	120.5	121.8
16	108.6	109.1	109.8	110.6	111.5	112.3	113.1	113.9	114.8	115.8	116.8	117.9	119.2	120.4	121.8
17	109.1	109.6	110.3	111.1	112.0	112.8	113.6	114.5	115.4	116.4	117.5	118.7	119.9	121.3	122.8
18	108.6	109.1	109.8	110.6	111.5	112.3	113.1	114.0	114.9	115.9	117.0	118.3	119.7	121.2	122.8
19	109.1	109.5	110.2	111.1	111.9	112.8	113.6	114.4	115.3	116.4	117.6	118.9	120.4	122.0	123.8
20	108.6	109.0	109.7	110.5	111.3	112.2	113.0	113.8	114.7	115.8	117.0	118.3	119.9	121.7	123.9
21	109.0	109.4	110.1	110.9	111.7	112.6	113.3	114.2	115.1	116.1	117.2	118.6	120.1	122.1	125.0
22	108.4	108.9	109.5	110.3	111.1	111.9	112.7	113.4	114.3	115.3	116.4	117.6	119.1	120.7	122.7
23	107.9	108.3	108.9	109.6	110.4	111.2	111.9	112.7	113.5	114.4	115.4	116.5	117.8	119.1	120.5
24	108.3	108.7	109.3	110.0	110.7	111.5	112.2	112.9	113.6	114.5	115.4	116.4	117.4	118.5	119.5
25	107.7	108.1	108.6	109.3	110.0	110.7	111.4	112.0	112.7	113.5	114.3	115.2	116.0	116.9	117.7
26	108.1	108.4	109.0	109.7	110.3	111.0	111.6	112.2	112.8	113.5	114.2	115.0	115.7	116.5	117.2
27	107.5	107.8	108.4	109.0	109.6	110.2	110.8	111.3	111.9	112.5	113.2	113.8	114.5	115.1	115.7
28	107.9	108.2	108.7	109.3	109.9	110.4	111.0	111.5	112.0	112.6	113.1	113.7	114.3	114.9	115.4

30	423.6	424.9	426.9	429.2	431.4	433.5	435.4	437.3	439.2	441.2	443.2	445.3	447.5	449.6	451.7
31	422.3	423.6	425.4	427.6	429.7	431.6	433.4	435.1	436.9	438.7	440.6	442.6	444.5	446.5	448.4
32	422.1	423.2	425.0	427.0	428.9	430.8	432.4	434.0	435.6	437.3	439.1	440.8	442.6	444.4	446.1
33	420.8	421.9	423.5	425.4	427.2	428.8	430.3	431.8	433.3	434.8	436.4	438.0	439.6	441.1	442.7
34	419.7	420.7	422.1	423.8	425.4	427.0	428.3	429.6	431.0	432.4	433.8	435.2	436.6	438.0	439.4
35	418.6	419.5	420.9	422.4	423.9	425.3	426.5	427.7	428.9	430.1	431.4	432.6	433.9	435.1	436.3
36	417.9	418.8	420.0	421.4	422.7	424.0	425.1	426.1	427.2	428.3	429.5	430.6	431.7	432.8	433.9
37	416.3	417.1	418.2	419.5	420.8	422.0	423.0	424.0	425.0	426.0	427.1	428.1	429.2	430.2	431.2

30	107.7	108.0	108.4	108.9	109.4	109.9	110.4	110.8	111.2	111.7	112.2	112.7	113.1	113.6	114.0
31	107.1	107.3	107.8	108.2	108.7	109.2	109.6	110.0	110.4	110.8	111.3	111.7	112.1	112.5	112.9
32	107.5	107.8	108.2	108.6	109.1	109.5	109.9	110.2	110.6	111.0	111.4	111.8	112.2	112.5	112.9
33	107.0	107.3	107.7	108.1	108.5	108.9	109.2	109.5	109.9	110.2	110.6	110.9	111.3	111.6	112.0
34	106.7	106.9	107.3	107.6	108.0	108.4	108.7	109.0	109.3	109.6	109.9	110.2	110.6	110.9	111.2
35	106.5	106.7	107.0	107.4	107.7	108.0	108.3	108.6	108.9	109.2	109.4	109.7	110.0	110.3	110.6
36	106.6	106.8	107.0	107.4	107.7	108.0	108.2	108.5	108.7	109.0	109.2	109.5	109.8	110.0	110.3
37	105.5	105.6	105.9	106.2	106.5	106.8	107.0	107.2	107.5	107.7	108.0	108.2	108.5	108.7	108.9

30	453.8	455.8	457.6	459.3	460.7	461.9	462.8	463.4	463.7	463.7	463.4	462.7	461.8	460.7	459.4
31	450.2	452.0	453.7	455.1	456.4	457.5	458.3	458.9	459.2	459.3	459.0	458.5	457.8	456.9	455.9
32	447.7	449.3	450.8	452.1	453.3	454.2	455.0	455.6	455.9	456.0	455.8	455.5	454.9	454.2	453.4
33	444.2	445.6	446.9	448.0	449.1	450.0	450.7	451.2	451.5	451.6	451.6	451.4	451.0	450.5	449.9
34	440.7	441.9	443.0	444.1	445.0	445.8	446.4	446.9	447.3	447.5	447.5	447.4	447.2	446.8	446.4
35	437.5	438.5	439.6	440.5	441.3	442.0	442.6	443.1	443.5	443.7	443.8	443.8	443.7	443.5	443.2
36	434.9	435.9	436.8	437.6	438.4	439.1	439.6	440.1	440.5	440.7	440.9	441.0	440.9	440.8	440.6
37	432.2	433.1	433.9	434.7	435.4	436.0	436.6	437.0	437.4	437.7	437.9	438.0	438.0	438.0	437.9

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	118.1	118.9	119.7	120.5	121.3	122.2	123.0	123.7	124.5	125.1	125.7	126.2	126.5	126.8	126.9
2	118.1	118.9	119.7	120.6	121.5	122.4	123.3	124.2	125.1	125.9	126.7	127.3	127.7	127.9	127.9
3	118.8	119.7	120.6	121.5	122.5	123.5	124.5	125.6	126.7	127.9	129.1	130.2	131.0	130.9	130.5
4	119.3	120.2	121.1	122.1	123.2	124.2	125.4	126.6	128.0	129.5	131.3	133.8	137.5	134.7	133.2
5	119.6	120.5	121.5	122.5	123.5	124.7	125.8	127.1	128.5	130.0	131.6	133.2	134.6	134.6	134.1
6	119.6	120.6	121.6	122.6	123.7	124.8	126.0	127.2	128.6	130.1	131.6	133.2	134.6	135.4	135.4
7	119.5	120.5	121.5	122.5	123.6	124.7	125.9	127.1	128.5	129.9	131.5	133.3	135.3	137.2	137.1
8	120.4	121.3	122.3	123.4	124.4	125.5	126.7	127.9	129.2	130.6	132.2	134.1	136.8	142.0	139.6
9	120.2	121.2	122.2	123.2	124.3	125.4	126.5	127.6	128.8	130.1	131.5	133.1	135.0	137.0	136.8
10	121.1	122.1	123.1	124.1	125.1	126.2	127.3	128.3	129.4	130.6	131.8	133.0	134.2	135.1	135.2
11	121.0	122.0	123.0	124.0	125.0	126.1	127.1	128.1	129.1	130.1	131.0	131.9	132.6	133.1	133.1
12	121.9	123.0	124.0	125.0	126.0	127.0	127.9	128.9	129.8	130.6	131.3	131.9	132.4	132.6	132.6
13	121.9	123.0	124.0	125.1	126.0	126.9	127.8	128.7	129.6	130.4	130.9	131.2	131.4	131.5	131.4
14	121.9	123.1	124.2	125.2	126.1	126.9	127.7	128.7	129.6	130.4	130.6	130.6	130.6	130.6	130.5
15	123.0	124.3	125.5	126.5	127.3	127.9	128.7	129.6	130.8	132.1	131.6	131.1	130.9	130.8	130.8
16	123.2	124.6	126.0	127.1	127.6	127.9	128.4	129.3	131.0	134.5	131.5	130.4	130.1	130.1	130.4
17	124.3	125.9	127.7	129.5	129.1	128.8	128.9	129.4	130.2	131.3	130.6	130.1	129.9	130.1	131.0
18	124.5	126.2	128.5	133.2	129.5	128.3	127.9	128.1	128.4	128.7	128.6	128.4	128.3	128.4	128.8
19	125.6	126.8	128.1	129.4	128.6	127.9	127.6	127.5	127.6	127.7	127.7	127.6	127.5	127.5	127.6
20	126.3	126.4	126.7	126.9	126.6	126.3	126.0	125.9	125.9	125.9	125.9	125.8	125.7	125.7	125.6
21	130.2	127.1	126.2	126.0	125.7	125.5	125.4	125.3	125.2	125.2	125.2	125.1	125.0	124.9	124.7
22	124.7	124.5	124.2	124.0	123.9	123.8	123.7	123.6	123.6	123.5	123.5	123.4	123.3	123.2	123.0
23	121.6	122.0	122.1	122.1	122.1	122.1	122.0	122.0	122.0	121.9	121.9	121.8	121.7	121.6	121.4
24	120.3	120.8	121.1	121.2	121.3	121.4	121.4	121.4	121.4	121.4	121.3	121.3	121.2	121.1	120.9
25	118.4	118.9	119.3	119.5	119.6	119.7	119.8	119.9	119.9	119.9	119.9	119.8	119.7	119.6	119.5
26	117.8	118.2	118.6	118.9	119.1	119.2	119.3	119.4	119.4	119.4	119.4	119.4	119.3	119.3	119.2
27	116.3	116.7	117.1	117.3	117.6	117.7	117.9	118.0	118.0	118.1	118.1	118.1	118.0	118.0	117.9
28	115.9	116.3	116.6	116.9	117.2	117.3	117.5	117.6	117.7	117.7	117.8	117.8	117.8	117.7	117.6
29	114.6	115.0	115.3	115.6	115.8	116.0	116.2	116.3	116.4	116.5	116.5	116.6	116.5	116.5	116.5

SUBSIDENCE IN TENTHS OF FEET -- CASE 3
STRESS PERIOD 1

11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	15	15	15	15	15	15
11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14
11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	15	15	15	15
11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	15	15	15	15	15	15	15
11	11	11	11	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15
11	11	11	11	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15
11	11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14
11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
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11	11	12	12	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14	15	15	15	15	16	16	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15
11	11	11	12	12	12	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	15	15	16	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
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11	11	12	12	12	12	12	12	12	13	13	13	13	14	14	14	14	15	15	15	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
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11	11	11	12	12	12	12	12	12	13	13	13	13	14	14	14	15	15	16	16	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14	14
11	11	12	12	12	12	12	12	13	13	13	13	13	14	14	15	15	15	16	16	16	16	16	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
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11	11	11	11	11	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
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11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 6

	31	32	33	34	35	36	37	38	39	40	41	42
1	126.8	126.7	126.5	126.3	126.0	125.7	125.3	124.9	124.4	123.8	123.3	123.0
2	127.7	127.5	127.1	126.7	126.3	125.9	125.4	124.8	124.2	123.6	123.1	122.7
3	130.0	129.4	128.8	128.1	127.5	126.9	126.3	125.6	124.9	124.1	123.5	123.0
4	132.0	131.1	130.2	129.3	128.5	127.7	126.9	126.0	125.2	124.3	123.6	123.1
5	133.3	132.3	131.2	130.1	129.0	128.1	127.2	126.2	125.2	124.3	123.5	123.0
6	134.8	133.4	131.9	130.5	129.3	128.2	127.1	126.0	125.0	124.0	123.2	122.6
7	136.8	134.5	132.3	130.6	129.2	128.0	126.8	125.7	124.6	123.5	122.7	122.2
8	141.6	136.2	133.3	131.3	129.8	128.5	127.4	126.2	125.1	124.0	123.1	122.6
9	136.6	134.4	132.3	130.6	129.1	127.9	126.8	125.6	124.5	123.4	122.6	122.0
10	134.7	133.5	132.0	130.6	129.3	128.2	127.1	126.0	124.9	123.8	122.9	122.4
11	132.7	131.8	130.7	129.6	128.5	127.4	126.4	125.3	124.2	123.1	122.3	121.7
12	132.2	131.5	130.5	129.5	128.5	127.5	126.6	125.5	124.4	123.4	122.6	122.0
13	131.0	130.3	129.5	128.5	127.6	126.7	125.7	124.7	123.7	122.7	121.9	121.3
14	130.1	129.4	128.6	127.6	126.6	125.7	124.8	123.8	122.9	121.9	121.1	120.6
15	130.6	129.8	128.7	127.7	126.7	125.8	124.9	124.0	123.0	122.1	121.3	120.8
16	130.8	129.4	128.0	126.8	125.7	124.8	123.9	123.0	122.1	121.2	120.5	120.0
17	133.9	130.0	128.1	126.7	125.7	124.8	123.9	123.1	122.2	121.4	120.7	120.2
18	129.2	127.9	126.5	125.4	124.5	123.6	122.9	122.0	121.2	120.5	119.8	119.4
19	127.5	126.7	125.8	125.0	124.2	123.4	122.7	122.0	121.3	120.5	119.9	119.5
20	125.3	124.8	124.2	123.5	122.8	122.2	121.6	120.9	120.3	119.6	119.0	118.7
21	124.5	124.1	123.6	123.0	122.5	122.0	121.4	120.9	120.2	119.6	119.1	118.8
22	122.8	122.4	122.1	121.6	121.2	120.7	120.3	119.8	119.2	118.7	118.2	117.9
23	121.2	120.9	120.6	120.3	119.9	119.5	119.1	118.7	118.2	117.7	117.3	117.0
24	120.7	120.5	120.2	119.9	119.6	119.3	119.0	118.6	118.2	117.8	117.4	117.2
25	119.3	119.2	118.9	118.7	118.4	118.2	117.9	117.6	117.2	116.8	116.5	116.3
26	119.0	118.9	118.7	118.5	118.3	118.0	117.8	117.5	117.2	116.9	116.6	116.4
27	117.8	117.6	117.5	117.3	117.1	117.0	116.7	116.5	116.2	116.0	115.7	115.5
28	117.6	117.5	117.3	117.2	117.0	116.9	116.7	116.5	116.3	116.1	115.8	115.7
29	116.4	116.3	116.2	116.1	116.0	115.9	115.7	115.6	115.4	115.2	115.0	114.8

SUBSIDENCE IN TENTHS OF FEET -- CASE 3
STRESS PERIOD 2

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16	16	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18	18	19	19	19	19	19	19	20	20	20	20	20	20	20	20	20	20	21	21	21	21	21	21	21	21

CASE 2 - YEAR 2030

SUBSIDENCE

29	94.7	95.1	95.6	96.0	96.3	96.7	97.0	97.2	97.5	97.7	97.8	98.0	98.2	98.3	98.4
30	94.8	95.2	95.6	95.9	96.3	96.6	96.9	97.1	97.4	97.6	97.8	97.9	98.1	98.2	98.3
31	93.9	94.2	94.6	95.0	95.3	95.6	95.9	96.1	96.4	96.6	96.8	96.9	97.1	97.2	97.3
32	94.0	94.4	94.7	95.0	95.4	95.7	95.9	96.2	96.4	96.6	96.8	97.0	97.1	97.2	97.3
33	93.3	93.6	93.9	94.2	94.5	94.8	95.1	95.3	95.5	95.7	95.9	96.1	96.2	96.4	96.5
34	92.6	92.9	93.3	93.5	93.8	94.1	94.3	94.6	94.8	95.0	95.2	95.3	95.5	95.6	95.8
35	92.2	92.5	92.8	93.1	93.3	93.6	93.8	94.0	94.2	94.4	94.6	94.8	94.9	95.1	95.2
36	92.1	92.3	92.6	92.8	93.1	93.3	93.6	93.8	94.0	94.2	94.4	94.5	94.7	94.8	95.0
37	90.8	91.1	91.3	91.6	91.8	92.0	92.3	92.5	92.7	92.9	93.1	93.2	93.4	93.5	93.7

```
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CCCCCCCCCC    77777777777777777777777  Digital Equipment Corporation - VAX/VMS Version V4.7  77777777777777777777777    CCCCCCCCCC
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                  H   H  O   O   11    E      N   N  B   B
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                  HHHHH  O O O    1    EEEE   N N N  BBBB
                  H   H  OO  O    1    E      N  NN  B   B
                  H   H  O   O    1    E      N   N  B   B
                  H   H   OOO    111   EEEEE  N   N  BBBB

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               SS           UU      UU  BB      BB  22      22
               SS           UU      UU  BB      BB          22
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               DD      DD   AA      AA        TT           ;;;;       1111
               DD      DD   AA      AA        TT           ;;;;       1111
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               DD      DD   AA      AA        TT                        11
               DD      DD   AA      AA        TT           ;;;;         11
               DD      DD   AA      AA        TT           ;;;;         11
               DD      DD   AAAAAAAAAA        TT           ;;;;         11
               DD      DD   AAAAAAAAAA        TT           ;;;;         11
         ....  DD      DD   AA      AA        TT             ;;         11
         ....  DD      DD   AA      AA        TT             ;;         11
         ....  DDDDDDDD     AA      AA        TT           ;;         111111
         ....  DDDDDDDD     AA      AA        TT           ;;         111111
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LATEST VERS 10/30/87

12

File _DUA1:[HO1ENB.TEST]SUB2.DAT;1 (2651,186,0), last revised on 15-DEC-1988 15:06, is a 57 block sequential file owned by UIC [HO1ENB]. The records are variable length with FORTRAN (FTN) carriage control. The longest record is 126 bytes.

Job SUB2 (1601) queued to SYS$PRINT on 16-DEC-1988 11:09 by user HO1ENB, UIC [HO1ENB], under account 245401 at priority 100, started on printer LTA9107 on 16-DEC-1988 11:10 from queue LTA9107.


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CCCCCCCCCC    77777777777777777777777  Digital Equipment Corporation - VAX/VMS Version V4.7  77777777777777777777777    CCCCCCCCCC
CCCCCCCCCC    777777777777777777777777777777777777777777777777777777777777777777777777777777777777777777777777    CCCCCCCCCC
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29	98.4	98.5	98.5	98.4	98.4	98.4	98.3	98.2	99.1	97.9	97.8	97.7
30	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.3	98.2	98.1	98.0	97.9
31	97.4	97.4	97.5	97.5	97.5	97.5	97.5	97.4	97.4	97.3	97.2	97.1
32	97.4	97.5	97.5	97.6	97.6	97.6	97.6	97.6	97.5	97.5	97.4	97.4
33	96.6	96.7	96.7	96.8	96.8	96.8	96.8	96.8	96.8	96.8	96.8	96.7
34	95.9	95.9	96.0	96.1	96.1	96.2	96.2	96.2	96.2	96.2	96.2	96.2
35	95.3	95.4	95.5	95.6	95.6	95.7	95.7	95.8	95.8	95.8	95.8	95.8
36	95.1	95.2	95.3	95.3	95.4	95.5	95.5	95.6	95.6	95.7	95.7	95.7
37	93.8	93.9	94.0	94.1	94.1	94.2	94.3	94.3	94.4	94.4	94.5	94.5

DRAWDOWN WILL BE SAVED ON UNIT 27 AT END OF TIME STEP 5, STRESS PERIOD 6

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 5 IN STRESS PERIOD 6

