LEAGUE CITY REGIONAL WASTEWATER PLAN

May 15, 1992

Presented To:

CITY OF LEAGUE CITY

Utility Division

DEC DANNENBAUM ENGINEERING CORPORATION

LEAGUE CITY REGIONAL WASTEWATER PLAN

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Date: **May 15, 1992**

DEC Job No.: **2863-01**
D:3857; D:3862

TABLE OF CONTENTS

BIBLIOGRAPHY

TABLES

EXHIBITS

EXHIBITS (continued)

APPENDIXES

I. INTRODUCTION

A. Purpose.

The purpose of the League City Wastewater Plan, hereafter referred to as the Plan, is to regionalize the wastewater treatment and collection facilities within the City of League City and its jurisdiction. The City and the region have adopted several wastewater planning documents. As growth continues, there is an ever present need to update and modify those plans. Plans are effective only if they reflect current levels and qualities of services. The City of League City, hereafter referred to as the City, recognizes its responsibility to guide these levels of service to match the expectations of its residents and the requirements of the regulatory agencies.

B. Contracts.

The City requested a research and planning grant from the Texas Water Development Board (TWDB) in November of 1990 for the Plan. With the approval of the grant, the City entered into contracts with the TWDB and Dannenbaum Engineering Corporation (DEC) to create the Plan. The contract with the TWDB specifies the terms of the grant and the contents of the Plan. The contract with DEC provides engineering services to the City so that DEC, on behalf of the City, can produce the required plan.

C. Service Area.

1. Boundaries

The service area includes the City limits for League City and

its applicable extraterritorial jurisdiction (ETJ). The area covers over 54 square miles in Harris and Galveston Counties. The service area is identified on the exhibits 5A through 5C.

Peripheral areas are considered for inclusion into the Plan on a case by case basis. Those peripheral ETJ areas which are served by existing utility districts and have independent wastewater treatment facilities are excluded from the Plan. These districts include Galveston County Water Control and Improvement District No. 12, Galveston County Water Control and Improvement District No. 1, Bayview Municipal Utility District, and Bacliff Municipal Utility District. Those peripheral City areas which are already or will ultimately be served by municipal wastewater treatment facilities are included in the Plan. For example, Dove Meadows and Bay Colony are included in the plan because even though they are temporarily being served by Galveston County Water Control Improvement District (GCWCID) No. 1 in the City of Dickinson, they will ultimately be served by League City. The northwest portion of League City is included in the plan because it will ultimately be served by the Gulf Coast Waste Disposal Authority (GCWDA) at their regional Blackhawk facility in Friendswood, under a service contract between League City and GCWDA. The temporary use of the GCWCID No. 1 plant and the future use of the Blackhawk plant optimizes the benefits of regionalization and are justified further, later in the report.

The service and surrounding areas are made up of various City, County and District units. The region falls under many regulatory, political and planning jurisdictions. These jurisdictions are identified in Table 1. Continued liaison with these entities insures that regionalization options are accurate and appropriate.

D. Reference Material.

Several of the jurisdictional entities have existing planning documents. These documents were collected and reviewed, and are listed in the bibliography. The existing information was incorporated into the Plan wherever appropriate, insuring a consistency of planning documentation for the region. Some documents were more helpful than others and are identified later in the report.

E. Process.

Through a step by step process the Plan identified the regional wastewater facilities needed to meet existing demands, the projected demands for the years 2000, 2010 and 2020, and the ultimate demands. The ultimate scenario assumes that all of the service area is developed to its full capacity. The ultimate scenario is evaluated to insure that the incremental improvements completed in the years 2000, 2010 and 2020 are in keeping with the ultimate needs for the area. The steps of the process are identified in each of the report sections. The wastewater demands, existing wastewater facilities,

TABLE 1

REGULATORY, POLITICAL AND PLANNING JURISDICTIONS

City of Houston
City of Friendswood
City of Dickinson
City of Kemah
City of Clear Lake Shores
City of Nassau Bay
City of Webster
City of El Lago
City of Seabrook
City of Taylor Lake Village
City of San Leon
Galveston County
Harris County
Brazoria County
Gulf Coast Waste Disposal Authority
Gulf Coast Water Authority
Galveston County Water Control and Improvement District No. 1
Galveston County Water Control and Improvement District No. 8
Galveston County Water Control and Improvement District No. 12
Bacliff Municipal Utility District
Bay Ridge Municipal Utility District
Bay View Municipal Utility District
Galveston County Municipal Utility District No. 2
Galveston County Municipal Utility District No. 3
Galveston County Municipal Utility District No. 6
Galveston County Municipal Utility District No. 13
Galveston County Municipal Utility District No. 14
San Leon Municipal Utility District
South Shore Harbour Municipal Utility District No. 2
South Shore Harbour Municipal Utility District No. 3
South Shore Harbour Municipal Utility District No. 6
Tara Glen Municipal Utility District
Galveston County Drainage District No. 1
Galveston County Drainage District No. 2
Galveston County Drainage District No. 3
Galveston County Drainage District No. 4
Clear Creek Drainage District
Galveston County Water Authority
Texas Water Development Board

2863-01/D:3857

and water conservation trends are evaluated to create several alternate wastewater systems. These systems are evaluated for technical, economical and political feasibility. The proposed wastewater plan is then outlined in detail. The Plan includes the proposed facilities and the associated costs, phasing, and funding for those facilities.