```
CUMULATIVE VOLUMES      L**3                    RATES FOR THIS TIME STEP      L**3/T
------------------                              ------------------------

      IN:                                             IN:
      ---                                             ---
           STORAGE =   0.13840E+11                         STORAGE =   0.29752E+09
     CONSTANT HEAD =   0.00000E+00                   CONSTANT HEAD =   0.00000E+00
             WELLS =   0.00000E+00                           WELLS =   0.00000E+00
          RECHARGE =   0.78556E+10                        RECHARGE =   0.19639E+09

          TOTAL IN =   0.21696E+11                        TOTAL IN =   0.49391E+09

     OUT:                                            OUT:
     ----                                            ----
           STORAGE =   0.35365E+09                         STORAGE =   0.00000E+00
     CONSTANT HEAD =   0.00000E+00                   CONSTANT HEAD =   0.00000E+00
             WELLS =   0.13492E+11                           WELLS =   0.29773E+09
          RECHARGE =   0.78556E+10                        RECHARGE =   0.19639E+09

         TOTAL OUT =   0.21701E+11                       TOTAL OUT =   0.49412E+09

          IN - OUT =  -0.51507E+07                        IN - OUT =  -0.21485E+06

PERCENT DISCREPANCY =              -0.02        PERCENT DISCREPANCY =              -0.04
```

TIME SUMMARY AT END OF TIME STEP 5 IN STRESS PERIOD 6

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.378401E+08	630668.	10511.1	437.964	1.19908

SUBSIDENCE IN TENTHS OF FEET -- CASE 2
STRESS PERIOD 2

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SUBSIDENCE IN TENTHS OF FEET -- CASE 1
STRESS PERIOD 4

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SUBSIDENCE IN TENTHS OF FEET -- CASE 2
STRESS PERIOD 6

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30	25.1	25.3	25.8	26.3	26.8	27.2	27.7	28.1	28.6	29.1	29.7	30.2	30.8	31.4	32.0
31	26.0	26.3	26.7	27.2	27.7	28.2	28.6	29.0	29.5	30.0	30.6	31.1	31.7	32.3	32.9
32	26.0	26.3	26.7	27.2	27.7	28.2	28.6	29.0	29.5	30.0	30.5	31.1	31.7	32.3	32.9
33	26.2	26.4	26.9	27.3	27.8	28.3	28.7	29.2	29.6	30.1	30.6	31.2	31.8	32.4	33.2
34	26.5	26.8	27.2	27.7	28.1	26.6	29.0	29.5	29.9	30.4	30.9	31.5	32.0	32.6	33.2
35	27.0	27.3	27.7	28.2	28.6	29.1	29.5	30.0	30.4	30.9	31.4	31.9	32.5	33.0	33.6
36	26.7	27.0	27.4	27.8	28.3	28.8	29.2	29.6	30.1	30.6	31.1	31.6	32.2	32.7	33.3
37	26.5	26.8	27.2	27.7	28.2	28.6	29.1	29.5	30.0	30.5	31.0	31.6	32.1	32.7	33.3

CASE 3 - YEAR 2030

DRAWDOWN IN CHICOT AQUIFER

30	32.6	33.2	33.8	34.4	35.0	35.6	36.2	36.8	37.4	38.0	38.6	39.2	39.8	40.3	40.8
31	33.5	34.0	34.6	35.2	35.8	36.4	37.0	37.6	38.2	38.8	39.4	40.0	40.5	41.0	41.5
32	33.4	34.0	34.5	35.1	35.7	36.3	36.8	37.4	38.0	38.6	39.2	39.8	40.3	40.8	41.3
33	33.6	34.1	34.6	35.2	35.7	36.3	36.9	37.5	38.1	38.7	39.2	39.8	40.3	40.7	41.2
34	33.8	34.3	34.9	35.4	36.0	36.6	37.2	37.8	38.3	38.9	39.4	39.9	40.4	40.9	41.3
35	34.2	34.8	35.4	36.0	36.6	37.2	37.8	38.3	38.8	39.3	39.8	40.3	40.7	41.2	41.6
36	33.9	34.5	35.2	35.9	36.6	37.3	37.7	38.1	38.5	39.0	39.4	39.8	40.3	40.7	41.1
37	33.9	34.4	35.0	35.6	36.2	36.8	37.3	37.8	38.3	38.7	39.2	39.6	40.0	40.4	40.8

CASE 3

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	54.9	55.6	56.8	58.1	59.5	60.8	62.1	63.3	64.7	66.2	67.8	69.5	71.4	73.4	75.5
2	53.1	53.8	55.0	56.3	57.7	59.1	60.3	61.6	63.0	64.5	66.1	67.9	69.7	71.7	73.9
3	53.6	54.3	55.5	56.8	58.3	59.6	60.9	62.2	63.6	65.1	66.7	68.5	70.4	72.4	74.5
4	53.9	54.7	55.9	57.2	58.6	60.0	61.3	62.6	64.0	65.6	67.2	69.0	70.9	72.9	75.1
5	54.1	54.9	56.1	57.4	58.9	60.3	61.6	62.9	64.3	65.9	67.6	69.4	71.3	73.3	75.5
6	54.1	54.9	56.1	57.5	59.0	60.4	61.7	63.0	64.5	66.1	67.8	69.6	71.5	73.6	75.8
7	54.0	54.8	56.0	57.4	58.9	60.3	61.7	63.0	64.5	66.1	67.8	69.7	71.7	73.7	75.9
8	54.9	55.7	56.9	58.3	59.8	61.2	62.6	63.9	65.4	67.0	68.8	70.7	72.8	74.7	76.9
9	54.7	55.5	56.8	58.2	59.7	61.2	62.5	63.9	65.4	67.0	68.7	70.6	72.7	74.7	77.0
10	54.6	55.4	56.7	58.1	59.6	61.1	62.5	63.9	65.4	67.0	68.7	70.6	72.6	74.8	77.0
11	55.6	56.4	57.6	59.1	60.6	62.1	63.5	64.9	66.4	68.0	69.8	71.7	73.7	75.8	78.1
12	55.5	56.3	57.6	59.1	60.6	62.1	63.5	64.9	66.4	68.0	69.8	71.8	73.8	75.9	78.2
13	56.5	57.3	58.6	60.1	61.6	63.1	64.5	65.9	67.5	69.1	70.9	72.9	75.0	77.1	79.3
14	56.5	57.3	58.6	60.1	61.7	63.2	64.6	66.0	67.5	69.2	71.0	73.0	75.3	77.2	79.4
15	56.5	57.4	58.7	60.2	61.7	63.3	64.7	66.1	67.7	69.3	71.1	73.1	75.2	77.3	79.5
16	57.6	58.4	59.8	61.3	62.8	64.4	65.8	67.2	68.8	70.5	72.3	74.2	76.2	78.4	80.6
17	57.7	58.6	59.9	61.4	63.0	64.5	66.0	67.4	69.0	70.6	72.4	74.4	76.4	78.5	80.8
18	57.8	58.7	60.0	61.6	63.2	64.7	66.2	67.6	69.2	70.8	72.6	74.6	76.6	78.8	81.0
19	59.0	59.9	61.2	62.8	64.4	65.9	67.4	68.8	70.4	72.1	73.9	75.8	77.9	80.1	82.4
20	59.2	60.1	61.4	63.0	64.6	66.2	67.7	69.1	70.7	72.4	74.2	76.2	78.2	80.4	82.7
21	59.5	60.4	61.7	63.3	64.9	66.5	68.0	69.5	71.1	72.6	74.6	76.6	78.7	80.9	83.2
22	60.6	61.7	63.0	64.6	66.3	67.9	69.4	70.8	72.5	74.2	76.1	78.0	80.1	82.4	84.7
23	61.1	62.0	63.4	65.0	66.6	68.3	69.8	71.3	72.9	74.7	76.6	78.6	80.7	82.9	85.3
24	61.5	62.4	63.8	65.4	67.1	68.7	70.2	71.8	73.4	75.3	77.2	79.2	81.3	83.6	86.0
25	63.0	63.9	65.3	66.9	68.5	70.2	71.7	73.3	75.0	76.9	79.1	80.9	83.0	85.3	87.8
26	63.5	64.4	65.9	67.4	69.1	70.7	72.3	73.8	75.5	77.4	79.4	81.5	83.6	86.0	88.7
27	64.0	64.9	66.3	68.0	69.7	71.3	72.9	74.4	76.1	78.0	80.0	82.1	84.3	86.7	89.2
28	65.7	66.6	68.0	69.6	71.3	73.0	74.5	76.1	77.8	79.6	81.6	83.7	86.0	88.4	90.8
29	66.3	67.2	68.7	70.3	72.0	73.7	75.2	76.8	78.5	80.3	82.3	84.5	86.7	89.0	91.3

30	107.7	108.0	108.4	108.9	109.4	109.9	110.4	110.8	111.2	111.7	112.2	112.7	113.1	113.6	114.0
31	107.1	107.3	107.8	108.2	108.7	109.2	109.6	110.0	110.4	110.8	111.3	111.7	112.1	112.5	112.9
32	107.5	107.8	108.2	108.6	109.1	109.5	109.9	110.2	110.6	111.0	111.4	111.8	112.2	112.5	112.9
33	107.0	107.3	107.7	108.1	108.5	108.9	109.2	109.5	109.9	110.2	110.6	110.9	111.3	111.6	112.0
34	106.7	106.9	107.3	107.6	108.0	108.4	108.7	109.0	109.3	109.6	109.9	110.2	110.6	110.9	111.2
35	106.5	106.7	107.0	107.4	107.7	108.0	108.3	108.6	108.9	109.2	109.4	109.7	110.0	110.3	110.6
36	106.6	106.8	107.0	107.4	107.7	108.0	108.2	108.5	108.7	109.0	109.2	109.5	109.8	110.0	110.3
37	105.5	105.6	105.9	106.2	106.5	106.8	107.0	107.2	107.5	107.7	108.0	108.2	108.5	108.7	108.9

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	77.8	80.2	82.8	85.6	88.3	91.0	93.6	96.3	98.9	101.5	104.1	106.7	109.3	111.8	114.4
2	76.2	78.6	81.2	83.9	86.7	89.4	92.0	94.7	97.3	99.9	102.5	105.1	107.7	110.3	112.9
3	76.8	79.3	81.9	84.7	87.4	90.1	92.8	95.5	98.1	100.7	103.4	105.9	108.5	111.1	113.7
4	77.4	79.9	82.5	85.3	88.0	90.8	93.5	96.1	98.8	101.4	104.1	106.7	109.2	111.8	114.4
5	77.9	80.3	83.0	85.8	88.5	91.3	94.0	96.7	99.4	102.0	104.6	107.2	109.8	112.3	114.9
6	78.1	80.6	83.3	86.1	88.8	91.6	94.3	97.0	99.8	102.5	105.0	107.6	110.1	112.7	115.2
7	78.2	80.7	83.4	86.2	89.0	91.7	94.5	97.2	100.0	103.1	105.3	107.7	110.2	112.8	115.4
8	79.3	81.8	84.5	87.3	90.1	92.8	95.5	98.2	101.0	103.7	106.2	108.7	111.3	113.8	116.4
9	79.3	81.9	84.6	87.6	90.2	92.9	95.5	98.2	100.9	103.6	106.1	108.7	111.3	113.9	116.5
10	79.4	82.0	84.8	88.0	90.4	93.0	95.6	98.2	100.9	103.5	106.1	108.7	111.3	113.9	116.6
11	80.6	83.1	85.8	88.7	91.3	94.0	96.6	99.3	101.9	104.6	107.2	109.8	112.4	115.0	117.7
12	80.8	83.2	85.8	88.6	91.3	94.0	96.7	99.3	102.0	104.6	107.3	109.9	112.5	115.1	117.8
13	81.7	84.2	86.8	89.6	92.4	95.1	97.8	100.4	103.1	105.7	108.4	111.0	113.6	116.3	118.9
14	81.8	84.2	86.9	89.7	92.5	95.2	97.9	100.5	103.2	105.9	108.5	111.1	113.8	116.4	119.1
15	81.8	84.4	87.0	89.8	92.6	95.3	98.0	100.7	103.4	106.0	108.6	111.3	113.9	116.6	119.3
16	83.0	85.5	88.2	91.0	93.8	96.5	99.2	101.9	104.5	107.2	109.8	112.5	115.1	117.8	120.4
17	83.2	85.7	88.4	91.2	94.0	96.7	99.4	102.1	104.7	107.4	110.0	112.6	115.3	118.0	120.6
18	83.5	86.0	88.7	91.5	94.2	97.0	99.6	102.3	104.9	107.6	110.2	112.9	115.5	118.2	120.8
19	84.8	87.3	90.0	92.8	95.5	98.2	100.9	103.6	106.2	108.8	111.5	114.1	116.8	119.4	122.0
20	85.2	87.7	90.4	93.2	95.9	98.6	101.2	103.9	106.5	109.1	111.7	114.3	117.0	119.7	122.2
21	85.6	88.2	90.9	93.6	96.3	98.9	101.6	104.2	106.8	109.4	112.0	114.6	117.3	119.9	122.4
22	87.2	89.8	92.4	95.1	97.7	100.3	102.9	105.5	108.1	110.7	113.3	115.9	118.5	121.2	123.6
23	87.8	90.4	93.0	95.6	98.2	100.8	103.3	105.9	108.4	111.0	113.6	116.2	118.8	121.4	123.8
24	88.6	91.1	93.6	96.2	98.7	101.2	103.7	106.3	108.8	111.4	113.9	116.5	119.2	121.7	124.0
25	90.5	92.9	95.3	97.7	100.2	102.7	105.2	107.7	110.2	112.7	115.3	117.9	120.5	122.9	125.3
26	91.7	93.6	95.9	98.3	100.7	103.2	105.6	108.1	110.6	113.1	115.6	118.2	120.8	123.2	125.5
27	91.8	94.1	96.5	98.8	101.3	103.7	106.1	108.5	111.0	113.5	116.0	118.6	121.1	123.5	125.7
28	93.2	95.6	98.0	100.4	102.8	105.2	107.6	110.0	112.4	114.9	117.4	120.0	122.4	124.7	126.9
29	93.7	96.1	98.5	101.0	103.5	105.8	108.1	110.4	112.9	115.3	117.9	120.5	122.8	125.0	127.1

DRAWDOWN IN LAYER 1 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	31	32	33	34	35	36	37	38	39	40	41	42
1	116.9	119.5	122.0	124.6	126.9	129.0	131.1	133.4	135.8	138.0	140.0	141.3
2	115.5	118.0	120.6	123.1	125.3	127.4	129.5	131.8	134.1	136.3	138.3	139.5
3	116.3	118.9	121.5	123.9	126.1	128.1	130.2	132.4	134.7	136.9	138.8	140.0
4	117.0	119.7	122.2	124.5	126.7	128.7	130.7	132.9	135.1	137.3	139.2	140.4
5	117.5	120.2	122.7	125.0	127.1	129.1	131.0	133.2	135.4	137.5	139.4	140.6
6	117.8	120.5	122.9	125.2	127.3	129.2	131.2	133.3	135.5	137.6	139.4	140.6
7	118.0	120.6	123.0	125.2	127.3	129.3	131.2	133.3	135.4	137.5	139.3	140.5
8	119.0	121.6	124.0	126.2	128.3	130.2	132.1	134.2	136.3	138.4	140.1	141.3
9	119.1	121.7	124.0	126.2	128.3	130.2	132.1	134.1	136.2	138.2	140.0	141.1
10	119.2	121.7	124.1	126.2	128.3	130.1	132.0	134.0	136.1	138.1	139.8	141.0
11	120.3	122.8	125.1	127.3	129.3	131.1	133.0	134.9	137.0	139.0	140.7	141.8
12	120.4	122.9	125.2	127.3	129.3	131.1	132.9	134.9	136.9	138.9	140.6	141.7
13	121.5	124.0	126.2	128.4	130.3	132.1	133.9	135.9	137.9	139.8	141.5	142.6
14	121.7	124.1	126.3	128.4	130.3	132.1	133.9	135.8	137.8	139.7	141.4	142.4
15	121.8	124.2	126.4	128.5	130.4	132.1	133.9	135.8	137.7	139.6	141.3	142.3
16	123.0	125.3	127.5	129.5	131.4	133.1	134.9	136.8	138.7	140.5	142.2	143.2
17	123.1	125.4	127.6	129.6	131.5	133.2	134.9	136.7	138.6	140.5	142.1	143.1
18	123.3	125.6	127.7	129.7	131.5	133.2	134.9	136.7	138.6	140.4	142.0	143.0
19	124.4	126.7	128.8	130.7	132.5	134.2	135.9	137.7	139.5	141.3	142.9	143.9
20	124.6	126.8	128.9	130.8	132.6	134.2	135.9	137.7	139.5	141.2	142.8	143.8
21	124.8	126.9	129.0	130.9	132.6	134.3	135.9	137.6	139.4	141.2	142.7	143.7
22	125.9	128.1	130.1	132.0	133.7	135.3	136.9	138.6	140.4	142.1	143.6	144.5
23	126.1	128.2	130.2	132.0	133.7	135.3	136.9	138.6	140.3	142.0	143.5	144.4
24	126.3	128.3	130.3	132.1	133.8	135.3	136.9	138.5	140.2	141.9	143.4	144.3
25	127.4	129.5	131.4	133.1	134.8	136.3	137.8	139.5	141.2	142.8	144.2	145.2
26	127.6	129.6	131.5	133.2	134.8	136.3	137.8	139.4	141.1	142.7	144.1	145.0
27	127.8	129.7	131.5	133.2	134.8	136.3	137.8	139.3	141.0	142.6	144.0	144.9
28	128.9	130.8	132.6	134.3	135.8	137.3	138.7	140.3	141.9	143.5	144.8	145.7
29	129.0	130.9	132.6	134.3	135.8	137.2	138.6	140.2	141.8	143.3	144.7	145.5

CASE 3 - YEAR 2030

DRAWDOWN IN EVANGELINE AQUIFER

SUBSIDENCE IN TENTHS OF FEET -- CASE 2
STRESS PERIOD 1

11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14
10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13
10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	14	14	14	14
10	10	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14
10	10	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	13	13	13
10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	13	13	13	13	13	13	13
11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
10	10	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13
10	10	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13	13
11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
11	11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	13	13	13	13	14	14	14	14	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
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10	11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14	15	15	15	14	14	14	14	14	14	14	14	14	14	14	13	13	13
11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	13	13	14	14	14	14	14	14	14	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13
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11	11	11	11	11	11	11	11	12	12	12	12	12	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13	13	13	13	13	13
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11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
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11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	10	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	10	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13
10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	13
10	10	10	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	13	13	13	13	13	13

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	423.5	424.6	426.1	427.8	429.5	431.1	432.5	433.9	435.3	436.8	438.3	439.8	441.4	443.0	444.6
2	423.8	424.9	426.5	428.3	430.1	431.8	433.3	434.7	436.2	437.7	439.3	440.9	442.6	444.3	445.9
3	425.0	426.2	428.0	429.9	431.9	433.7	435.3	436.8	438.4	440.0	441.7	443.5	445.2	447.0	448.8
4	426.1	427.4	429.3	431.4	433.5	435.5	437.2	438.9	440.6	442.4	444.2	446.1	448.0	449.9	451.8
5	426.9	428.3	430.4	432.7	435.0	437.1	439.0	440.8	442.7	444.6	446.5	448.5	450.5	452.6	454.7
6	427.4	428.9	431.2	433.7	436.2	438.5	440.6	442.5	444.5	446.5	448.6	450.7	452.8	455.0	457.2
7	427.7	429.3	431.8	434.5	437.2	439.7	441.9	443.9	446.0	448.1	450.3	452.5	454.8	457.1	459.4
8	428.8	430.6	433.2	436.2	439.1	441.7	444.1	446.2	448.5	450.7	453.0	455.3	457.7	460.1	462.5
9	428.9	430.8	433.6	436.8	440.0	442.9	445.4	447.7	450.1	452.4	454.8	457.2	459.7	462.2	464.7
10	430.0	432.0	435.1	438.5	442.0	445.2	447.9	450.4	452.9	455.4	457.8	460.3	462.8	465.4	468.1
11	430.1	432.2	435.5	439.2	443.0	446.6	449.6	452.3	454.9	457.5	460.0	462.5	465.1	467.8	470.6
12	431.1	433.3	436.8	440.9	445.1	449.1	452.5	455.5	458.3	460.8	463.3	465.8	468.4	471.2	474.2
13	431.0	433.3	437.0	441.4	446.1	450.7	454.8	458.1	461.1	463.5	465.8	468.2	470.8	473.7	476.8
14	430.8	433.2	437.0	441.7	446.9	452.4	457.6	461.1	464.7	466.5	468.4	470.6	473.1	476.1	479.4
15	431.5	433.9	437.9	442.8	448.4	454.7	462.9	465.2	471.3	470.6	472.0	473.8	476.2	479.2	482.8
16	431.1	433.6	437.6	442.5	448.1	454.1	460.1	464.8	470.0	471.9	474.3	475.7	477.9	481.1	485.0
17	431.5	434.0	438.0	442.9	448.3	453.9	459.4	465.1	473.1	473.8	479.0	478.0	479.9	483.4	487.8
18	430.9	433.4	437.3	442.0	447.2	452.3	457.2	462.1	467.2	470.5	474.1	476.5	479.7	483.9	489.1
19	431.2	433.6	437.4	441.9	446.7	451.4	455.8	460.1	464.3	468.1	471.8	475.3	479.5	484.7	491.2
20	430.3	432.6	436.3	440.6	445.1	449.4	453.4	457.2	461.1	464.9	468.8	472.8	477.5	483.4	491.6
21	430.4	432.6	436.1	440.1	444.3	448.3	452.0	455.5	459.1	462.9	466.7	470.9	475.6	481.0	487.5
22	429.3	431.5	434.8	438.6	442.5	446.2	449.6	452.9	456.3	459.9	463.6	467.7	472.1	476.9	482.1
23	428.2	430.3	433.4	437.0	440.6	444.1	447.2	450.3	453.5	456.9	460.4	464.2	468.3	472.6	477.1
24	428.1	430.0	432.9	436.3	439.7	442.9	445.9	448.7	451.7	454.9	458.2	461.8	465.5	469.3	473.3
25	426.9	428.7	431.5	434.6	437.8	440.8	443.5	446.2	449.0	451.9	455.0	458.3	461.7	465.2	468.7
26	426.6	428.4	430.9	433.9	436.9	439.7	442.2	444.7	447.3	450.0	452.9	455.9	459.0	462.1	465.3
27	425.4	427.0	429.4	432.2	434.9	437.5	439.9	442.2	444.6	447.2	449.8	452.6	455.4	458.2	461.1
28	425.1	426.6	428.9	431.5	434.0	436.5	438.7	440.8	443.1	445.4	447.8	450.3	452.9	455.5	458.1
29	423.8	425.2	427.4	429.8	432.2	434.5	436.5	438.5	440.6	442.7	445.0	447.3	449.6	452.0	454.3

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	446.1	447.7	449.2	450.7	452.2	453.5	454.8	456.0	457.0	458.0	458.7	459.3	459.6	459.8	459.8
2	447.6	449.2	450.9	452.5	454.0	455.5	456.9	458.2	459.5	460.5	461.5	462.2	462.6	462.7	462.5
3	450.6	452.4	454.2	455.9	457.7	459.3	460.9	462.5	464.0	465.4	466.7	467.8	468.6	468.3	467.7
4	453.8	455.7	457.7	459.6	461.4	463.3	465.1	466.9	468.6	470.4	472.3	474.7	478.1	475.3	473.4
5	456.8	459.9	461.0	463.0	465.1	467.1	469.0	470.9	472.7	474.5	476.2	477.8	478.9	478.6	477.7
6	459.5	461.7	464.0	466.2	468.4	470.5	472.6	474.6	476.5	478.2	479.9	481.4	482.5	482.9	482.3
7	461.8	464.2	466.6	468.9	471.3	473.6	475.8	477.8	479.8	481.6	483.3	484.9	486.5	487.9	487.1
8	465.0	467.5	470.1	472.6	475.1	477.5	479.9	482.1	484.1	485.9	487.6	489.2	491.4	495.8	492.8
9	467.4	470.1	472.8	475.5	478.1	480.8	483.3	485.7	487.8	489.6	491.0	492.2	493.4	494.6	493.7
10	470.9	473.8	476.7	479.6	482.4	485.3	488.1	490.7	493.0	494.8	495.9	496.4	496.7	496.5	495.7
11	473.6	476.6	479.7	482.9	486.0	489.1	492.2	495.2	498.0	500.0	500.4	500.2	499.5	498.2	496.7
12	477.4	480.6	484.0	487.4	490.8	494.2	497.6	501.2	504.9	508.0	506.8	505.5	504.3	501.5	498.8
13	480.2	483.8	487.4	491.1	494.7	498.4	502.1	506.4	511.6	519.4	512.7	509.8	509.8	503.7	499.8
14	483.1	487.0	491.1	495.1	498.9	502.6	506.4	510.9	515.9	517.4	515.2	511.2	508.1	503.9	500.3
15	486.9	491.3	496.0	500.6	504.5	507.7	511.2	516.0	524.9	520.3	520.6	513.1	508.6	504.8	501.6
16	489.5	494.5	500.1	506.1	509.9	512.0	513.9	516.2	518.7	517.4	515.4	511.3	507.5	504.4	502.1
17	492.8	498.3	505.2	514.9	518.3	517.5	517.3	517.5	517.6	516.3	513.7	510.3	507.0	504.4	503.4
18	494.8	500.1	506.5	515.7	530.0	521.7	519.6	518.1	516.9	515.8	512.0	508.3	504.9	502.2	500.1
19	498.5	501.8	506.3	512.5	519.3	520.7	522.7	519.4	517.6	519.0	511.6	507.1	503.5	500.4	497.6
20	505.4	501.7	503.6	507.9	513.1	518.6	530.1	518.7	514.0	511.7	507.6	504.0	500.8	497.6	494.4
21	494.5	496.9	499.9	503.6	507.7	511.7	515.2	512.3	509.5	507.1	504.4	501.8	499.2	496.0	492.4
22	487.2	491.0	494.5	498.2	501.7	504.3	505.9	505.1	503.7	502.1	500.3	498.8	497.4	494.1	489.6
23	481.4	485.4	489.3	493.2	496.9	498.3	499.0	498.9	498.3	497.5	496.3	495.7	497.6	493.6	486.7
24	477.2	481.1	485.2	489.7	495.5	494.2	494.1	494.2	494.4	494.4	492.8	491.4	490.2	487.2	482.9
25	472.3	476.0	479.7	484.0	489.3	488.2	488.2	488.7	489.8	492.0	488.4	486.0	483.8	481.1	477.9
26	468.6	471.8	475.1	478.4	481.3	482.3	483.0	483.9	485.3	488.1	484.1	481.4	479.1	476.7	474.1
27	464.0	466.9	469.7	472.3	474.5	475.9	476.9	477.8	478.6	479.1	477.6	475.7	473.8	471.7	469.6
28	460.7	463.2	465.6	467.8	469.6	471.0	472.1	472.8	473.3	473.4	472.6	471.3	469.8	468.1	466.3
29	456.6	458.8	460.9	462.8	464.4	465.7	466.7	467.4	467.7	467.7	467.2	466.3	465.1	463.7	462.2

DRAWDOWN IN LAYER 2 AT END OF TIME STEP 10 IN STRESS PERIOD 5

	31	32	33	34	35	36	37	38	39	40	41	42
1	459.6	459.2	458.7	458.1	457.4	456.7	455.8	454.8	453.6	452.4	451.2	450.3
2	462.0	461.4	460.7	459.9	459.0	458.0	457.0	455.8	454.4	452.9	451.5	450.6
3	466.8	465.7	464.6	463.4	462.2	460.9	459.5	458.0	456.2	454.4	452.8	451.7
4	471.8	470.3	468.7	467.0	465.4	463.7	462.0	460.0	457.9	455.7	453.8	452.6
5	476.3	474.5	472.5	470.4	468.3	466.3	464.1	461.7	459.2	456.8	454.6	453.2
6	480.9	478.7	476.1	473.4	470.8	468.4	465.8	463.1	460.2	457.4	455.0	453.4
7	486.0	482.7	479.3	475.9	472.8	469.9	467.0	463.9	460.8	457.8	455.2	453.5
8	494.0	487.7	483.1	479.1	475.5	472.2	469.0	465.6	462.2	458.9	456.2	454.4
9	492.9	490.1	485.5	481.0	477.0	473.4	469.8	466.1	462.5	459.0	456.1	454.2
10	495.0	495.5	488.9	483.7	479.2	475.3	471.5	467.5	463.6	460.0	456.9	455.0
11	495.2	493.6	490.1	484.9	480.1	475.9	471.9	467.7	463.7	459.9	456.7	454.7
12	496.6	494.8	494.2	486.8	481.5	477.1	473.0	468.7	464.5	460.6	457.4	455.3
13	496.7	493.9	490.8	485.9	481.2	477.0	472.8	468.5	464.2	460.3	456.9	454.8
14	496.9	493.3	489.4	485.0	480.6	476.5	472.4	468.1	463.8	459.7	456.4	454.2
15	496.4	494.3	489.8	485.3	480.9	476.8	472.7	468.4	464.1	460.1	456.7	454.5
16	500.0	494.7	489.5	484.6	480.0	475.9	471.8	467.6	463.3	459.3	455.9	453.8
17	500.2	496.3	490.0	484.7	480.0	475.8	471.7	467.5	463.3	459.3	456.0	453.9
18	498.3	493.4	488.6	483.3	478.6	474.4	470.4	466.2	462.1	458.2	455.0	452.9
19	494.8	491.4	489.1	482.7	477.8	473.7	469.8	465.8	461.8	458.0	454.8	452.8
20	491.0	487.6	484.1	479.6	475.4	471.6	467.9	464.1	460.3	456.7	453.6	451.6
21	488.6	485.0	481.3	477.6	473.7	470.3	466.9	463.3	459.6	456.2	453.3	451.4
22	485.4	481.5	477.9	474.3	471.0	467.8	464.7	461.3	457.9	454.6	451.9	450.1
23	482.0	478.1	474.5	471.2	468.2	465.3	462.4	459.3	456.1	453.0	450.4	448.7
24	478.9	475.4	472.1	469.1	466.3	463.7	461.0	458.1	455.2	452.3	449.9	448.3
25	474.7	471.6	468.7	466.0	463.4	461.0	458.6	456.0	453.2	450.6	448.3	446.8
26	471.4	468.8	466.2	463.8	461.5	459.4	457.2	454.8	452.3	449.8	447.7	446.3
27	467.3	465.0	462.8	460.7	458.6	456.7	454.7	452.5	450.3	448.0	446.0	444.8
28	464.3	462.4	460.5	458.6	456.8	455.1	453.3	451.4	449.3	447.2	445.4	444.2
29	460.6	459.0	457.3	455.7	454.1	452.6	451.0	449.2	447.3	445.5	443.8	442.7

30	129.1	131.0	132.7	134.3	135.8	137.2	138.6	140.1	141.6	143.2	144.5	145.4
31	130.2	132.0	133.7	135.3	136.7	138.1	139.5	141.0	142.5	144.0	145.3	146.2
32	130.4	132.1	133.8	135.3	136.8	138.1	139.4	140.9	142.4	143.9	145.2	146.0
33	130.7	132.4	134.0	135.5	137.0	138.3	139.6	141.0	142.5	144.0	145.2	146.1
34	131.3	132.9	134.5	136.0	137.3	138.6	139.9	141.3	142.8	144.2	145.5	146.3
35	132.0	133.6	135.1	136.6	137.9	139.2	140.4	141.8	143.2	144.6	145.9	146.7
36	131.9	133.5	134.9	136.3	137.7	138.9	140.1	141.5	142.9	144.3	145.5	146.3
37	131.9	133.4	134.9	136.3	137.6	138.8	140.0	141.3	142.7	144.1	145.3	146.1

CASE 3 - YEAR 2030

SUBSIDENCE

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BBBBBBBBBB   66666666666666666666666666  Digital Equipment Corporation - VAX/VMS Version V4.7  66666666666666666666666666   BBBBBBBBBB
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LATEST VERSION 12/30/88

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              H   H   OOO     L       EEEEE  N   N  BBBB
              H   H  O   O    LL      E      N   N  B   B
              H   H  O  OO    L       E      NN  N  B   B
              HHHHH  O O O    L       EEEE   N N N  BBBB
              H   H  OO  O    L       E      N  NN  B   B
              H   H  O   O    L       E      N   N  B   B
              H   H   OOO    LLL      EEEEE  N   N  BBBB

            SSSSSSSS  UU       UU  BBBBBBBB       333333
            SSSSSSSS  UU       UU  BBBBBBBB       333333
          SS          UU       UU  BB       BB  33      33
          SS          UU       UU  BB       BB  33      33
          SS          UU       UU  BB       BB          33
          SS          UU       UU  BB       BB          33
            SSSSSS    UU       UU  BBBBBBBB           33
            SSSSSS    UU       UU  BBBBBBBB           33
                  SS  UU       UU  BB       BB          33
                  SS  UU       UU  BB       BB          33
                  SS  UU       UU  BB       BB  33      33
                  SS  UU       UU  BB       BB  33      33
          SSSSSSSS    UUUUUUUUUU   BBBBBBBB       333333
          SSSSSSSS    UUUUUUUUUU   BBBBBBBB       333333

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          DDDDDDDD      AAAAAA     TTTTTTTTTT      ;;;;        11
          DD      DD  AA      AA       TT          ;;;;      1111
          DD      DD  AA      AA       TT          ;;;;      1111
          DD      DD  AA      AA       TT                    11
          DD      DD  AA      AA       TT                    11
          DD      DD  AA      AA       TT          ;;;;      11
          DD      DD  AA      AA       TT          ;;;;      11
          DD      DD  AAAAAAAAAA       TT          ;;;;      11
          DD      DD  AAAAAAAAAA       TT          ;;;;      11
    ....  DD      DD  AA      AA       TT            ;;      11
    ....  DD      DD  AA      AA       TT            ;;      11
    ....  DDDDDDDD    AA      AA       TT          ;;      111111
    ....  DDDDDDDD    AA      AA       TT          ;;      111111
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File _DUA1:[HOLENB.TEST]SUB3.DAT;1 (3185,240,0), last revised on 15-DEC-1988 15:06, is a 47 block sequential file owned by UIC [HOLENB]. The records are variable length with FORTRAN (FTN) carriage control. The longest record is 126 bytes.

Job SUB3 (1602) queued to SYS$PRINT on 16-DEC-1988 11:10 by user HOLENB, UIC [HOLENB], under account 245401 at priority 100, started on printer LTA9107 on 16-DEC-1988 11:10 from queue LTA9107.

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BBBBBBBBBB   6666666666666666666666666666666666666666666666666666666666666666666666666666666666666666666   BBBBBBBBBB
BBBBBBBBBB   66666666666666666666666666  Digital Equipment Corporation - VAX/VMS Version V4.7  66666666666666666666666666   BBBBBBBBBB
BBBBBBBBBB   6666666666666666666666666666666666666666666666666666666666666666666666666666666666666666666   BBBBBBBBBB
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30	458.1	456.7	455.3	453.8	452.5	451.1	449.7	448.1	446.4	444.7	443.2	442.2
31	454.8	453.6	452.4	451.1	449.9	448.7	447.5	446.1	444.6	443.0	441.7	440.8
32	452.5	451.5	450.5	449.4	448.4	447.4	446.3	445.0	443.7	442.3	441.1	440.3
33	449.1	448.3	447.5	446.7	445.8	444.9	444.0	442.9	441.8	440.6	439.5	438.8
34	445.8	445.2	444.6	443.9	443.2	442.5	441.7	440.9	439.9	438.9	438.0	437.3
35	442.8	442.4	441.9	441.4	440.8	440.3	439.7	438.9	438.2	437.3	436.6	436.0
36	440.4	440.1	439.7	439.3	438.9	438.5	438.0	437.5	436.8	436.1	435.5	435.1
37	437.7	437.5	437.2	436.9	436.5	436.2	435.8	435.3	434.8	434.2	433.6	433.3

DRAWDOWN WILL BE SAVED ON UNIT 27 AT END OF TIME STEP 10, STRESS PERIOD 5

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 10 IN STRESS PERIOD 5

CUMULATIVE VOLUMES	L**3	RATES FOR THIS TIME STEP	L**3/T
IN:		IN:	
STORAGE =	0.41713E+11	STORAGE =	0.15361E+10
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
WELLS =	0.00000E+00	WELLS =	0.00000E+00
RECHARGE =	0.78556E+10	RECHARGE =	0.19639E+09
TOTAL IN =	0.49569E+11	TOTAL IN =	0.17325E+10
OUT:		OUT:	
STORAGE =	0.41973E+08	STORAGE =	0.00000E+00
CONSTANT HEAD =	0.00000E+00	CONSTANT HEAD =	0.00000E+00
WELLS =	0.41697E+11	WELLS =	0.15364E+10
RECHARGE =	0.78556E+10	RECHARGE =	0.19639E+09
TOTAL OUT =	0.49594E+11	TOTAL OUT =	0.17328E+10
IN - OUT =	-0.25633E+08	IN - OUT =	-0.32960E+06
PERCENT DISCREPANCY =	-0.05	PERCENT DISCREPANCY =	-0.02

TIME SUMMARY AT END OF TIME STEP 10 IN STRESS PERIOD 5

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TIME STEP LENGTH	0.466896E+08	778160.	12969.3	540.389	1.47950
STRESS PERIOD TIME	0.315576E+09	0.525960E+07	87660.0	3652.50	10.0000
TOTAL SIMULATION TIME	0.126230E+10	0.210384E+08	350640.	14610.0	40.0000

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27	27	27	27	28	28	28	28	29	29	29	29	30	30	30	30	31	31	32	32	32	33	33	33	34	34	34	35	35	35	35	36	36	36	36	36	37	37	37	37	37	37