The Plan is conceptual in nature. Facility locations are approximated. Unit costs are estimated. Projected growth rates and locations are interpreted from existing planning documents and information supplied by the City. Given the report detail, the Plan assumptions can be easily modified as actual changes in development occur, to insure that the report remains a viable planning tool.

II. WASTEWATER DEMANDS

In that the location and size of wastewater facilities are determined by wastewater flows, it is essential that methods are used to accurately monitor existing flows and to project future flows. In addition, these methods need to be consistent with those used previously in and around the planning area.

The relatively accurate existing information of the census, City sewer accounts, and monitored plant flows are generalized into consistent units of measurement. This information is consolidated by land use and used to derive a number of equivalent single family connections (ESFC). ESFC is the standard unit of measurement used to record existing wastewater demands and to project future flows.

The wastewater facilities are designed to handle the current anticipated ESFC flows with some infiltration. Since the majority of infiltration is due to rainwater, the amounts vary with the size of the rainfall event, the distance the rainfall must travel in the system, and the wastewater line condition. For small service areas, the distances traveled by the rainfall are minimal. These shorter systems do not allow for rainfall attenuation. A conservative peaking factor of 4.0 is used for those small service areas with populations of less than 5,000. As the system enlarges and the infiltrating rainfall is more likely to attenuate, the peaking factor is reduced accordingly. The smallest peaking factor used in the Plan is 3.1 on the 54-inch wastewater line connection into the Dallas-Salmon plant and the 54-inch and 66-inch wastewater line connections into the South wastewater treatment plant. Refer to Appendix A for the peaking factor calculation. The wastewater collection system flows are based on the ESFC demand multiplied by the appropriate peaking factor. The wastewater treatment system flows are based on the ESFC demand, without a peaking factor.

Land use information, both existing and projected, is used to locate and determine the ESFC. The locations are used to generate wastewater flows at major wastewater collection nodes. Only wastewater gravity collection lines 18 inches and larger are included in the Plan. Smaller internal lines and lift stations may be identified but are not included in the wastewater evaluations.

A. Existing Demands.

The existing demands are based on the same reference material previously used to determine the consistent units of measurement. The U.S. Bureau of Census publishes population and housing statistics for the City, included as Appendix B. The City Customer Service Department keeps monthly records of active sewer connections or accounts, included as Appendix C. Actual flows are monitored daily at each of the wastewater plants, summarized in Table 2. The derived number of existing ESFC is shown in Table 3.

Commercial development wastewater flows vary with the commercial type (commercial, institutional, industrial, etc.). The most accurate way of estimating the number of ESFC for commercial development is to base it on actual flows. Using the census, the monthly active accounts, and the process monitoring information, the number of commercial ESFC is calculated. The usage factors and connection numbers for residential (single family and multi family) development are fairly reliable. The estimated residential flows or ESFC are subtracted from the total historical flows or ESFC. The remaining flows or ESFC are then allocated to all the existing commercial development.

An ESFC is made up of 3.5 people and 350 gallons of wastewater per day. A multi-family connection is made up of 2.25 people and 225 gallons of wastewater per day. These usage or demand factors are consistent with those used in the "Water/Sewer Master Plan", the "Calculation of Water

TABLE 2

EXISTING FLOWS

Month	Plant Monthly Average (MGD)(1)					
	Dallas-Salmon	Bayridge	Countryside	Subtotal	GCWCID No.1	Total
7/90	2.1539	0.05360	0.4790	--	--	--
8/90	1.9315	0.04800	0.4886	--	--	--
9/90	2.0816	0.05440	0.4967	--	--	--
10/90	2.1995	0.05440	0.3636	--	--	--
11/90	2.1679	0.08280	0.3284	--	--	--
12/90	2.5074	0.07960	0.2815	--	--	--
1/91	8.8377	0.01194	0.3384	--	--	--
2/91	3.9424	0.08500	0.3345	--	--	--
3/91	2.4803	0.06870	0.3605	--	--	--
4/91	4.3799	0.09950	0.4990	--	--	--
5/91	4.3771	0.09941	0.5394	--	--	--
6/91	3.6739	0.08498	0.5947	--	--	--
Yearly Average	3.3944	0.06853	0.4132	3.8761	0.0371(2)	3.9132

(1) Flows from League City process monitoring/reporting data.

(2) Theoretical flow based on 94 Dove Meadow connections, 10 Bay Colony connections and 2 commercial connections all at 350 gallons per connection per day [(94 + 10 + 2) x 350]. The GCWCID No. 1 plant treats Dove Meadow and Bay Colony in addition to development within GCWCID No. 1. The flows for Dove Meadow and Bay Colony are not specifically monitored and are more accurately identified using theoretical usage rates for single family and commercial connections.