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SUBSIDENCE IN TENTHS OF FEET -- CASE 3
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58	59	59	60	61	62	63	64	65	65	66	66	67	68	69	70	71	72	74	75	75	76	76	77	77	77	78	78	78	78	79	79	78	78	78	78	78	78	78	78	78	78
58	59	59	60	61	62	63	63	64	65	66	66	67	68	69	70	71	72	74	76	76	76	76	77	77	77	77	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
58	59	59	60	61	62	63	63	64	65	66	67	67	68	70	71	72	73	74	75	76	77	77	77	78	78	78	78	78	78	78	78	79	78	78	78	78	78	78	78	78	78
58	59	59	60	61	62	63	63	64	65	65	66	67	68	70	72	72	72	73	75	76	77	77	77	77	77	77	77	78	78	78	78	78	78	78	78	78	78	78	78	78	78
58	59	59	60	61	62	62	63	64	65	65	66	67	68	69	71	71	72	73	74	75	76	76	76	77	77	77	77	78	78	78	78	78	78	78	78	78	78	78	78	77	77
59	59	60	60	61	62	62	63	64	65	65	66	67	68	69	70	71	72	73	74	75	75	76	76	76	77	77	77	78	78	78	78	78	78	78	78	78	78	78	78	78	78
58	57	59	60	61	62	62	63	64	64	65	66	67	68	69	70	71	71	72	73	74	75	75	76	76	76	77	78	78	77	77	77	77	77	77	77	77	77	77	77	77	77
59	59	60	60	61	62	62	63	63	64	65	66	67	67	68	69	70	71	72	73	74	74	75	75	76	76	76	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
59	59	60	60	61	62	62	63	63	64	65	66	66	67	68	69	70	71	72	73	73	74	74	75	76	76	76	76	77	77	77	77	77	77	77	77	77	77	77	77	77	77
59	59	60	60	61	62	62	63	63	64	65	66	66	67	68	69	70	70	71	72	73	73	74	75	75	75	76	76	76	76	76	77	77	77	77	77	77	77	77	77	77	77
59	59	60	60	61	62	62	63	63	64	65	65	66	67	68	68	69	70	71	71	72	73	73	74	74	75	75	75	76	76	76	76	76	76	76	77	77	77	77	77	77	77
59	59	60	61	61	62	62	63	63	64	65	65	66	67	68	68	69	70	71	71	72	72	73	74	74	75	75	75	75	76	76	76	76	76	77	77	77	77	77	77	77	77
59	59	60	60	61	62	62	63	63	64	65	65	66	67	67	68	69	69	70	71	71	72	73	73	74	74	74	75	75	75	76	76	76	76	76	76	76	77	77	77	77	77
59	59	60	61	61	62	62	63	63	64	64	65	66	66	67	68	69	69	70	71	71	72	72	73	73	74	74	74	75	75	75	76	76	76	76	76	76	76	77	77	77	77
59	60	60	61	61	62	62	63	63	64	65	65	66	66	67	68	68	69	70	70	71	71	72	73	73	74	74	74	75	75	75	75	76	76	76	76	76	76	77	77	77	77
60	60	60	61	61	62	62	63	63	64	65	65	66	66	67	68	68	69	69	70	71	71	72	72	73	73	74	74	74	75	75	75	75	76	76	76	76	76	76	77	77	77
60	60	60	61	61	62	62	63	63	64	64	65	66	66	67	67	68	69	69	70	70	71	71	72	72	73	73	74	74	74	75	75	75	75	76	76	76	76	76	76	77	77
60	60	61	61	62	62	62	63	63	64	64	65	65	66	67	67	68	68	69	70	70	71	71	72	72	73	73	73	74	74	74	75	75	75	75	76	76	76	76	76	76	76
60	60	61	61	62	62	63	63	63	64	64	65	65	66	67	67	68	68	69	69	70	71	71	72	72	72	73	73	74	74	74	74	75	75	75	75	76	76	76	76	76	76
60	60	61	61	62	62	63	63	63	64	64	65	65	66	66	67	68	68	69	69	70	70	71	71	72	72	73	73	73	74	74	74	74	75	75	75	75	76	76	76	76	76
60	60	61	61	62	62	62	63	63	64	64	65	65	66	66	67	67	68	69	69	70	70	71	71	71	72	72	73	73	73	74	74	74	74	75	75	75	75	76	76	76	76

APPENDIX NO. III

INVENTORY OF EXISTING WATER SYSTEM - ROSENBERG

CITY OF ROSENBERG
WATER SUPPLY FACILITIES

Plant	Year Plant Constructed	Well Capacity	Year Well Installed	Distribution Pumps	Ground Storage	Elevated Storage
1	1952	350 GPM 300 GPM	1950 1945	-	-	150,000 Gal.
2	1966	1200 GPM	1958	2@1200 GPM Each	1,000,000 Gallons	200,000 Gal.
3	1967	1700 GPM	1967	2@1000 GPM Each	1,000,000 Gallons	500,000 Gal.
4	1986	2200 GPM	1986	-	-	1,000,000 Gal.

APPENDIX NO. IV

INVENTORY OF EXISTING WATER SUPPLY FACILITIES - RICHMOND

CITY OF RICHMOND
WATER SUPPLY FACILITIES

Plant	Year Plant Constructed	Well Capacity	Year Well Installed	Distribution Pumps	Ground Storage	Elevated Storage
1	1949	125 GPM 800 GPM	1949 1959	2@775 GPM Each	355,000 Gallons	135,000 Gal.
2	1955	425 GPM	1953	1@400 GPM	109,000 Gallons	-
3	1979	1325 GPM	1978	2@750 GPM Each	500,000 Gallons	350,000 Gal.
Brazos Terrace		-	-	-	-	350,000 Gal.

APPENDIX NO. V

INVENTORY OF ROSENBERG/RICHMOND AREA PARK FACILITIES

ROSENBERG AREA

Park	Acreage
Brazos Park	11.26
Community Park	6.50
Garcia Park	12.10
Harwood Park	0.33
Riverbend Park	15.00
Sunset Park	20.00
Travis Park	15.00

RICHMOND AREA

George Park	218
Jane Long Park	N/A
T.W. Davis Memorial Park	N/A
K.A. Crawford Park	N/A

APPENDIX VI

CITY OF ROSENBERG

CAPITAL IMPROVEMENT PLAN

PROGRAM: PROJECT SUMMARY - CITY OF ROSENBERG SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TP	SURFACE WATER TREATMENT PLANT*	-	12,483	1,160	2,205	3,490	324	19,662
TL	LOW PRESSURE SURFACE WATER TRANSMISSION LINES	-	4,150	385				4,535
	SURFACE WATER PROJECTS TOTAL	-	16,633	1,545	2,205	3,490	324	24,197
GW	GROUNDWATER PRODUCTION AND STORAGE FACILITIES	1,285	320		1,489	931		4,025
DL	DISTRIBUTION LINES	112	997	836	391	1,049		3,385
	GROUNDWATER PROJECTS TOTAL	1,397	1,317	836	1,880	1,980		7,410
	ALL PROJECTS TOTAL	1,397	17,950	2,381	4,085	5,470	324	31,607

*BASED ON PRO RATA SHARE OF PLANT CAPACITY

PROGRAM: CITY OF ROSENBERG SURFACE WATER TREATMENT PLANT CONSTRUCTION SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TP-1	6.4 MGD FIRST PHASE OF PLANT		9,128	848				9,976
TP-2	TERMINATION STORAGE PHASE 1		3,355	312				3,667
TP-3	3.6 MGD SECOND PHASE OF PLANT (10.0 MGD TOTAL)				2,205	218		2,423
TP-4	3.3 MGD FINAL PHASE OF PLANT (13.3 MGD TOTAL)					1,743	173	1,916
TP-5	TERMINATION STORAGE FINAL PHASE					1,529	151	1,680
	TREATMENT PLANT		12,483	1,160	2,205	3,490	324	19,662

PROJECT: CONSTRUCT FIRST PHASE OF PLANT (TP-1)

DESCRIPTION: CONSTRUCT 6.4 MGD AVER. DAILY FLOW PLANT ON ULTIMATE PLANT TRACT

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		498					498
DESIGN		998					998
CONSTRUCTION		7,632	848				8,480
TOTAL ALLOCATION		9,128	848				9,976

PROJECT: TERMINATION STORAGE (TP-2)

DESCRIPTION: CONSTRUCTION OF RAW WATER STORAGE FACILITY (PHASE I - 10.0 MGD)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN		388					388
CONSTRUCTION		2,967	312				3,279
TOTAL ALLOCATION		3,355	312				3,667

PROJECT: CONSTRUCT SECOND PHASE OF PLANT (TP-3)

DESCRIPTION: CONSTRUCT 3.6 MGD ADDITION TO BRING TOTAL PLANT CAPACITY TO 10.0 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN				242			242
CONSTRUCTION				1,962	219		2,181
TOTAL ALLOCATION				2,204	219		2,423

PROJECT: CONSTRUCT FINAL PHASE OF PLANT (TP-4)

DESCRIPTION: CONSTRUCT 3.3 MGD ADDITION TO BRING TOTAL PLANT CAPACITY TO 13.3 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2030-2030	
ACQUISITION							-
DESIGN					192		192
CONSTRUCTION					1,551	173	1,724
TOTAL ALLOCATION					1,743	173	1,916

PROJECT: TERMINATION STORAGE (TP-5)

DESCRIPTION: CONSTRUCTION OF RAW WATER STORAGE FACILITY
(PHASE III - 3.3 MGD) (13.3 MGD TOTAL)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN					168		168
CONSTRUCTION					1,361	151	1,512
TOTAL ALLOCATION					1,529	151	1,680

PROGRAM: CITY OF ROSENBERG SURFACE WATER TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TL-1	30" LOW PRESSURE LINE: PLANT TO US 59		1,076	99				1,175
TL-2	24" LOW PRESSURE LINE: US 59 TO PLANT NO. 4		1,135	105				1,240
TL-3	18" LOW PRESSURE LINE: PLANT NO. 4 TO PLANT NO. 3		1,497	138				1,635
TL-4	18" LOW PRESSURE LINE: INTERCONNECTION WITH RICHMOND FEED		443	42				485
	TRANSMISSION LINES		4,151	384				4,535

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-1)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF A 30" LINE FROM THE SURFACE WATER TREATMENT PLANT TO US 59

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		59					59
DESIGN		118					118
CONSTRUCTION		899	99				998
TOTAL ALLOCATION		1,076	99				1,175

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-2)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF A 24" LINE FROM US 59 TO STORAGE/PUMPING FACILITY AT PLANT NO. 4

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		62					62
DESIGN		124					124
CONSTRUCTION		949	105				1,054
TOTAL ALLOCATION		1,135	105				1,240

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-3)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF AN 18" LINE FROM PLANT NO. 4 TO STORAGE/PUMPING FACILITY AT PLANT NO. 3

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		82					82
DESIGN		164					164
CONSTRUCTION		1,251	138				1,389
TOTAL ALLOCATION		1,497	138				1,635

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-4)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF AN 18" INTERCONNECTION WITH THE RICHMOND FEED LINE

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		24					24
DESIGN		48					48
CONSTRUCTION		371	42				413
TOTAL ALLOCATION		443	42				485

PROGRAM: CITY OF ROSENBERG GROUNDWATER PRODUCTION AND STORAGE FACILITIES SUMMARY OF FUNDS (Thousands)

CIP No.	Proposed Encumbrances (Thousands)							Project Total
	Project	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
GW-1	BOOSTER PUMPS AT PLANT NO. 2 OR 3	65						65
GW-2	CONTROL BUILDING AND IMPROVEMENTS AT PLANT NO. 4	900						900
GW-3	NEW WELLS AT PLANT NO. 2 AND 3	320	320					640
GW-4	STORAGE TANKS				1,489	931		2,420
	GROUNDWATER FACILITIES	1,285	320		1,489	931		4,025

PROJECT: ADDITIONAL BOOSTER PUMPS AT GROUNDWATER PLANT NO. 2 OR 3 (GW-1)

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN	6						6
CONSTRUCTION	59						59
TOTAL ALLOCATION	65						65

(GW-2)
PROJECT: CONTROL BUILDING BOOSTER PUMPS AND 1.0 MGD STORAGE TANK AT GROUNDWATER PLANT NO. 4

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN	95						95
CONSTRUCTION	805						805
TOTAL ALLOCATION	900						900

PROJECT: 1500 GPM WELLS AT GROUNDWATER PLANT NO. 2 AND 3 (GW-3)

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN	34	34					68
CONSTRUCTION	286	286					572
TOTAL ALLOCATION	320	320					640

(GW-4)

PROJECT: GROUND AND ELEVATED STORAGE TANKS AT: MUD 101/102/103/104; 59/63; 65/66/77/78

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION				121			121
DESIGN				144	98		242
CONSTRUCTION				1,224	833		2,057
TOTAL ALLOCATION				1,489	931		2,420

PROGRAM: CITY OF ROSENBERG DISTRIBUTION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
DL-1	12" LINE TO MUD 101/ 102/103/104	67	383					450
DL-2	8" LINE TO MUD 59/63	18	102					120
DL-3	8" LINE TO MUD 65/66 77/78	27	158					185
DL-4	12" LINE TO MUD 101/ 102/103/104		54	311				365
DL-5	8" LINE TO MUD 59/63		30	165				195
DL-6	8" LINE TO MUD 65/66/ 77/78		20	110				130
DL-7	12" LINE ALONG US 59 AND FM 529				141	799		940
DL-8	INTERNAL SYSTEM LINE WORK		250	250	250	250		1,000
	DISTRIBUTION LINES	112	997	836	391	1,049		3,385

PROJECT: 12" WATERLINE TO MUD 101/102/103/104 (DL-1)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	22						22
DESIGN	45						45
CONSTRUCTION		383					383
TOTAL ALLOCATION	67	383					450

PROJECT: 8" WATERLINE TO MUD 59/63 (DL-2)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	6						6
DESIGN	12						12
CONSTRUCTION		102					102
TOTAL ALLOCATION	18	102					120

PROJECT: 8" WATERLINE TO MUD 65/66/77/78 (DL-3)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	9						9
DESIGN	18						18
CONSTRUCTION		158					158
TOTAL ALLOCATION	27	158					185

PROJECT: 12" WATERLINE TO MUD 101/102/103/104 (DL-4)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		18					18
DESIGN		36					36
CONSTRUCTION			311				311
TOTAL ALLOCATION		54	311				365

PROJECT: 8" WATERLINE TO MUD 59/63 (DL-5)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		10					10
DESIGN		20					20
CONSTRUCTION			165				165
TOTAL ALLOCATION		30	165				195

PROJECT: 8" WATERLINE TO MUD 65/66/77/78 (DL-6)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		7					7
DESIGN		13					13
CONSTRUCTION			110				110
TOTAL ALLOCATION		20	110				130

PROJECT: 12" WATERLINE ALONG US 59 AND FM 529 (DL-7)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION				47			47
DESIGN				94			94
CONSTRUCTION					799		799
TOTAL ALLOCATION				141	799		940

PROJECT: ADDITIONAL WATERLINES FOR EXISTING DISTRIBUTION SYSTEM WITHIN CITY LIMITS (DL-8)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		13	13	13	13		52
DESIGN		25	25	25	25		100
CONSTRUCTION		212	212	212	212		848
TOTAL ALLOCATION		250	250	250	250		1,000

APPENDIX VII

CITY OF RICHMOND

CAPITAL IMPROVEMENT PLAN

PROGRAM: PROJECT SUMMARY - CITY OF RICHMOND SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TP	SURFACE WATER TREATMENT PLANT*	-	7,386	686	1,112	1,772	164	11,120
TL	LOW PRESSURE SURFACE WATER TRANSMISSION LINES	-	3,326	309				3,635
	SURFACE WATER PROJECTS TOTAL	-	10,712	995	1,112	1,772	164	14,755
GW	GROUNDWATER PRODUCTION AND STORAGE FACILITIES	588	376	591	415	415	320	2,705
DL	DISTRIBUTION LINES	455	886	274	179	431		2,225
	GROUNDWATER PROJECTS TOTAL	1,043	1,262	865	594	846	320	4,930
	ALL PROJECTS TOTAL	1,043	11,974	1,860	1,706	2,618	484	19,685

*BASED ON PRO RATA SHARE OF PLANT CAPACITY

PROGRAM: CITY OF RICHMOND SURFACE WATER TREATMENT PLANT CONSTRUCTION SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TP-1	3.8 MGD FIRST PHASE OF PLANT		5,391	501				5,892
TP-2	TERMINATION STORAGE PHASE 1		1,995	185				2,180
TP-3	1.8 MGD SECOND PHASE OF PLANT (5.6 MGD TOTAL)				1,112	110		1,222
TP-4	1.6 MGD THIRD PHASE OF PLANT (7.2 MGD TOTAL)					921	91	1,012
TP-5	TERMINATION STORAGE PHASE III					741	73	814
	TREATMENT PLANT		7,386	686	1,112	1,772	164	11,120

PROJECT: CONSTRUCT FIRST PHASE OF PLANT (TP-1)

DESCRIPTION: CONSTRUCT 3.8 MGD AVER. DAILY FLOW PLANT ON ULTIMATE PLANT TRACT

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		294					294
DESIGN		591					591
CONSTRUCTION		4,506	501				5,007
TOTAL ALLOCATION		5,391	501				5,892

PROJECT: TERMINATION STORAGE (TP-2)

DESCRIPTION: CONSTRUCTION OF RAW WATER STORAGE FACILITY (PHASE I - 5.6 MGD)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN		231					231
CONSTRUCTION		1,764	185				1,949
TOTAL ALLOCATION		1,995	185				2,180

PROJECT: CONSTRUCT SECOND PHASE OF PLANT (TP-3)

DESCRIPTION: CONSTRUCT 1.8 MGD ADDITION TO BRING TOTAL PLANT CAPACITY TO 5.6 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN				113			113
CONSTRUCTION				999	110		1,109
TOTAL ALLOCATION				1,112	110		1,222

PROJECT: CONSTRUCT FINAL PHASE OF PLANT (TP-4)

DESCRIPTION: CONSTRUCT 1.6 MGD ADDITION TO BRING TOTAL PLANT CAPACITY TO 7.2 MGD AVERAGE DAILY FLOW

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2030-2030	
ACQUISITION							-
DESIGN					103		103
CONSTRUCTION					818	91	909
TOTAL ALLOCATION					921	91	1,012

PROJECT: TERMINATION STORAGE (TP-5)

DESCRIPTION: CONSTRUCTION OF RAW WATER STORAGE FACILITY
(PHASE III - 1.6 MGD) (7.2 MGD TOTAL)

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN					81		81
CONSTRUCTION					660	73	733
TOTAL ALLOCATION					741	73	814

PROGRAM: CITY OF RICHMOND SURFACE WATER TRANSMISSION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
TL-5	18" LOW PRESSURE LINE: INTERCONNECTION WITH ROSENBERG FEED		443	42				485
TL-6	24" LOW PRESSURE LINE: PLANT TO FM 2759		1,102	103				1,205
TL-7	20" LOW PRESSURE LINE: FM 2759 TO PLANT NO. 3		1,779	166				1,945
	TRANSMISSION LINES		3,324	311				3,635

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-5)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF AN 18" INTERCONNECTION WITH THE ROSENBERG FEED LINE

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		24					24
DESIGN		48					48
CONSTRUCTION		371	42				413
TOTAL ALLOCATION		443	42				485

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-6)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF A 24" LINE FROM THE SURFACE WATER TREATMENT PLANT TO FM 2759

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		60					60
DESIGN		120					120
CONSTRUCTION		922	103				1,025
TOTAL ALLOCATION		1,102	103				1,205

PROJECT: LOW PRESSURE SURFACE WATER TRANSMISSION LINE (TL-7)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF A 20" LINE FROM FM 2759 TO STORAGE/PUMPING FACILITY AT PLANT NO. 3

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		97					97
DESIGN		194					194
CONSTRUCTION		1,488	166				1,654
TOTAL ALLOCATION		1,779	166				1,945

PROGRAM: CITY OF RICHMOND GROUNDWATER PRODUCTION AND STORAGE FACILITIES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
GW-1	WATER PLANT NO. 4 AT FBPV	540						540
GW-2	NEW WELL AT PLANT NO. 2	48	272					320
GW-3	STORAGE TANKS		104	591	415	415	320	1,845
	GROUNDWATER FACILITIES	588	376	591	415	415	320	2,705

PROJECT: GROUNDWATER PLANT NO. 4 AT FORT BEND PARTNERS VENTURE (GW-1)

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	27						27
DESIGN	54						54
CONSTRUCTION	459						459
TOTAL ALLOCATION	540						540

PROJECT: 1200 GPM WELL AT GROUNDWATER PLANT NO. 2 (GW-2)

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION							
DESIGN	34						34
CONSTRUCTION		286					286
TOTAL ALLOCATION	34	286					320

PROJECT: GROUND AND ELEVATED STORAGE TANKS AT: GROUNDWATER PLANT NO. 3, FORT BEND PARTNERS VENTURE, GROUNDWATER PLANT NO. 4, AREA ALONG US 90A EAST OF BRAZOS RIVER (GW-3)

DESCRIPTION: GROUNDWATER PRODUCTION AND STORAGE FACILITY IMPROVEMENTS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		35		21	21	16	93
DESIGN		69		41	41	32	183
CONSTRUCTION			591	353	353	272	1,569
TOTAL ALLOCATION		104	591	415	415	320	1,845

PROGRAM: CITY OF RICHMOND DISTRIBUTION LINES SUMMARY OF FUNDS (Thousands)

CIP No.	Project	Proposed Encumbrances (Thousands)						Project Total
		1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
DL-1	12" LINE TO FBPV	46	264					310
DL-2	12" LINE ALONG US 90A	84	471					555
DL-3	8" LINE TO FBPV		26	149				175
DL-4	12" LINE ALONG US 59				54	306		350
DL-5	INTERNAL SYSTEM LINE WORK	325	125	125	125	125		825
	DISTRIBUTION LINES	455	886	274	179	431		2,225

PROJECT: 12" WATERLINE TO FORT BEND PARTNERS VENTURE (DL-1)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	15						15
DESIGN	31						31
CONSTRUCTION		264					264
TOTAL ALLOCATION	46	264					310

PROJECT: 12" WATERLINE TO PROJECTED DEVELOPMENT ALONG US 90A EAST OF CITY LIMITS (DL-2)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	28						28
DESIGN	56						56
CONSTRUCTION		471					471
TOTAL ALLOCATION	84	471					555

PROJECT: 8" WATERLINE TO FORT BEND PARTNERS VENTURE (DL-3)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION		9					9
DESIGN		17					17
CONSTRUCTION			149				149
TOTAL ALLOCATION		26	149				175

PROJECT: 12" WATERLINE ALONG US 59 (DL-4)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION				18			18
DESIGN				36			36
CONSTRUCTION					306		306
TOTAL ALLOCATION				54	306		360

PROJECT: ADDITIONAL WATERLINES FOR EXISTING DISTRIBUTION SYSTEM WITHIN CITY LIMITS (DL-5)

DESCRIPTION: ROW ACQUISITION AND CONSTRUCTION OF WATERLINES TO EXTEND DISTRIBUTION SYSTEM TO OUTLYING AREAS

Project Allocation	Planned Encumbrances (Thousands)						Total Project
	1990-1994	1995-1999	2000-2004	2005-2009	2010-2019	2020-2030	
ACQUISITION	16	6	6	6	6		40
DESIGN	32	12	12	12	12		80
CONSTRUCTION	277	107	107	107	107		705
TOTAL ALLOCATION	325	125	125	125	125		825

APPENDIX VIII

PROJECTED DEBT SERVICE SCHEDULES

FOR

ROSENBERG AND RICHMOND

Moroney, Beissner & Co., Inc.

Municipal Financial Advisors

Suite 1865 Post Oak Central
2000 Post Oak Boulevard
Houston, Texas 77056
713/960-8900

December 20, 1988

Mr. Larry Koonce
Director of Finance
City of Rosenberg
P.O. Box 32
Rosenberg, Texas 77471-0032

DEC 21 1988

Dear Larry:

As you requested, enclosed are projected debt service requirement schedules covering the issuance of revenue bonds by the Cities of Rosenberg and Richmond which are to be incorporated into a long range planning report being prepared by Dannenbaum Engineering Corporation.

Included in this package are proposed time schedules of issuance of bonds which were prepared with two criteria in mind: (1) minimum bond issue size of $1,000,000 and (2) frequency of issuance as required by Dannenbaum's schedule of capital expenditures, or in three-year intervals. This latter factor is important in that it is in accordance with current arbitrage regulations requiring that bond proceeds be expended within three years after their issuance.

The schedules reflect each individual bond issue; combined debt service schedule for each city (Schedules I and II) and the combined debt service of both cities together (Schedule III). We trust that these amortization tables satisfy the requirements for the planning report. However, if you have any questions or we can be of any further assistance, please don't hesitate to call.

Sincerely,

Peter C. Fisher
Vice President

PCF:cm
Enclosures

cc: Mayor
City Council
City Manager

CITY OF ROSENBERG, TEXAS

PROPOSED WATER SYSTEM IMPROVEMENTS

PROJECTED BOND SALE SCHEDULE

YEAR OF ISSUE	PRINCIPAL AMOUNT	MATURITIES
1990	$1,075,000	1991-2010
1994	3,230,000	1995-2014
1997	15,310,000	1998-2017
2000	2,430,000	2001-2020
2005	1,970,000	2006-2025
2008	3,345,000	2009-2028
2011	1,095,000	2012-2031
2016	2,020,000	2017-2036
2019	1,650,000	2020-2039
TOTAL	$32,125,000	

PREPARED BY MORONEY, BEISSNER & CO., INC.

DATE: 12/20/88
TIME: 14:22:57
FILE: ROSREV1

CITY OF ROSENBERG, TEXAS
PROJECTED WATER & SEWER REVENUE BOND ISSUANCE
1990 - 2019

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/90			43,000.00	43,000.00	43,000.00
8/ 1/91	25,000.00		86,000.00	111,000.00	111,000.00
8/ 1/92	25,000.00		84,000.00	109,000.00	109,000.00
8/ 1/93	30,000.00		82,000.00	112,000.00	112,000.00
8/ 1/94	30,000.00		208,800.00	238,800.00	238,800.00
8/ 1/95	100,000.00		335,600.00	435,600.00	435,600.00
8/ 1/96	110,000.00		327,600.00	437,600.00	437,600.00
8/ 1/97	120,000.00		931,200.00	1,051,200.00	1,051,200.00
8/ 1/98	465,000.00		1,534,000.00	1,999,000.00	1,999,000.00
8/ 1/99	500,000.00		1,496,800.00	1,996,800.00	1,996,800.00
8/ 1/ 0	540,000.00		1,554,000.00	2,094,000.00	2,094,000.00
8/ 1/ 1	635,000.00		1,608,000.00	2,243,000.00	2,243,000.00
8/ 1/ 2	690,000.00		1,557,200.00	2,247,200.00	2,247,200.00
8/ 1/ 3	740,000.00		1,502,000.00	2,242,000.00	2,242,000.00
8/ 1/ 4	800,000.00		1,442,800.00	2,242,800.00	2,242,800.00
8/ 1/ 5	870,000.00		1,457,600.00	2,327,600.00	2,327,600.00
8/ 1/ 6	985,000.00		1,466,800.00	2,451,800.00	2,451,800.00
8/ 1/ 7	1,060,000.00		1,388,000.00	2,448,000.00	2,448,000.00
8/ 1/ 8	1,135,000.00		1,437,000.00	2,572,000.00	2,572,000.00
8/ 1/ 9	1,315,000.00		1,480,000.00	2,795,000.00	2,795,000.00
8/ 1/10	1,415,000.00		1,374,800.00	2,789,800.00	2,789,800.00
8/ 1/11	1,415,000.00		1,305,400.00	2,720,400.00	2,720,400.00
8/ 1/12	1,555,000.00		1,236,000.00	2,791,000.00	2,791,000.00
8/ 1/13	1,675,000.00		1,111,600.00	2,786,600.00	2,786,600.00
8/ 1/14	1,815,000.00		977,600.00	2,792,600.00	2,792,600.00
8/ 1/15	1,625,000.00		832,400.00	2,457,400.00	2,457,400.00
8/ 1/16	1,755,000.00		783,200.00	2,538,200.00	2,538,200.00
8/ 1/17	1,940,000.00		723,600.00	2,663,600.00	2,663,600.00
8/ 1/18	540,000.00		568,400.00	1,108,400.00	1,108,400.00
8/ 1/19	575,000.00		591,200.00	1,166,200.00	1,166,200.00
8/ 1/20	660,000.00		611,200.00	1,271,200.00	1,271,200.00
8/ 1/21	470,000.00		558,400.00	1,028,400.00	1,028,400.00
8/ 1/22	500,000.00		520,800.00	1,020,800.00	1,020,800.00
8/ 1/23	545,000.00		480,800.00	1,025,800.00	1,025,800.00
8/ 1/24	585,000.00		437,200.00	1,022,200.00	1,022,200.00
8/ 1/25	635,000.00		390,400.00	1,025,400.00	1,025,400.00
8/ 1/26	485,000.00		339,600.00	824,600.00	824,600.00
8/ 1/27	520,000.00		300,800.00	820,800.00	820,800.00
8/ 1/28	565,000.00		259,200.00	824,200.00	824,200.00
8/ 1/29	270,000.00		214,000.00	484,000.00	484,000.00
8/ 1/30	295,000.00		192,400.00	487,400.00	487,400.00
8/ 1/31	320,000.00		168,800.00	488,800.00	488,800.00
8/ 1/32	230,000.00		143,200.00	373,200.00	373,200.00
8/ 1/33	250,000.00		124,800.00	374,800.00	374,800.00
8/ 1/34	270,000.00		104,800.00	374,800.00	374,800.00
8/ 1/35	290,000.00		83,200.00	373,200.00	373,200.00
8/ 1/36	315,000.00		60,000.00	375,000.00	375,000.00
8/ 1/37	135,000.00		34,800.00	169,800.00	169,800.00
8/ 1/38	145,000.00		24,000.00	169,000.00	169,000.00
8/ 1/39	155,000.00		12,400.00	167,400.00	167,400.00
	32,125,000.00		34,587,400.00	66,712,400.00	
ACCRUED					
	32,125,000.00		34,587,400.00	66,712,400.00	

CITY OF ROSENBERG, TEXAS
PROJECTED WATER & SEWER REVENUE BOND ISSUANCE
1990 - 2019

DEBT SERVICE SCHEDULE

DATED 2/ 1/90	WITH DELIVERY OF 2/ 1/90		
BOND YEARS	789,857.500		
AVERAGE COUPON	4.379		
AVERAGE LIFE	24.587		
N I C %	4.378942 %	USING	100.0000000
T I C %	3.644347 %	USING	100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:09:47 FILENAME: RB KEY: REVCOMB

CITY OF ROSENBERG, TEXAS
$1,075,000 WATER & SEWER REVENUE BONDS
SERIES 1990

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/90			43,000.00	43,000.00	43,000.00
8/ 1/91	25,000.00	8.000000	86,000.00	111,000.00	111,000.00
8/ 1/92	25,000.00	8.000000	84,000.00	109,000.00	109,000.00
8/ 1/93	30,000.00	8.000000	82,000.00	112,000.00	112,000.00
8/ 1/94	30,000.00	8.000000	79,600.00	109,600.00	109,600.00
8/ 1/95	30,000.00	8.000000	77,200.00	107,200.00	107,200.00
8/ 1/96	35,000.00	8.000000	74,800.00	109,800.00	109,800.00
8/ 1/97	35,000.00	8.000000	72,000.00	107,000.00	107,000.00
8/ 1/98	40,000.00	8.000000	69,200.00	109,200.00	109,200.00
8/ 1/99	45,000.00	8.000000	66,000.00	111,000.00	111,000.00
8/ 1/ 0	45,000.00	8.000000	62,400.00	107,400.00	107,400.00
8/ 1/ 1	50,000.00	8.000000	58,800.00	108,800.00	108,800.00
8/ 1/ 2	55,000.00	8.000000	54,800.00	109,800.00	109,800.00
8/ 1/ 3	60,000.00	8.000000	50,400.00	110,400.00	110,400.00
8/ 1/ 4	65,000.00	8.000000	45,600.00	110,600.00	110,600.00
8/ 1/ 5	70,000.00	8.000000	40,400.00	110,400.00	110,400.00
8/ 1/ 6	75,000.00	8.000000	34,800.00	109,800.00	109,800.00
8/ 1/ 7	80,000.00	8.000000	28,800.00	108,800.00	108,800.00
8/ 1/ 8	85,000.00	8.000000	22,400.00	107,400.00	107,400.00
8/ 1/ 9	95,000.00	8.000000	15,600.00	110,600.00	110,600.00
8/ 1/10	100,000.00	8.000000	8,000.00	108,000.00	108,000.00
	1,075,000.00		1,155,800.00	2,230,800.00	
ACCRUED					
	1,075,000.00		1,155,800.00	2,230,800.00	

DATED 2/ 1/90 WITH DELIVERY OF 2/ 1/90
BOND YEARS 14,447.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.440
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:32:16 FILENAME: RB KEY: 90REV

CITY OF ROSENBERG, TEXAS
$3,230,000 WATER & SEWER REVENUE BONDS
SERIES 1994

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/94			129,200.00	129,200.00	129,200.00
8/ 1/95	70,000.00	8.000000	258,400.00	328,400.00	328,400.00
8/ 1/96	75,000.00	8.000000	252,800.00	327,800.00	327,800.00
8/ 1/97	85,000.00	8.000000	246,800.00	331,800.00	331,800.00
8/ 1/98	90,000.00	8.000000	240,000.00	330,000.00	330,000.00
8/ 1/99	95,000.00	8.000000	232,800.00	327,800.00	327,800.00
8/ 1/ 0	105,000.00	8.000000	225,200.00	330,200.00	330,200.00
8/ 1/ 1	110,000.00	8.000000	216,800.00	326,800.00	326,800.00
8/ 1/ 2	120,000.00	8.000000	208,000.00	328,000.00	328,000.00
8/ 1/ 3	130,000.00	8.000000	198,400.00	328,400.00	328,400.00
8/ 1/ 4	140,000.00	8.000000	188,000.00	328,000.00	328,000.00
8/ 1/ 5	155,000.00	8.000000	176,800.00	331,800.00	331,800.00
8/ 1/ 6	165,000.00	8.000000	164,400.00	329,400.00	329,400.00