TABLE 3

1990 CENSUS INFORMATION WITH CONNECTION CONVERSIONS

Land Use	Census Information (housing units)	Monthly Active Accounts					Process Monitoring (flow in gal/day)
		Actual	ESFC				
			w/septic		w/o septic		
Residential	8,421(1)	7,967	68%	7,967	72%	7,967	--
(septic)			4%	454(3)	0%	0	
Multiple Units	2,165(2)	124	12%	1,392(4)	12%	1,392	--
Commercial	--	315	16%	1,822	16%	1,822(6)	--
TOTAL	10,586	8,406	100%	11,635	100%	11,181(5)	3,913,200

(1) 93% average occupancy of 1 unit detached and mobile homes (.93)(8,377 + 677).
(2) 93% average occupancy of attached and multiple units (.93)(236 + 458 + 257 + 1,376).
(3) Difference between census and monthly active accounts (8,421 - 7,967).
(4) Converted from Census using 2.25 people/multiple unit and 3.5 people/residential unit (2,165 x 2.25/3.5).
(5) 3,913,200 gallons per day / 350 gallons per ESFC per day = 11,181 ESFC.
(6) Difference between total and residential (w/o septic) and multiple (11,181 - 7,967 - 1,392).

2863-01/D:3857

and Sewer Capital Recovery (Impact) Fees Based on Ten-Year Requirements", the "South Shore Harbour Master Plan", and the "Design Criteria for Sewage Systems". (Refer to the Bibliography for the dates and authors of these documents.)

The ESFC are tabulated with and without the septic connections. The septic connections must be removed from the total existing number of ESFC when evaluating wastewater flows, or using the process monitoring information, since the plant flows do not include flows from those residences using septic systems. The septic connections are included in the total existing ESFC when evaluating population data. The census information does not identify those persons or residences counted who are using septic systems. The locations of the existing demands are derived from the City land use map and aerial photographs of the region. Exhibits 1A and 1B show the land uses and give the associated number of existing ESFC.

The majority of the wastewater produced within the planning area is generated by residential developments. Additional wastewater generators, in order of decreasing flows, include commercial/retail, office, and light industrial developments. Typical wastewater strengths for these types of developments are:

Source	Wastewater Strength ($mg/l\ BOD_5$)
Residential	180-220
Commercial/Retail	200-300
Offices	250-350
Industrial	250-350

The activated sludge wastewater treatment process is used at the plants in the planning area and is an effective method of treating the types of wastewater generated within the planning area.

B. Projected Demands.

Projections for the regions growth are continually being estimated by several planning jurisdictions. The units of growth vary with the jurisdictional emphasis of responsibility. Population and water use are most commonly used to project growth rates.

The percent of residential and commercial development ESFC to total ESFC are established for existing conditions. (Refer to Table 3.) Of the total number of existing ESFC, 16% are commercial. Background data for the "Water for Texas, Today and Tomorrow", from the Water Use and Projection Section, shows a consistency in existing and future percentages for water use for commercial development. For future commercial wastewater projections, the percentage of commercial ESFC to total ESFC is assumed a constant.

Given the ability to convert population to ESFC and then to demands, the unit is inconsequential and the rates are evaluated based on relative merit. The regional population projections are plotted on Exhibit 2A by title. Documents include "Water for Texas, Today and Tomorrow", "City of League City Water/Sewer Master Plan", "Greater Houston Area Water Quality Management Plan", and "Calculation of Water and Sewer Capital Recovery (Impact) Fees Based on Ten-Year Requirements". (Refer to the

LEGEND

- A1 Real Res Sin Fam
- A2 Real Res Mob Hms
- A9 Exm Res Sin Fam
- B1 Real Res Mul Fam
- B2 Real Com Mul Fam
- B9 Exm Com Mul Fam
- C1 Real Vac Plt Lot
- C9 Exm Vac Lot
- D1 Real Acr Ran Lnd
- D2 Timberland
- D3 Farmland
- D4 Undeveloped
- D8 Exm Acr Ran/Farm
- E1 Real Farm/Ran Imp
- E9 Exm Farm/Ran Imp
- F1 Real Commercial
- F2 Real Industrial
- F9 Exm Commercial
- G1 Oil/Gas/Min Res
- H1 Tan Pers Vehicles
- I1 Banks
- J1 Real/Tan Per Util
- J2 Gas Companies
- J3 Elec Companies
- J4 Telephone Co
- J5 Railroads
- J6 Pipelines
- J7 Other
- J8 Other
- J9 Exm Per Util
- L1 Tan Per Prop Farm
- L1 Tan Per Prop Com
- L2 Tan Per Prop Ind
- M1 Tan Per Mat Veh
- M2 Tan Per Aircraft
- M3 Tan Per Mob Home
- M4 Miscellaneous
- M9 Exm Mob Homes
- N1 Intangibles
- O1 Inv Vac Land
- O2 Inv Sin Fam
- O3 Inv Twnhm/Condo
- P9 Freeport Exm
- Not Classified

DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

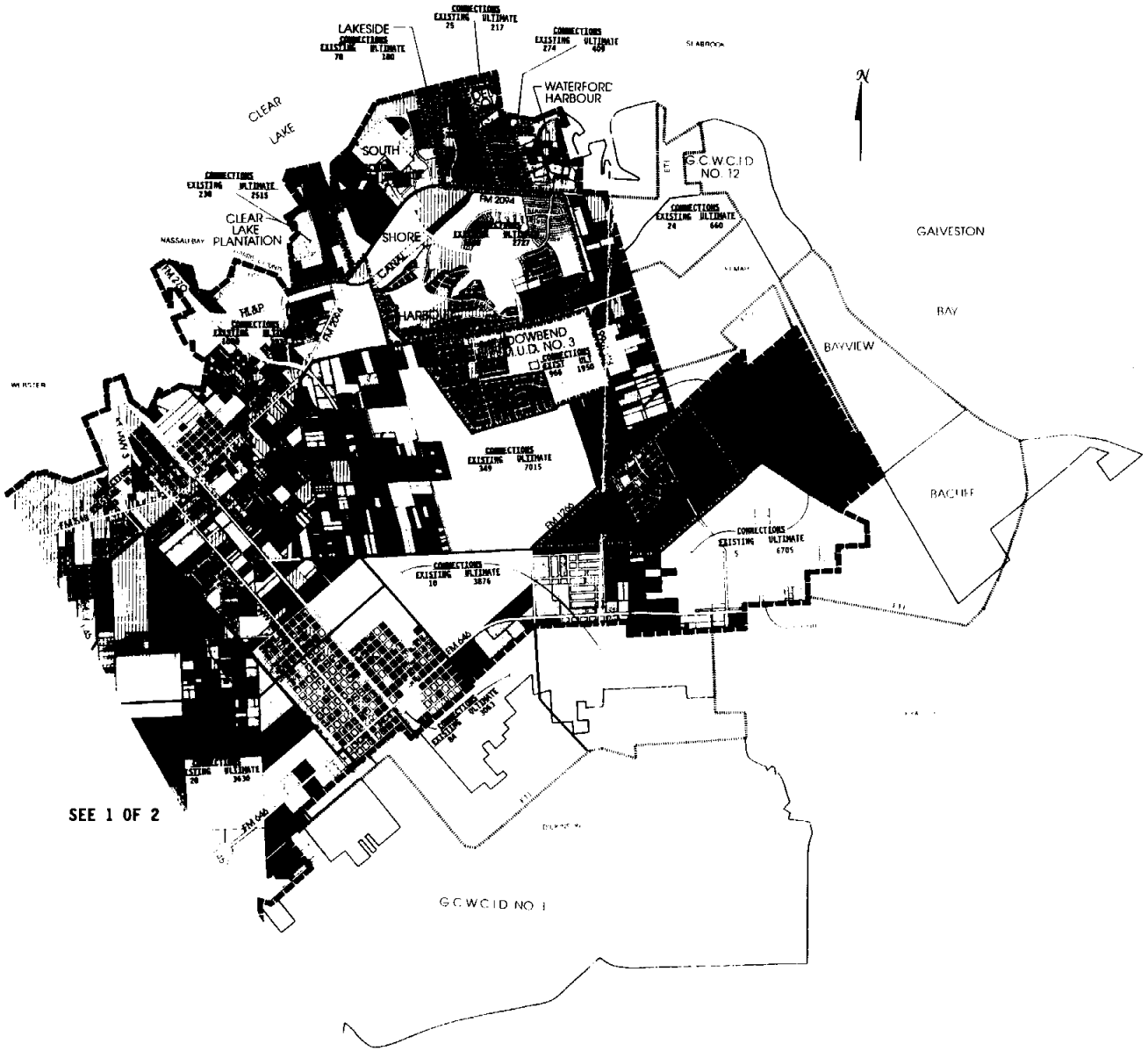
CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN

LAND USE AND CONNECTIONS
EXHIBIT 1A

DRAWN: M.A.S.	DATE: DECEMBER, 1994	SHT NO. 1 OF 2
CHECKED: C.C.L.		
APPROVED: D.D.P.	SCALE: NONE	JOB NO. 2863-01

LEGEND

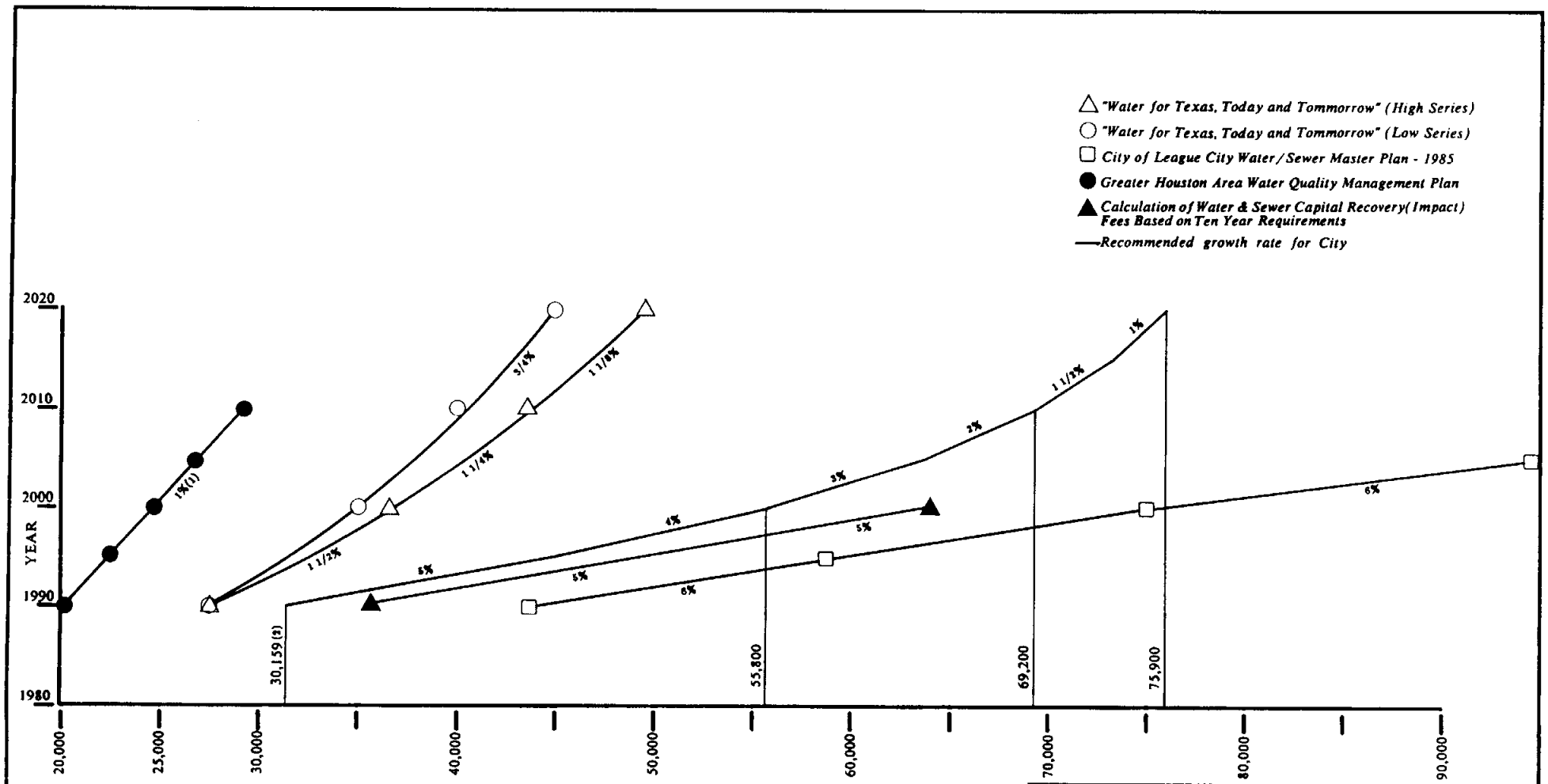
- A1 Real Res Sin Fam
- A2 Real Res Mob Hms
- A9 Exm Res Sin Fam
- B1 Real Res Mul Fam
- B2 Real Com Mul Fam
- B9 Exm Com Mul Fam
- C1 Real Vac Plt Lot
- C9 Exm Vac Lot
- D1 Real Agr Ran Ind
- D2 Timberland
- D3 Farmland
- D4 Undeveloped
- D8 Exm Agr Ran/Farm
- E1 Real Farm/Ran Imp
- E9 Exm Farm/Ran Imp
- F1 Real Commercial
- F2 Real Industrial
- F9 Exm Commercial
- G1 Oil/Gas/Min Res
- H1 Tan Pers Vehicles
- I1 Banks
- J1 Real/Tan Per Util
- J2 Gas Companies
- J3 Elec Companies
- J4 Telephone Co
- J5 Railroads
- J6 Pipelines
- J7 Other
- J8 Other
- J9 Exm Per Util
- K1 Tan Per Prop Farm
- L1 Tan Per Prop Com
- L2 Tan Per Prop Ind
- M1 Tan Per Mal Veh
- M2 Tan Per Aircraft
- M3 Tan Per Mob Home
- M4 Miscellaneous
- M9 Exm Mob Homes
- N1 Intangibles
- O1 Inv Vac Land
- O2 Inv Sin Fam
- O3 Inv Twnhm/Condo
- P9 Freeport Exm
- Not Classified



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
LAND USE AND CONNECTIONS
EXHIBIT 1B

DRAWN: M.A.S.	DATE: DECEMBER, 1994	SHT NO. 2 OF 2
CHECKED: C.C.J.	SCALE: NONE	JOB NO. 2863-01
APPROVED: D.D.P.		



(1) % given for approximated annual growth rate.

(2) Population for U.S. Bureau of Census information.

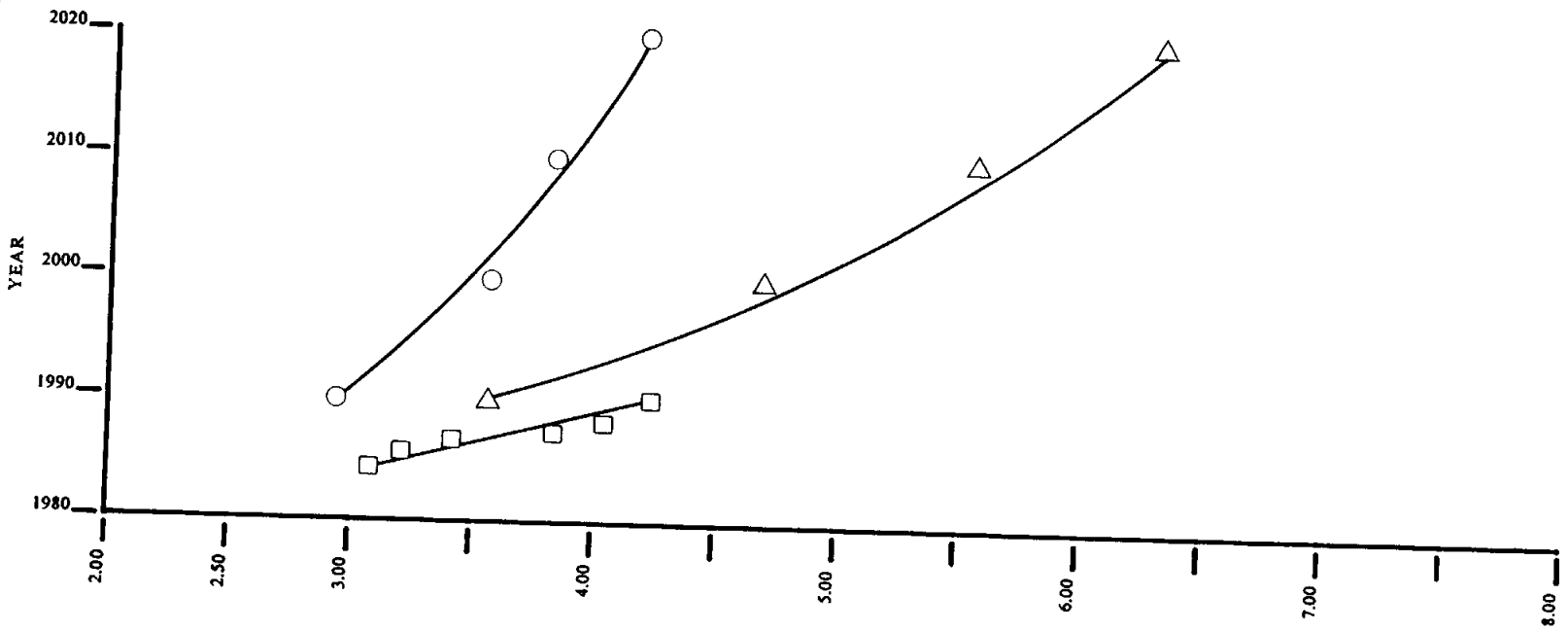
REVISIONS	
No.	Date

DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
POPULATION PROJECTIONS
EXHIBIT 2A

Drawn By: M.A.S.	Date DEC. 1991	Job No. 2863-01
Checked By: C.C.J.	Date DEC. 1991	Drawing No.
Approved By: D.D.P.	Date DEC. 1991	Sht. 1 of 1

TELEDYNE POST N30930



REVISIONS		DANNENBAUM ENGINEERING CORPORATION HOUSTON, TEXAS		
No.	Date	CITY OF LEAGUE CITY REGIONAL WASTEWATER PLAN WATER USE PROJECTIONS EXHIBIT 2B		
		Drawn By: M.A.S.	Date DEC. 1991	Job No. 2863-01
		Checked By: C.C.J.	Date DEC. 1991	Drawing No.
		Approved By: D.D.P.	Date DEC. 1991	Sht. 1 of 1

TELEDYNE POST N30930

Bibliography for the author and date information.) The projected population growth rates vary from as little as 3/4% per year from the "Water for Texas, Today and Tomorrow" low series, to as much as 6% per year from the "City of League City Water/Sewer Master Plan".

The regional water use projections are plotted on Exhibit 2B by title. Documents include "Water for Texas, Today and Tomorrow" and "Letter to The City Regarding Planning Analysis for the South Shore Harbour Water Plant Upgrade". The projected water use growth rates fall in between the minimum and maximum from the population growth rates.

The documents created specifically for the City of League City (i.e. the Master Plan, Impact Fee Plan and South Shore Harbour Master Plan) assume that the immediately preceding historical rates will continue at a constant rate into the future. The documents created for the general region take a less conservative approach to projected growths. For the Plan, the relatively high historical rates are assumed to continue into the immediate future but after approximately five years they are reduced exponentially to reflect the lower regional growth rates. The recommended projected growth rate is shown by population on Exhibit 2A. Note that this rate is for the overall planning area.