8/ 1/ 7	180,000.00	8.000000	151,200.00	331,200.00	331,200.00
8/ 1/ 8	190,000.00	8.000000	136,800.00	326,800.00	326,800.00
8/ 1/ 9	210,000.00	8.000000	121,600.00	331,600.00	331,600.00
8/ 1/10	225,000.00	8.000000	104,800.00	329,800.00	329,800.00
8/ 1/11	240,000.00	8.000000	86,800.00	326,800.00	326,800.00
8/ 1/12	260,000.00	8.000000	67,600.00	327,600.00	327,600.00
8/ 1/13	280,000.00	8.000000	46,800.00	326,800.00	326,800.00
8/ 1/14	305,000.00	8.000000	24,400.00	329,400.00	329,400.00
	3,230,000.00		3,477,600.00	6,707,600.00	
ACCRUED					
	3,230,000.00		3,477,600.00	6,707,600.00	

DATED 2/ 1/94 WITH DELIVERY OF 2/ 1/94
BOND YEARS 43,470.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.458
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:36:10 FILENAME: RB KEY: 94REV

CITY OF ROSENBERG, TEXAS
$15,310,000 WATER & SEWER REVENUE BONDS
SERIES 1997

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/97			612,400.00	612,400.00	612,400.00
8/ 1/98	335,000.00	8.000000	1,224,800.00	1,559,800.00	1,559,800.00
8/ 1/99	360,000.00	8.000000	1,198,000.00	1,558,000.00	1,558,000.00
8/ 1/ 0	390,000.00	8.000000	1,169,200.00	1,559,200.00	1,559,200.00
8/ 1/ 1	420,000.00	8.000000	1,138,000.00	1,558,000.00	1,558,000.00
8/ 1/ 2	455,000.00	8.000000	1,104,400.00	1,559,400.00	1,559,400.00
8/ 1/ 3	490,000.00	8.000000	1,068,000.00	1,558,000.00	1,558,000.00
8/ 1/ 4	530,000.00	8.000000	1,028,800.00	1,558,800.00	1,558,800.00
8/ 1/ 5	575,000.00	8.000000	986,400.00	1,561,400.00	1,561,400.00
8/ 1/ 6	620,000.00	8.000000	940,400.00	1,560,400.00	1,560,400.00
8/ 1/ 7	670,000.00	8.000000	890,800.00	1,560,800.00	1,560,800.00
8/ 1/ 8	720,000.00	8.000000	837,200.00	1,557,200.00	1,557,200.00
8/ 1/ 9	780,000.00	8.000000	779,600.00	1,559,600.00	1,559,600.00
8/ 1/10	845,000.00	8.000000	717,200.00	1,562,200.00	1,562,200.00
8/ 1/11	910,000.00	8.000000	649,600.00	1,559,600.00	1,559,600.00
8/ 1/12	985,000.00	8.000000	576,800.00	1,561,800.00	1,561,800.00
8/ 1/13	1,060,000.00	8.000000	498,000.00	1,558,000.00	1,558,000.00
8/ 1/14	1,145,000.00	8.000000	413,200.00	1,558,200.00	1,558,200.00
8/ 1/15	1,240,000.00	8.000000	321,600.00	1,561,600.00	1,561,600.00
8/ 1/16	1,335,000.00	8.000000	222,400.00	1,557,400.00	1,557,400.00
8/ 1/17	1,445,000.00	8.000000	115,600.00	1,560,600.00	1,560,600.00
	15,310,000.00		16,492,400.00	31,802,400.00	
ACCRUED					
	15,310,000.00		16,492,400.00	31,802,400.00	

DATED 2/ 1/97 WITH DELIVERY OF 2/ 1/97
BOND YEARS 206,155.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.465
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:39:38 FILENAME: RB KEY: 97REV

CITY OF ROSENBERG, TEXAS
$2,430,000 WATER & SEWER REVENUE BONDS
SERIES 2000

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 0			97,200.00	97,200.00	97,200.00
8/ 1/ 1	55,000.00	8.000000	194,400.00	249,400.00	249,400.00
8/ 1/ 2	60,000.00	8.000000	190,000.00	250,000.00	250,000.00
8/ 1/ 3	60,000.00	8.000000	185,200.00	245,200.00	245,200.00
8/ 1/ 4	65,000.00	8.000000	180,400.00	245,400.00	245,400.00
8/ 1/ 5	70,000.00	8.000000	175,200.00	245,200.00	245,200.00
8/ 1/ 6	80,000.00	8.000000	169,600.00	249,600.00	249,600.00
8/ 1/ 7	85,000.00	8.000000	163,200.00	248,200.00	248,200.00
8/ 1/ 8	90,000.00	8.000000	156,400.00	246,400.00	246,400.00
8/ 1/ 9	100,000.00	8.000000	149,200.00	249,200.00	249,200.00
8/ 1/10	105,000.00	8.000000	141,200.00	246,200.00	246,200.00
8/ 1/11	115,000.00	8.000000	132,800.00	247,800.00	247,800.00
8/ 1/12	125,000.00	8.000000	123,600.00	248,600.00	248,600.00
8/ 1/13	135,000.00	8.000000	113,600.00	248,600.00	248,600.00
8/ 1/14	145,000.00	8.000000	102,800.00	247,800.00	247,800.00
8/ 1/15	155,000.00	8.000000	91,200.00	246,200.00	246,200.00
8/ 1/16	170,000.00	8.000000	78,800.00	248,800.00	248,800.00
8/ 1/17	180,000.00	8.000000	65,200.00	245,200.00	245,200.00
8/ 1/18	195,000.00	8.000000	50,800.00	245,800.00	245,800.00
8/ 1/19	210,000.00	8.000000	35,200.00	245,200.00	245,200.00
8/ 1/20	230,000.00	8.000000	18,400.00	248,400.00	248,400.00
	2,430,000.00		2,614,400.00	5,044,400.00	
ACCRUED					
	2,430,000.00		2,614,400.00	5,044,400.00	

DATED 2/ 1/ 0 WITH DELIVERY OF 2/ 1/ 0
BOND YEARS 32,680.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.449
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:42:57 FILENAME: RB KEY: 00REV

CITY OF ROSENBERG, TEXAS
$1,970,000 WATER & SEWER REVENUE BONDS
SERIES 2005

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 5			78,800.00	78,800.00	78,800.00
8/ 1/ 6	45,000.00	8.000000	157,600.00	202,600.00	202,600.00
8/ 1/ 7	45,000.00	8.000000	154,000.00	199,000.00	199,000.00
8/ 1/ 8	50,000.00	8.000000	150,400.00	200,400.00	200,400.00
8/ 1/ 9	55,000.00	8.000000	146,400.00	201,400.00	201,400.00
8/ 1/10	60,000.00	8.000000	142,000.00	202,000.00	202,000.00
8/ 1/11	65,000.00	8.000000	137,200.00	202,200.00	202,200.00
8/ 1/12	70,000.00	8.000000	132,000.00	202,000.00	202,000.00
8/ 1/13	75,000.00	8.000000	126,400.00	201,400.00	201,400.00
8/ 1/14	80,000.00	8.000000	120,400.00	200,400.00	200,400.00
8/ 1/15	85,000.00	8.000000	114,000.00	199,000.00	199,000.00
8/ 1/16	95,000.00	8.000000	107,200.00	202,200.00	202,200.00
8/ 1/17	100,000.00	8.000000	99,600.00	199,600.00	199,600.00
8/ 1/18	110,000.00	8.000000	91,600.00	201,600.00	201,600.00
8/ 1/19	115,000.00	8.000000	82,800.00	197,800.00	197,800.00
8/ 1/20	125,000.00	8.000000	73,600.00	198,600.00	198,600.00
8/ 1/21	135,000.00	8.000000	63,600.00	198,600.00	198,600.00
8/ 1/22	145,000.00	8.000000	52,800.00	197,800.00	197,800.00
8/ 1/23	160,000.00	8.000000	41,200.00	201,200.00	201,200.00
8/ 1/24	170,000.00	8.000000	28,400.00	198,400.00	198,400.00
8/ 1/25	185,000.00	8.000000	14,800.00	199,800.00	199,800.00
	1,970,000.00		2,114,800.00	4,084,800.00	
ACCRUED					
	1,970,000.00		2,114,800.00	4,084,800.00	

DATED 2/ 1/ 5 WITH DELIVERY OF 2/ 1/ 5
BOND YEARS 26,435.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.419
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:45:43 FILENAME: RB KEY: 05REV

CITY OF ROSENBERG, TEXAS
$3,345,000 WATER & SEWER REVENUE BONDS
SERIES 2008

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 8			133,800.00	133,800.00	133,800.00
8/ 1/ 9	75,000.00	8.000000	267,600.00	342,600.00	342,600.00
8/ 1/10	80,000.00	8.000000	261,600.00	341,600.00	341,600.00
8/ 1/11	85,000.00	8.000000	255,200.00	340,200.00	340,200.00
8/ 1/12	90,000.00	8.000000	248,400.00	338,400.00	338,400.00
8/ 1/13	100,000.00	8.000000	241,200.00	341,200.00	341,200.00
8/ 1/14	110,000.00	8.000000	233,200.00	343,200.00	343,200.00
8/ 1/15	115,000.00	8.000000	224,400.00	339,400.00	339,400.00
8/ 1/16	125,000.00	8.000000	215,200.00	340,200.00	340,200.00
8/ 1/17	135,000.00	8.000000	205,200.00	340,200.00	340,200.00
8/ 1/18	145,000.00	8.000000	194,400.00	339,400.00	339,400.00
8/ 1/19	160,000.00	8.000000	182,800.00	342,800.00	342,800.00
8/ 1/20	170,000.00	8.000000	170,000.00	340,000.00	340,000.00
8/ 1/21	185,000.00	8.000000	156,400.00	341,400.00	341,400.00
8/ 1/22	200,000.00	8.000000	141,600.00	341,600.00	341,600.00
8/ 1/23	215,000.00	8.000000	125,600.00	340,600.00	340,600.00
8/ 1/24	230,000.00	8.000000	108,400.00	338,400.00	338,400.00
8/ 1/25	250,000.00	8.000000	90,000.00	340,000.00	340,000.00
8/ 1/26	270,000.00	8.000000	70,000.00	340,000.00	340,000.00
8/ 1/27	290,000.00	8.000000	48,400.00	338,400.00	338,400.00
8/ 1/28	315,000.00	8.000000	25,200.00	340,200.00	340,200.00
	3,345,000.00		3,598,600.00	6,943,600.00	
ACCRUED					
	3,345,000.00		3,598,600.00	6,943,600.00	

DATED 2/ 1/ 8 WITH DELIVERY OF 2/ 1/ 8
BOND YEARS 44,982.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.448
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:56:18 FILENAME: RB KEY: 08REV

CITY OF ROSENBERG, TEXAS
$1,095,000 WATER & SEWER REVENUE BONDS
SERIES 2011

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/11			43,800.00	43,800.00	43,800.00
8/ 1/12	25,000.00	8.000000	87,600.00	112,600.00	112,600.00
8/ 1/13	25,000.00	8.000000	85,600.00	110,600.00	110,600.00
8/ 1/14	30,000.00	8.000000	83,600.00	113,600.00	113,600.00
8/ 1/15	30,000.00	8.000000	81,200.00	111,200.00	111,200.00
8/ 1/16	30,000.00	8.000000	78,800.00	108,800.00	108,800.00
8/ 1/17	35,000.00	8.000000	76,400.00	111,400.00	111,400.00
8/ 1/18	40,000.00	8.000000	73,600.00	113,600.00	113,600.00
8/ 1/19	40,000.00	8.000000	70,400.00	110,400.00	110,400.00
8/ 1/20	45,000.00	8.000000	67,200.00	112,200.00	112,200.00
8/ 1/21	50,000.00	8.000000	63,600.00	113,600.00	113,600.00
8/ 1/22	50,000.00	8.000000	59,600.00	109,600.00	109,600.00
8/ 1/23	55,000.00	8.000000	55,600.00	110,600.00	110,600.00
8/ 1/24	60,000.00	8.000000	51,200.00	111,200.00	111,200.00
8/ 1/25	65,000.00	8.000000	46,400.00	111,400.00	111,400.00
8/ 1/26	70,000.00	8.000000	41,200.00	111,200.00	111,200.00
8/ 1/27	75,000.00	8.000000	35,600.00	110,600.00	110,600.00
8/ 1/28	80,000.00	8.000000	29,600.00	109,600.00	109,600.00
8/ 1/29	90,000.00	8.000000	23,200.00	113,200.00	113,200.00
8/ 1/30	95,000.00	8.000000	16,000.00	111,000.00	111,000.00
8/ 1/31	105,000.00	8.000000	8,400.00	113,400.00	113,400.00
	1,095,000.00		1,178,600.00	2,273,600.00	
ACCRUED					
	1,095,000.00		1,178,600.00	2,273,600.00	

DATED 2/ 1/11 WITH DELIVERY OF 2/ 1/11
BOND YEARS 14,732.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.454
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:53:20 FILENAME: RB KEY: 11REV

CITY OF ROSENBERG, TEXAS
$2,020,000 WATER & SEWER REVENUE BONDS
SERIES 2016

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/16			80,800.00	80,800.00	80,800.00
8/ 1/17	45,000.00	8.000000	161,600.00	206,600.00	206,600.00
8/ 1/18	50,000.00	8.000000	158,000.00	208,000.00	208,000.00
8/ 1/19	50,000.00	8.000000	154,000.00	204,000.00	204,000.00
8/ 1/20	55,000.00	8.000000	150,000.00	205,000.00	205,000.00
8/ 1/21	60,000.00	8.000000	145,600.00	205,600.00	205,600.00
8/ 1/22	65,000.00	8.000000	140,800.00	205,800.00	205,800.00
8/ 1/23	70,000.00	8.000000	135,600.00	205,600.00	205,600.00
8/ 1/24	75,000.00	8.000000	130,000.00	205,000.00	205,000.00
8/ 1/25	80,000.00	8.000000	124,000.00	204,000.00	204,000.00
8/ 1/26	90,000.00	8.000000	117,600.00	207,600.00	207,600.00
8/ 1/27	95,000.00	8.000000	110,400.00	205,400.00	205,400.00
8/ 1/28	105,000.00	8.000000	102,800.00	207,800.00	207,800.00
8/ 1/29	110,000.00	8.000000	94,400.00	204,400.00	204,400.00
8/ 1/30	120,000.00	8.000000	85,600.00	205,600.00	205,600.00
8/ 1/31	130,000.00	8.000000	76,000.00	206,000.00	206,000.00
8/ 1/32	140,000.00	8.000000	65,600.00	205,600.00	205,600.00
8/ 1/33	150,000.00	8.000000	54,400.00	204,400.00	204,400.00
8/ 1/34	165,000.00	8.000000	42,400.00	207,400.00	207,400.00
8/ 1/35	175,000.00	8.000000	29,200.00	204,200.00	204,200.00
8/ 1/36	190,000.00	8.000000	15,200.00	205,200.00	205,200.00
	2,020,000.00		2,174,000.00	4,194,000.00	
ACCRUED					
	2,020,000.00		2,174,000.00	4,194,000.00	

DATED 2/ 1/16 WITH DELIVERY OF 2/ 1/16
BOND YEARS 27,175.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.453
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 10:59:19 FILENAME: RB KEY: 16REV

CITY OF ROSENBERG, TEXAS
$1,650,000 WATER & SEWER REVENUE BONDS
SERIES 2019

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/19			66,000.00	66,000.00	66,000.00
8/ 1/20	35,000.00	8.000000	132,000.00	167,000.00	167,000.00
8/ 1/21	40,000.00	8.000000	129,200.00	169,200.00	169,200.00
8/ 1/22	40,000.00	8.000000	126,000.00	166,000.00	166,000.00
8/ 1/23	45,000.00	8.000000	122,800.00	167,800.00	167,800.00
8/ 1/24	50,000.00	8.000000	119,200.00	169,200.00	169,200.00
8/ 1/25	55,000.00	8.000000	115,200.00	170,200.00	170,200.00
8/ 1/26	55,000.00	8.000000	110,800.00	165,800.00	165,800.00
8/ 1/27	60,000.00	8.000000	106,400.00	166,400.00	166,400.00
8/ 1/28	65,000.00	8.000000	101,600.00	166,600.00	166,600.00
8/ 1/29	70,000.00	8.000000	96,400.00	166,400.00	166,400.00
8/ 1/30	80,000.00	8.000000	90,800.00	170,800.00	170,800.00
8/ 1/31	85,000.00	8.000000	84,400.00	169,400.00	169,400.00
8/ 1/32	90,000.00	8.000000	77,600.00	167,600.00	167,600.00
8/ 1/33	100,000.00	8.000000	70,400.00	170,400.00	170,400.00
8/ 1/34	105,000.00	8.000000	62,400.00	167,400.00	167,400.00
8/ 1/35	115,000.00	8.000000	54,000.00	169,000.00	169,000.00
8/ 1/36	125,000.00	8.000000	44,800.00	169,800.00	169,800.00
8/ 1/37	135,000.00	8.000000	34,800.00	169,800.00	169,800.00
8/ 1/38	145,000.00	8.000000	24,000.00	169,000.00	169,000.00
8/ 1/39	155,000.00	8.000000	12,400.00	167,400.00	167,400.00
	1,650,000.00		1,781,200.00	3,431,200.00	
ACCRUED					
	1,650,000.00		1,781,200.00	3,431,200.00	

DATED 2/ 1/19 WITH DELIVERY OF 2/ 1/19
BOND YEARS 22,265.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.494
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:01:59 FILENAME: RB KEY: 19REV

CITY OF RICHMOND, TEXAS

PROPOSED WATER SYSTEM IMPROVEMENTS

PROJECTED BOND SALE SCHEDULE

YEAR OF ISSUE	PRINCIPAL AMOUNT	MATURITIES
1990	$1,065,000	1991-2010
1994	2,420,000	1995-2014
1997	9,725,000	1998-2017
2000	1,895,000	2001-2020
2005	1,255,000	2006-2025
2009	1,460,000	2010-2029
2016	1,025,000	2017-2036
2019	1,165,000	2020-2039
TOTAL	$20,010,000	

PREPARED BY MORONEY, BEISSNER & CO., INC.

DATE: 12/20/88
TIME: 14:29:01
FILE: ROSREV2

Schedule II

CITY OF RICHMOND, TEXAS
PROPOSED WATER & SEWER REVENUE BOND ISSUANCE
1990 - 2019

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/90			42,600.00	42,600.00	42,600.00
8/ 1/91	25,000.00		85,200.00	110,200.00	110,200.00
8/ 1/92	25,000.00		83,200.00	108,200.00	108,200.00