The growth rates for the specific service areas will cumulatively equal that for the overall planning area. The growth rate for each specific service area is controlled by the anticipated increase in connections as defined in Table 4. These incremental increases in connections allow for

TABLE 4

CONNECTION INCREASES

Service Area	Approximate ESFC Increase per 10-Year Interval		
	Existing - 2000	2000 - 2010	2010 - 2020
Central	6,127	3,226	1,113
North	2,500	1,500	1,000
South	1,500	500	500
TOTAL	10,127	5,226	2,613

2863-01/D:3857

the continued development in and around South Shore Harbour, a substantial increase in development in the south, the continued development in the north and adequate connection increases to trigger utility construction. Even though drainage impact fees vary depending on the watershed, the fee differences should not impact regional development. The watershed issues are discussed further, later in the report.

The ultimate population or ESFC is based on 100% land development, less acreages required for drainage detention, per the "Master Drainage Plan for the City of League City". Land use or development densities are extrapolated from the "City of League City Water/Sewer Master Plan". (Refer to the Bibliography for the document date and author.)

The septic connections are included in the projected total numbers of ESFC since it is assumed that those residences currently using septic systems will be gradually converted to the wastewater system by the year 2010. The future wastewater demand per ESFC will decrease over time with the implementation of water conservation plans. As the ESFC use less water, less wastewater will be produced. "Water for Texas, Today and Tomorrow" shows a potential percent reduction in high case per capita water use for the southeast Texas region by the year 2020 of 20.9%. A more conservative wastewater reduction rate of 10% by ultimate development is anticipated. This 10% reduces the current wastewater demand of 350 gallons per ESFC per day to an ultimate 315 gallons per ESFC per day. The reduction should be gradual. The demand rate is

TABLE 5

EXISTING AND PROJECTED POPULATION, CONNECTIONS AND FLOWS

Unit	Existing(2) Conditions	Projections			
		Year 2000	Year 2010	Year 2020	Ultimate
Population	30,159(3)	55,800(1)	69,200(1)	75,900(1)	291,621(4)
Actual Connections	8,406	--	--	--	--
ESFC	11,635	21,762(4)(10)	26,988(4)	29,601(4)	112,504(9)
Avg. Daily Flow (mgd)	3.9(3)	7.4(8)	9.2	9.9	35.4
Usage Factor (gal/ESFC/day)	350	345(6)	340(6)	335(6)	315(7)

(1) Refer to Exhibit 2A, Population Projections.
(2) Refer to Table 3, 1990 Census Information with Connection Conversions.
(3) ETJ data excluded in existing conditions but included in projections.
(4) ESFC calculated using the existing conditions ratio of 11,635 ESFC per 30,159 people or 0.39 ESFC/person.
(5) Number includes 454 septic ESFC which are excluded from flow calculations.
(6) Assume a reduction in the wastewater flow rate of 1% every 10 years due to increasing water conservation.
(7) Total reduction in the wastewater flow rate of 10%.
(8) ESFC x Usage factor [(21,762 - 403) x 345].
(9) Summarized from ultimate projections on Exhibit 1, Land Use and Connections.
(10) Number includes 403 septic ESFC which are excluded from flow calculation. (Note that 51 septic ESFC located in north service area are converted to the wastewater system for the year 2000 calculation.)

2863-01/D:3857

TABLE 6

GROWTH PROJECTIONS BY SERVICE AREA

Year	Connection Projections per Service Area							
	Central		North		South		Total(1)	
	Growth (%/yr)(6)	ESFC	Growth (%/yr)(6)	ESFC	Growth (%/yr)(6)	ESFC	Growth (%/yr)(5)	ESFC
Existing(1)	--	10,083(2)	--	1,202(3)	--	350(4)	--	11,635
2000	4.9	16,210(2)	11.9	3,702	18.1	1,850(4)	6.5	21,762
2010	1.8	19,436	3.5	5,202	2.4	2,350	2.2	26,988
2020	0.6	20,549	1.8	6,202	1.9	2,850	0.9	29,601
Ultimate(1)	--	65,078	--	10,602	--	36,824	--	112,504

		Flow Projection per Service Area (million gallons per day)(7)			
		Central	North	South	Total(1)
	Usage Factor (gal/ESFC/day)(1)				
Existing	350	3.41	0.40	0.11	3.91
2000	345	5.47	1.28	0.62	7.37
2010	340	6.61	1.77	0.80	9.18
2020	335	6.88	2.08	0.95	9.92
Ultimate	315	20.50	3.34	11.60	35.44

FOOTNOTES FOR TABLE 6, GROWTH PROJECTIONS BY SERVICE AREA

(1) From Table 5, Existing and Projected Population, Connections and Flows.
(2) Number includes 354 septic ESFC which are excluded from the flow calculation.
(3) Number includes 51 septic ESFC which are excluded from the flow calculation.
(4) Number includes 49 septic ESFC which are excluded from the flow calculation.
(5) Calculated from $F = P\ (1+i)^{(n)}$ where F = future ESFC, P = present ESFC, i = annual growth percentage, and n = 10 year interval.
(6) Annual growth rates calculated from Table 4, Connection Increases.
(7) Calculated from [ESFC - septic ESFC (if applicable)] x usage factor.