8/ 1/93	25,000.00		81,200.00	106,200.00	106,200.00
8/ 1/94	30,000.00		176,000.00	206,000.00	206,000.00
8/ 1/95	85,000.00		270,400.00	355,400.00	355,400.00
8/ 1/96	90,000.00		263,600.00	353,600.00	353,600.00
8/ 1/97	95,000.00		645,400.00	740,400.00	740,400.00
8/ 1/98	315,000.00		1,026,800.00	1,341,800.00	1,341,800.00
8/ 1/99	345,000.00		1,001,600.00	1,346,600.00	1,346,600.00
8/ 1/ 0	370,000.00		1,049,800.00	1,419,800.00	1,419,800.00
8/ 1/ 1	440,000.00		1,096,000.00	1,536,000.00	1,536,000.00
8/ 1/ 2	480,000.00		1,060,800.00	1,540,800.00	1,540,800.00
8/ 1/ 3	520,000.00		1,022,400.00	1,542,400.00	1,542,400.00
8/ 1/ 4	560,000.00		980,800.00	1,540,800.00	1,540,800.00
8/ 1/ 5	605,000.00		986,200.00	1,591,200.00	1,591,200.00
8/ 1/ 6	685,000.00		988,000.00	1,673,000.00	1,673,000.00
8/ 1/ 7	735,000.00		933,200.00	1,668,200.00	1,668,200.00
8/ 1/ 8	790,000.00		874,400.00	1,664,400.00	1,664,400.00
8/ 1/ 9	850,000.00		869,600.00	1,719,600.00	1,719,600.00
8/ 1/10	955,000.00		860,000.00	1,815,000.00	1,815,000.00
8/ 1/11	925,000.00		783,600.00	1,708,600.00	1,708,600.00
8/ 1/12	995,000.00		709,600.00	1,704,600.00	1,704,600.00
8/ 1/13	1,075,000.00		630,000.00	1,705,000.00	1,705,000.00
8/ 1/14	1,170,000.00		544,000.00	1,714,000.00	1,714,000.00
8/ 1/15	1,005,000.00		450,400.00	1,455,400.00	1,455,400.00
8/ 1/16	1,090,000.00		411,000.00	1,501,000.00	1,501,000.00
8/ 1/17	1,200,000.00		364,800.00	1,564,800.00	1,564,800.00
8/ 1/18	310,000.00		268,800.00	578,800.00	578,800.00
8/ 1/19	330,000.00		290,600.00	620,600.00	620,600.00
8/ 1/20	385,000.00		310,800.00	695,800.00	695,800.00
8/ 1/21	220,000.00		280,000.00	500,000.00	500,000.00
8/ 1/22	240,000.00		262,400.00	502,400.00	502,400.00
8/ 1/23	250,000.00		243,200.00	493,200.00	493,200.00
8/ 1/24	280,000.00		223,200.00	503,200.00	503,200.00
8/ 1/25	300,000.00		200,800.00	500,800.00	500,800.00
8/ 1/26	195,000.00		176,800.00	371,800.00	371,800.00
8/ 1/27	215,000.00		161,200.00	376,200.00	376,200.00
8/ 1/28	220,000.00		144,000.00	364,000.00	364,000.00
8/ 1/29	245,000.00		126,400.00	371,400.00	371,400.00
8/ 1/30	115,000.00		106,800.00	221,800.00	221,800.00
8/ 1/31	125,000.00		97,600.00	222,600.00	222,600.00
8/ 1/32	135,000.00		87,600.00	222,600.00	222,600.00
8/ 1/33	145,000.00		76,800.00	221,800.00	221,800.00
8/ 1/34	160,000.00		65,200.00	225,200.00	225,200.00
8/ 1/35	170,000.00		52,400.00	222,400.00	222,400.00
8/ 1/36	180,000.00		38,800.00	218,800.00	218,800.00
8/ 1/37	95,000.00		24,400.00	119,400.00	119,400.00
8/ 1/38	100,000.00		16,800.00	116,800.00	116,800.00
8/ 1/39	110,000.00		8,800.00	118,800.00	118,800.00
	20,010,000.00		21,554,000.00	41,564,000.00	
ACCRUED					
	20,010,000.00		21,554,000.00	41,564,000.00	

CITY OF RICHMOND, TEXAS
PROPOSED WATER & SEWER REVENUE BOND ISSUANCE
1990 - 2019

DEBT SERVICE SCHEDULE

DATED 2/ 1/90	WITH DELIVERY OF 2/ 1/90			
BOND YEARS	473,130.000			
AVERAGE COUPON	4.556			
AVERAGE LIFE	23.645			
N I C %	4.555619 %	USING	100.0000000	
T I C %	3.832818 %	USING	100.0000000	

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:49:06 FILENAME: RICH KEY: REVCOMB

CITY OF RICHMOND, TEXAS
$1,065,000 WATER & SEWER REVENUE BONDS
SERIES 1990

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/90			42,600.00	42,600.00	42,600.00
8/ 1/91	25,000.00	8.000000	85,200.00	110,200.00	110,200.00
8/ 1/92	25,000.00	8.000000	83,200.00	108,200.00	108,200.00
8/ 1/93	25,000.00	8.000000	81,200.00	106,200.00	106,200.00
8/ 1/94	30,000.00	8.000000	79,200.00	109,200.00	109,200.00
8/ 1/95	30,000.00	8.000000	76,800.00	106,800.00	106,800.00
8/ 1/96	35,000.00	8.000000	74,400.00	109,400.00	109,400.00
8/ 1/97	35,000.00	8.000000	71,600.00	106,600.00	106,600.00
8/ 1/98	40,000.00	8.000000	68,800.00	108,800.00	108,800.00
8/ 1/99	45,000.00	8.000000	65,600.00	110,600.00	110,600.00
8/ 1/ 0	45,000.00	8.000000	62,000.00	107,000.00	107,000.00
8/ 1/ 1	50,000.00	8.000000	58,400.00	108,400.00	108,400.00
8/ 1/ 2	55,000.00	8.000000	54,400.00	109,400.00	109,400.00
8/ 1/ 3	60,000.00	8.000000	50,000.00	110,000.00	110,000.00
8/ 1/ 4	65,000.00	8.000000	45,200.00	110,200.00	110,200.00
8/ 1/ 5	70,000.00	8.000000	40,000.00	110,000.00	110,000.00
8/ 1/ 6	75,000.00	8.000000	34,400.00	109,400.00	109,400.00
8/ 1/ 7	80,000.00	8.000000	28,400.00	108,400.00	108,400.00
8/ 1/ 8	85,000.00	8.000000	22,000.00	107,000.00	107,000.00
8/ 1/ 9	90,000.00	8.000000	15,200.00	105,200.00	105,200.00
8/ 1/10	100,000.00	8.000000	8,000.00	108,000.00	108,000.00
	1,065,000.00		1,146,600.00	2,211,600.00	
ACCRUED					
	1,065,000.00		1,146,600.00	2,211,600.00	

DATED 2/ 1/90 WITH DELIVERY OF 2/ 1/90
BOND YEARS 14,332.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.458
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:18:38 FILENAME: RICH KEY: 90REV

CITY OF RICHMOND, TEXAS
$2,420,000 WATER & SEWER REVENUE BONDS
SERIES 1994

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/94			96,800.00	96,800.00	96,800.00
8/ 1/95	55,000.00	8.000000	193,600.00	248,600.00	248,600.00
8/ 1/96	55,000.00	8.000000	189,200.00	244,200.00	244,200.00
8/ 1/97	60,000.00	8.000000	184,800.00	244,800.00	244,800.00
8/ 1/98	65,000.00	8.000000	180,000.00	245,000.00	245,000.00
8/ 1/99	70,000.00	8.000000	174,800.00	244,800.00	244,800.00
8/ 1/ 0	75,000.00	8.000000	169,200.00	244,200.00	244,200.00
8/ 1/ 1	85,000.00	8.000000	163,200.00	248,200.00	248,200.00
8/ 1/ 2	90,000.00	8.000000	156,400.00	246,400.00	246,400.00
8/ 1/ 3	100,000.00	8.000000	149,200.00	249,200.00	249,200.00
8/ 1/ 4	105,000.00	8.000000	141,200.00	246,200.00	246,200.00
8/ 1/ 5	115,000.00	8.000000	132,800.00	247,800.00	247,800.00
8/ 1/ 6	125,000.00	8.000000	123,600.00	248,600.00	248,600.00
8/ 1/ 7	135,000.00	8.000000	113,600.00	248,600.00	248,600.00
8/ 1/ 8	145,000.00	8.000000	102,800.00	247,800.00	247,800.00
8/ 1/ 9	155,000.00	8.000000	91,200.00	246,200.00	246,200.00
8/ 1/10	170,000.00	8.000000	78,800.00	248,800.00	248,800.00
8/ 1/11	180,000.00	8.000000	65,200.00	245,200.00	245,200.00
8/ 1/12	195,000.00	8.000000	50,800.00	245,800.00	245,800.00
8/ 1/13	210,000.00	8.000000	35,200.00	245,200.00	245,200.00
8/ 1/14	230,000.00	8.000000	18,400.00	248,400.00	248,400.00
	2,420,000.00		2,610,800.00	5,030,800.00	
ACCRUED					
	2,420,000.00		2,610,800.00	5,030,800.00	

DATED 2/ 1/94 WITH DELIVERY OF 2/ 1/94
BOND YEARS 32,635.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.486
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:22:03 FILENAME: RICH KEY: 94REV

CITY OF RICHMOND, TEXAS
$9,725,000 WATER & SEWER REVENUE BONDS
SERIES 1997

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/97			389,000.00	389,000.00	389,000.00
8/ 1/98	210,000.00	8.000000	778,000.00	988,000.00	988,000.00
8/ 1/99	230,000.00	8.000000	761,200.00	991,200.00	991,200.00
8/ 1/ 0	250,000.00	8.000000	742,800.00	992,800.00	992,800.00
8/ 1/ 1	265,000.00	8.000000	722,800.00	987,800.00	987,800.00
8/ 1/ 2	290,000.00	8.000000	701,600.00	991,600.00	991,600.00
8/ 1/ 3	310,000.00	8.000000	678,400.00	988,400.00	988,400.00
8/ 1/ 4	335,000.00	8.000000	653,600.00	988,600.00	988,600.00
8/ 1/ 5	365,000.00	8.000000	626,800.00	991,800.00	991,800.00
8/ 1/ 6	395,000.00	8.000000	597,600.00	992,600.00	992,600.00
8/ 1/ 7	425,000.00	8.000000	566,000.00	991,000.00	991,000.00
8/ 1/ 8	460,000.00	8.000000	532,000.00	992,000.00	992,000.00
8/ 1/ 9	495,000.00	8.000000	495,200.00	990,200.00	990,200.00
8/ 1/10	535,000.00	8.000000	455,600.00	990,600.00	990,600.00
8/ 1/11	580,000.00	8.000000	412,800.00	992,800.00	992,800.00
8/ 1/12	625,000.00	8.000000	366,400.00	991,400.00	991,400.00
8/ 1/13	675,000.00	8.000000	316,400.00	991,400.00	991,400.00
8/ 1/14	730,000.00	8.000000	262,400.00	992,400.00	992,400.00
8/ 1/15	785,000.00	8.000000	204,000.00	989,000.00	989,000.00
8/ 1/16	850,000.00	8.000000	141,200.00	991,200.00	991,200.00
8/ 1/17	915,000.00	8.000000	73,200.00	988,200.00	988,200.00
	9,725,000.00		10,477,000.00	20,202,000.00	
ACCRUED					
	9,725,000.00		10,477,000.00	20,202,000.00	

DATED 2/ 1/97 WITH DELIVERY OF 2/ 1/97
BOND YEARS 130,962.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.467
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:25:45 FILENAME: RICH KEY: 97REV

CITY OF RICHMOND, TEXAS
$1,895,000 WATER & SEWER REVENUE BONDS
SERIES 2000

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 0			75,800.00	75,800.00	75,800.00
8/ 1/ 1	40,000.00	8.000000	151,600.00	191,600.00	191,600.00
8/ 1/ 2	45,000.00	8.000000	148,400.00	193,400.00	193,400.00
8/ 1/ 3	50,000.00	8.000000	144,800.00	194,800.00	194,800.00
8/ 1/ 4	55,000.00	8.000000	140,800.00	195,800.00	195,800.00
8/ 1/ 5	55,000.00	8.000000	136,400.00	191,400.00	191,400.00
8/ 1/ 6	60,000.00	8.000000	132,000.00	192,000.00	192,000.00
8/ 1/ 7	65,000.00	8.000000	127,200.00	192,200.00	192,200.00
8/ 1/ 8	70,000.00	8.000000	122,000.00	192,000.00	192,000.00
8/ 1/ 9	75,000.00	8.000000	116,400.00	191,400.00	191,400.00
8/ 1/10	85,000.00	8.000000	110,400.00	195,400.00	195,400.00
8/ 1/11	90,000.00	8.000000	103,600.00	193,600.00	193,600.00
8/ 1/12	95,000.00	8.000000	96,400.00	191,400.00	191,400.00
8/ 1/13	105,000.00	8.000000	88,800.00	193,800.00	193,800.00
8/ 1/14	115,000.00	8.000000	80,400.00	195,400.00	195,400.00
8/ 1/15	120,000.00	8.000000	71,200.00	191,200.00	191,200.00
8/ 1/16	130,000.00	8.000000	61,600.00	191,600.00	191,600.00
8/ 1/17	140,000.00	8.000000	51,200.00	191,200.00	191,200.00
8/ 1/18	155,000.00	8.000000	40,000.00	195,000.00	195,000.00
8/ 1/19	165,000.00	8.000000	27,600.00	192,600.00	192,600.00
8/ 1/20	180,000.00	8.000000	14,400.00	194,400.00	194,400.00
	1,895,000.00		2,041,000.00	3,936,000.00	
ACCRUED					
	1,895,000.00		2,041,000.00	3,936,000.00	

DATED 2/ 1/ 0 WITH DELIVERY OF 2/ 1/ 0
BOND YEARS 25,512.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.463
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:29:04 FILENAME: RICH KEY: 00REV

CITY OF RICHMOND, TEXAS
$1,255,000 WATER & SEWER REVENUE BONDS
SERIES 2005

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 5			50,200.00	50,200.00	50,200.00
8/ 1/ 6	30,000.00	8.000000	100,400.00	130,400.00	130,400.00
8/ 1/ 7	30,000.00	8.000000	98,000.00	128,000.00	128,000.00
8/ 1/ 8	30,000.00	8.000000	95,600.00	125,600.00	125,600.00
8/ 1/ 9	35,000.00	8.000000	93,200.00	128,200.00	128,200.00
8/ 1/10	35,000.00	8.000000	90,400.00	125,400.00	125,400.00
8/ 1/11	40,000.00	8.000000	87,600.00	127,600.00	127,600.00
8/ 1/12	45,000.00	8.000000	84,400.00	129,400.00	129,400.00
8/ 1/13	45,000.00	8.000000	80,800.00	125,800.00	125,800.00
8/ 1/14	50,000.00	8.000000	77,200.00	127,200.00	127,200.00
8/ 1/15	55,000.00	8.000000	73,200.00	128,200.00	128,200.00
8/ 1/16	60,000.00	8.000000	68,800.00	128,800.00	128,800.00
8/ 1/17	65,000.00	8.000000	64,000.00	129,000.00	129,000.00
8/ 1/18	70,000.00	8.000000	58,800.00	128,800.00	128,800.00
8/ 1/19	75,000.00	8.000000	53,200.00	128,200.00	128,200.00
8/ 1/20	80,000.00	8.000000	47,200.00	127,200.00	127,200.00
8/ 1/21	85,000.00	8.000000	40,800.00	125,800.00	125,800.00
8/ 1/22	95,000.00	8.000000	34,000.00	129,000.00	129,000.00
8/ 1/23	100,000.00	8.000000	26,400.00	126,400.00	126,400.00
8/ 1/24	110,000.00	8.000000	18,400.00	128,400.00	128,400.00
8/ 1/25	120,000.00	8.000000	9,600.00	129,600.00	129,600.00
	1,255,000.00		1,352,200.00	2,607,200.00	
ACCRUED					
	1,255,000.00		1,352,200.00	2,607,200.00	

DATED 2/ 1/ 5 WITH DELIVERY OF 2/ 1/ 5
BOND YEARS 16,902.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.468
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:30:59 FILENAME: RICH KEY: 05REV

CITY OF RICHMOND, TEXAS
$1,460,000 WATER & SEWER REVENUE BONDS
SERIES 2009

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/ 9			58,400.00	58,400.00	58,400.00
8/ 1/10	30,000.00	8.000000	116,800.00	146,800.00	146,800.00
8/ 1/11	35,000.00	8.000000	114,400.00	149,400.00	149,400.00
8/ 1/12	35,000.00	8.000000	111,600.00	146,600.00	146,600.00
8/ 1/13	40,000.00	8.000000	108,800.00	148,800.00	148,800.00
8/ 1/14	45,000.00	8.000000	105,600.00	150,600.00	150,600.00
8/ 1/15	45,000.00	8.000000	102,000.00	147,000.00	147,000.00
8/ 1/16	50,000.00	8.000000	98,400.00	148,400.00	148,400.00
8/ 1/17	55,000.00	8.000000	94,400.00	149,400.00	149,400.00
8/ 1/18	60,000.00	8.000000	90,000.00	150,000.00	150,000.00
8/ 1/19	65,000.00	8.000000	85,200.00	150,200.00	150,200.00
8/ 1/20	70,000.00	8.000000	80,000.00	150,000.00	150,000.00
8/ 1/21	75,000.00	8.000000	74,400.00	149,400.00	149,400.00
8/ 1/22	80,000.00	8.000000	68,400.00	148,400.00	148,400.00
8/ 1/23	85,000.00	8.000000	62,000.00	147,000.00	147,000.00
8/ 1/24	95,000.00	8.000000	55,200.00	150,200.00	150,200.00
8/ 1/25	100,000.00	8.000000	47,600.00	147,600.00	147,600.00
8/ 1/26	110,000.00	8.000000	39,600.00	149,600.00	149,600.00
8/ 1/27	120,000.00	8.000000	30,800.00	150,800.00	150,800.00
8/ 1/28	125,000.00	8.000000	21,200.00	146,200.00	146,200.00
8/ 1/29	140,000.00	8.000000	11,200.00	151,200.00	151,200.00
	1,460,000.00		1,576,000.00	3,036,000.00	
ACCRUED					
	1,460,000.00		1,576,000.00	3,036,000.00	

DATED 2/ 1/ 9 WITH DELIVERY OF 2/ 1/ 9
BOND YEARS 19,700.000
AVERAGE COUPON 8.000
AVERAGE LIFE 13.493
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:34:54 FILENAME: RICH KEY: 09REV

CITY OF RICHMOND, TEXAS
$1,025,000 WATER & SEWER REVENUE BONDS
SERIES 2016

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/16			41,000.00	41,000.00	41,000.00
8/ 1/17	25,000.00	8.000000	82,000.00	107,000.00	107,000.00
8/ 1/18	25,000.00	8.000000	80,000.00	105,000.00	105,000.00
8/ 1/19	25,000.00	8.000000	78,000.00	103,000.00	103,000.00
8/ 1/20	30,000.00	8.000000	76,000.00	106,000.00	106,000.00
8/ 1/21	30,000.00	8.000000	73,600.00	103,600.00	103,600.00
8/ 1/22	35,000.00	8.000000	71,200.00	106,200.00	106,200.00
8/ 1/23	35,000.00	8.000000	68,400.00	103,400.00	103,400.00
8/ 1/24	40,000.00	8.000000	65,600.00	105,600.00	105,600.00
8/ 1/25	40,000.00	8.000000	62,400.00	102,400.00	102,400.00
8/ 1/26	45,000.00	8.000000	59,200.00	104,200.00	104,200.00
8/ 1/27	50,000.00	8.000000	55,600.00	105,600.00	105,600.00
8/ 1/28	50,000.00	8.000000	51,600.00	101,600.00	101,600.00
8/ 1/29	55,000.00	8.000000	47,600.00	102,600.00	102,600.00
8/ 1/30	60,000.00	8.000000	43,200.00	103,200.00	103,200.00
8/ 1/31	65,000.00	8.000000	38,400.00	103,400.00	103,400.00
8/ 1/32	70,000.00	8.000000	33,200.00	103,200.00	103,200.00
8/ 1/33	75,000.00	8.000000	27,600.00	102,600.00	102,600.00
8/ 1/34	85,000.00	8.000000	21,600.00	106,600.00	106,600.00
8/ 1/35	90,000.00	8.000000	14,800.00	104,800.00	104,800.00
8/ 1/36	95,000.00	8.000000	7,600.00	102,600.00	102,600.00
	1,025,000.00		1,098,600.00	2,123,600.00	
ACCRUED					
	1,025,000.00		1,098,600.00	2,123,600.00	

DATED 2/ 1/16 WITH DELIVERY OF 2/ 1/16
BOND YEARS 13,732.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.398
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:37:10 FILENAME: RICH KEY: 16REV

CITY OF RICHMOND, TEXAS
$1,165,000 WATER & SEWER REVENUE BONDS
SERIES 2019

DEBT SERVICE SCHEDULE

DATE	PRINCIPAL	COUPON	INTEREST	PERIOD TOTAL	FISCAL TOTAL
8/ 1/19			46,600.00	46,600.00	46,600.00
8/ 1/20	25,000.00	8.000000	93,200.00	118,200.00	118,200.00
8/ 1/21	30,000.00	8.000000	91,200.00	121,200.00	121,200.00
8/ 1/22	30,000.00	8.000000	88,800.00	118,800.00	118,800.00
8/ 1/23	30,000.00	8.000000	86,400.00	116,400.00	116,400.00
8/ 1/24	35,000.00	8.000000	84,000.00	119,000.00	119,000.00
8/ 1/25	40,000.00	8.000000	81,200.00	121,200.00	121,200.00
8/ 1/26	40,000.00	8.000000	78,000.00	118,000.00	118,000.00
8/ 1/27	45,000.00	8.000000	74,800.00	119,800.00	119,800.00
8/ 1/28	45,000.00	8.000000	71,200.00	116,200.00	116,200.00
8/ 1/29	50,000.00	8.000000	67,600.00	117,600.00	117,600.00
8/ 1/30	55,000.00	8.000000	63,600.00	118,600.00	118,600.00
8/ 1/31	60,000.00	8.000000	59,200.00	119,200.00	119,200.00
8/ 1/32	65,000.00	8.000000	54,400.00	119,400.00	119,400.00
8/ 1/33	70,000.00	8.000000	49,200.00	119,200.00	119,200.00
8/ 1/34	75,000.00	8.000000	43,600.00	118,600.00	118,600.00
8/ 1/35	80,000.00	8.000000	37,600.00	117,600.00	117,600.00
8/ 1/36	85,000.00	8.000000	31,200.00	116,200.00	116,200.00
8/ 1/37	95,000.00	8.000000	24,400.00	119,400.00	119,400.00
8/ 1/38	100,000.00	8.000000	16,800.00	116,800.00	116,800.00
8/ 1/39	110,000.00	8.000000	8,800.00	118,800.00	118,800.00
	1,165,000.00		1,251,800.00	2,416,800.00	
ACCRUED					
	1,165,000.00		1,251,800.00	2,416,800.00	

DATED 2/ 1/19 WITH DELIVERY OF 2/ 1/19
BOND YEARS 15,647.500
AVERAGE COUPON 8.000
AVERAGE LIFE 13.431
N I C % 8.000000 % USING 100.0000000
T I C % 8.000000 % USING 100.0000000

PREPARED BY MORONEY, BEISSNER & CO., INC.

RUNDATE: 12-20-1988 @ 11:39:16 FILENAME: RICH KEY: 19REV

SCHEDULE III

CITIES OF ROSENBERG AND RICHMOND

PROPOSED WATER SYSTEM IMPROVEMENTS

PROJECTED COMBINED DEBT SERVICE REQUIREMENTS

FISCAL YEAR END 9/30	CITY OF ROSENBERG PROPOSED DEBT SERVICE (1)	CITY OF RICHMOND PROPOSED DEBT SERVICE (2)	TOTAL COMBINED DEBT SERVICE
1990	$43,000	$42,600	$85,600
1991	111,000	110,200	221,200
1992	109,000	108,200	217,200
1993	112,000	106,200	218,200
1994	238,800	206,000	444,800
1995	435,600	355,400	791,000
1996	437,600	353,600	791,200
1997	1,051,200	740,400	1,791,600
1998	1,999,000	1,341,800	3,340,800
1999	1,996,800	1,346,600	3,343,400
2000	2,094,000	1,419,800	3,513,800
2001	2,243,000	1,536,000	3,779,000
2002	2,247,200	1,540,800	3,788,000
2003	2,242,000	1,542,400	3,784,400
2004	2,242,800	1,540,800	3,783,600
2005	2,327,600	1,591,200	3,918,800
2006	2,451,800	1,673,000	4,124,800
2007	2,448,000	1,668,200	4,116,200
2008	2,572,000	1,664,400	4,236,400
2009	2,795,000	1,719,600	4,514,600
2010	2,789,800	1,815,000	4,604,800
2011	2,720,400	1,708,600	4,429,000
2012	2,791,000	1,704,600	4,495,600
2013	2,786,600	1,705,000	4,491,600
2014	2,792,600	1,714,000	4,506,600
2015	2,457,400	1,455,400	3,912,800
2016	2,538,200	1,501,000	4,039,200
2017	2,663,600	1,564,800	4,228,400
2018	1,108,400	578,800	1,687,200
2019	1,166,200	620,600	1,786,800
2020	1,271,200	695,800	1,967,000

CONTINUED ON NEXT PAGE

FISCAL YEAR END 9/30	CITY OF ROSENBERG PROPOSED DEBT SERVICE (1)	CITY OF RICHMOND PROPOSED DEBT SERVICE (2)	TOTAL COMBINED DEBT SERVICE
2021	1,028,400	500,000	1,528,400
2022	1,020,800	502,400	1,523,200
2023	1,025,800	493,200	1,519,000
2024	1,022,200	503,200	1,525,400
2025	1,025,400	500,800	1,526,200
2026	824,600	371,800	1,196,400
2027	820,800	376,200	1,197,000
2028	824,200	364,000	1,188,200
2029	484,000	371,400	855,400
2030	487,400	221,800	709,200
2031	488,800	222,600	711,400
2032	373,200	222,600	595,800
2033	374,800	221,800	596,600
2034	374,800	225,200	600,000
2035	373,200	222,400	595,600
2036	375,000	218,800	593,800
2037	169,800	119,400	289,200
2038	169,000	116,800	285,800
2039	167,400	118,800	286,200
	$66,712,400	$41,564,000	$108,276,400

(1) FROM SCHEDULE I
(2) FROM SCHEDULE II

DATE: 12/20/88
TIME: 13:06:30
FILE: ROS REV

PREPARED BY MORONEY, BEISSNER & CO., INC.

BIBLIOGRAPHY

1. Houston Water Master Plan, Appendices A through M, August 1985 to March 1987 and latest revisions, by Metcalf and Eddy, Inc.

2. District Plan, Adopted November 1985, by Harris-Galveston Coastal Subsidence District.

3. Subsidence '87, February 1987 by Harris-Galveston Coastal Subsidence District.

4. West Harris County Surface Water Implementation Plan, February 1989 by Dannenbaum Engineering Corporation.

5. Surface Water Supply Plan for Fort Bend County WCID No. 2 and Sugar Land by Jones and Carter Inc/Pate Engineers, Inc. a Joint Venture.

6. Utility District Listing, Creation and Bond Issue Reports, Texas Water Commission Records, January 1987.

7. Waste Load Evaluation for Upper Oyster Creek in the Brazos River Basin, Segment 1245, June 1985 by Texas Department of Water Resources.

8. Intensive Survey of Oyster Creek, Segment 1110, March 1984 by Texas Department of Water Resources.

9. Intensive Surface Water Monitoring Survey for Segment 1110, Oyster Creek - Above Tidal, September 1977 by Texas Department of Water Resources.

TABLE 8.3

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF ROSENBERG

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
	W/O CONS.	W/CONS.		TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS: FUTURE BRA	RAW WATER COSTS: CURRENT BRA	RAW WATER COSTS: HL&P CANAL	OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	(MGD)	(MGD)							(MG)		
1990	4.07		-0-						1632	$1,142,000	$145,000
1991	4.22	4.20	-0-						1684	1,179,000	820,000
1992	4.36	4.33	-0-						1736	1,215,000	16,000
1993	4.51	4.47	-0-						1792	1,254,000	70,000
1994	4.65	4.60	-0-						1845	1,292,000	347,000
1995	4.80	4.73	-0-						1897	1,328,000	1,125,000
1996	5.18	5.07	-0-						2033	1,423,000	1,693,000
1997	5.55	5.41	-0-		$12,000				2170	1,519,000	1,121,000
1998	5.93	5.74	-0-		12,000				2302	1,611,000	7,761,000
1999	6.30	6.08	-0-		12,000				2438	1,707,000	6,249,000
2000	6.68	6.42	6.42	2343	-	$469,000	$136,000	$1,078,000	231	162,000	2,143,000
2001	7.07	6.78	6.42	2343	-	469,000	136,000	1,078,000	376	263,000	24,000
2002	7.47	7.14	6.42	2343	-	469,000	136,000	1,078,000	520	364,000	214,000
2003	7.86	7.50	6.42	2343	-	469,000	136,000	1,078,000	664	465,000	-
2004	8.26	7.86	6.42	2343	-	469,000	136,000	1,078,000	809	566,000	-
2005	8.65	8.22	6.42	2343	-	469,000	136,000	1,078,000	953	667,000	84,000
2006	9.04	8.58	6.42	2343	-	469,000	136,000	1,078,000	1097	768,000	326,000
2007	9.44	8.94	6.42	2343	18,000	469,000	136,000	1,078,000	1241	869,000	1,522,000
2008	9.83	9.30	6.42	2343	18,000	469,000	136,000	1,078,000	1386	970,000	1,138,000
2009	10.23	9.66	6.42	2343	18,000	469,000	136,000	1,078,000	1531	1,072,000	1,016,000
2010	10.62	10.02	10.02	3657	-	731,000	212,000	1,682,000	361	253,000	1,127,000
2011	10.98	10.34	10.02	3657	-	731,000	212,000	1,682,000	489	342,000	857,000
2012	11.35	10.67	10.02	3698	-	731,000	214,000	1,701,000	581	407,000	214,000
2013	11.71	10.99	10.02	3729	-	731,000	216,000	1,715,000	680	476,000	-
2014	12.08	11.31	10.02	3760	-	731,000	218,000	1,730,000	778	545,000	-
2015	12.44	11.64	10.02	3791	-	731,000	220,000	1,744,000	876	613,000	-
2016	12.80	11.96	10.02	3822	-	731,000	222,000	1,758,000	975	683,000	234,000

TABLE 8.3 (CONT'D)

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF ROSENBERG

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
				TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS			OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	W/O CONS.	W/CONS.			FUTURE BRA	CURRENT BRA	HL&P CANAL		(MG)		
2017	13.17	12.28	10.02	3853	$24,000	$731,000	$223,000	$1,772,000	1073	$751,000	$ 126,000
2018	13.53	12.60	10.02	3884	24,000	731,000	225,000	1,787,000	1172	820,000	1,618,000
2019	13.90	12.93	10.02	3915	24,000	731,000	227,000	1,801,000	1270	889,000	1,294,000
2020	14.26	13.25	13.25	4926	-	967,000	286,000	2,266,000	387	271,000	324,000
2021	14.62	13.57	13.25	4957	-	967,000	288,000	2,280,000	485	340,000	-
2022	14.98	13.90	13.25	4988	-	967,000	289,000	2,294,000	583	408,000	-
2023	15.34	14.22	13.25	5019	-	967,000	291,000	2,309,000	682	477,000	-
2024	15.70	14.54	13.25	5050	-	967,000	293,000	2,323,000	780	546,000	-
2025	16.06	14.87	13.25	5264	-	967,000	305,000	2,421,000	699	489,000	-
2026	16.42	15.19	13.25	5295	-	967,000	307,000	2,436,000	797	558,000	-
2027	16.78	15.51	13.25	5326	-	967,000	309,000	2,450,000	895	627,000	-
2028	17.14	15.83	13.25	5357	-	967,000	311,000	2,464,000	993	695,000	-
2029	17.50	16.16	13.25	5387	-	967,000	312,000	2,478,000	1091	764,000	-
2030	17.86	16.48	13.25	5418	-	967,000	314,000	2,492,000	1189	832,000	-

TABLE 8.4

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF RICHMOND

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
	W/O CONS.	W/CONS.		TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS			OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
					FUTURE BRA	CURRENT BRA	HL&P CANAL				
	(MGD)	(MGD)							(MG)		
1990	2.20		-0-						869	$438,000	$ 81,000
1991	2.35	2.33	-0-						921	464,000	475,000
1992	2.50	2.46	-0-						972	490,000	33,000
1993	2.64	2.60	-0-						1027	518,000	335,000
1994	2.79	2.73	-0-						1079	544,000	119,000
1995	2.94	2.86	-0-						1130	570,000	1,306,000
1996	3.14	3.05	-0-						1205	607,000	1,066,000
1997	3.35	3.24	-0-		$ 7,000				1280	645,000	517,000
1998	3.55	3.42	-0-		7,000				1351	681,000	5,019,000
1999	3.76	3.61	-0-		7,000				1426	719,000	4,066,000
2000	3.96	3.80	3.80	1387	-	$277,000	$ 80,000	$ 638,000	114	57,000	1,741,000
2001	4.16	3.98	3.80	1387	-	277,000	80,000	638,000	185	93,000	13,000
2002	4.37	4.16	3.80	1387	-	277,000	80,000	638,000	256	129,000	106,000
2003	4.57	4.34	3.80	1387	-	277,000	80,000	638,000	327	165,000	-
2004	4.78	4.52	3.80	1387	-	277,000	80,000	638,000	398	201,000	-
2005	4.98	4.71	3.80	1387	-	277,000	80,000	638,000	474	239,000	27,000
2006	5.18	4.89	3.80	1387	-	277,000	80,000	638,000	545	275,000	133,000
2007	5.39	5.07	3.80	1387	10,000	277,000	80,000	638,000	616	310,000	502,000
2008	5.59	5.25	3.80	1387	10,000	277,000	80,000	638,000	687	346,000	567,000
2009	5.80	5.43	3.80	1387	10,000	277,000	80,000	638,000	758	382,000	475,000
2010	6.00	5.61	5.61	2048	-	410,000	119,000	942,000	169	85,000	442,000
2011	6.18	5.77	5.61	2048	-	410,000	119,000	942,000	232	117,000	54,000
2012	6.36	5.94	5.61	2048	-	410,000	119,000	942,000	299	151,000	459,000
2013	6.54	6.10	5.61	2048	-	410,000	119,000	942,000	362	182,000	-
2014	6.72	6.27	5.61	2048	-	410,000	119,000	942,000	429	216,000	-
2015	6.90	6.43	5.61	2048	-	410,000	119,000	942,000	493	248,000	-
2016	7.08	6.59	5.61	2048	-	410,000	119,000	942,000	556	280,000	119,000

TABLE 8.4 (CONT'D)

ANNUAL COST SUMMARY FOR FINAL RECOMMENDED PLAN
CITY OF RICHMOND

YEAR	PROJECTED DEMAND (ADF)		AVAILABLE PLANT CAPACITY (ADF)	SURFACE WATER					GROUNDWATER		CAPITAL EXPENDI-TURES
				TOTAL S.W. REQUIRED (AVG+PEAK)	RAW WATER COSTS			OPERATION AND MAINTENANCE	TOTAL G.W. REQUIRED (AVG+PEAK)	OPERATION AND MAINTENANCE	
	W/O CONS.	W/CONS.			FUTURE BRA	CURRENT BRA	HL&P CANAL		(MG)		
2017	7.26	6.76	5.61	2048	$13,000	$410,000	$119,000	$ 942,000	623	$314,000	$ 64,000
2018	7.44	6.92	5.61	2058	13,000	410,000	119,000	947,000	675	340,000	821,000
2019	7.62	7.09	5.61	2073	13,000	410,000	120,000	954,000	728	367,000	657,000
2020	7.80	7.25	7.25	2705	-	529,000	157,000	1,244,000	159	80,000	180,000
2021	7.99	7.42	7.25	2720	-	529,000	158,000	1,251,000	211	106,000	32,000
2022	8.18	7.60	7.25	2736	-	529,000	159,000	1,259,000	266	134,000	272,000
2023	8.37	7.77	7.25	2752	-	529,000	160,000	1,266,000	318	160,000	-
2024	8.56	7.94	7.25	2767	-	529,000	160,000	1,273,000	369	186,000	-
2025	8.76	8.12	7.25	2783	-	529,000	161,000	1,280,000	424	214,000	-
2026	8.95	8.29	7.25	2798	-	529,000	162,000	1,287,000	477	240,000	-
2027	9.14	8.46	7.25	2814	-	529,000	163,000	1,294,000	529	267,000	-
2028	9.33	8.63	7.25	2829	-	529,000	164,000	1,301,000	582	293,000	-
2029	9.52	8.81	7.25	2845	-	529,000	165,000	1.309,000	634	320,000	-
2030	9.71	8.98	7.25	2860	-	529,000	166,000	1,316,000	687	346,000	-