2863-01/D:3857

reduced in five gallon increments per each ten-year interval. Additional information on the City water conservation plan is given, further in the report. (See Table 5.)

The existing and projected populations, ESFC, and flows for the planning area are summarized in Table 5. The existing and projected ESFC and flows for each of the service areas are summarized in Table 6.

Future developments within the planning area are expected to generate wastewater in proportions and strengths similar to the wastewater generated by existing developments, and the activated sludge treatment process will continue to be an effective treatment method.

III. EXISTING WASTEWATER SYSTEM

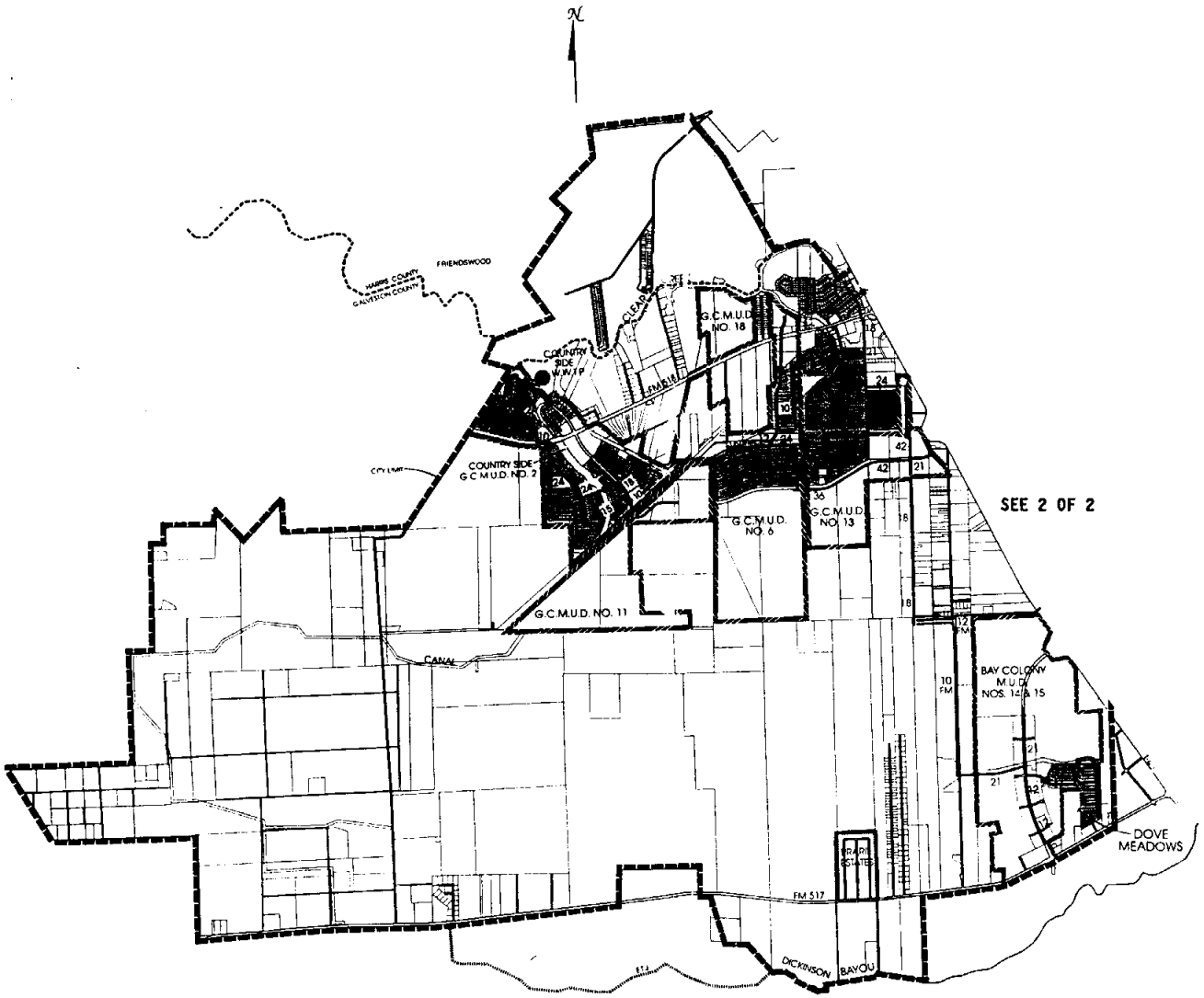
In that the Plan is limited to the evaluation of 18-inch gravity wastewater lines and larger, the inventory of existing facilities is limited as well. Smaller gravity lines, force mains and lift stations may be shown on the exhibits only if they are crucial to the routing for flows and/or are to be expanded or removed and replaced with larger facilities. Existing facilities are utilized whenever possible. Temporary facilities may be abandoned.

A. Collection System.

The existing wastewater collection system is shown on Exhibits 3A and 3B. The data is taken from the "City of League City Wastewater System Layouts" and supplemented with information from various discussions with the League City staff. The existing lift station

LEGEND

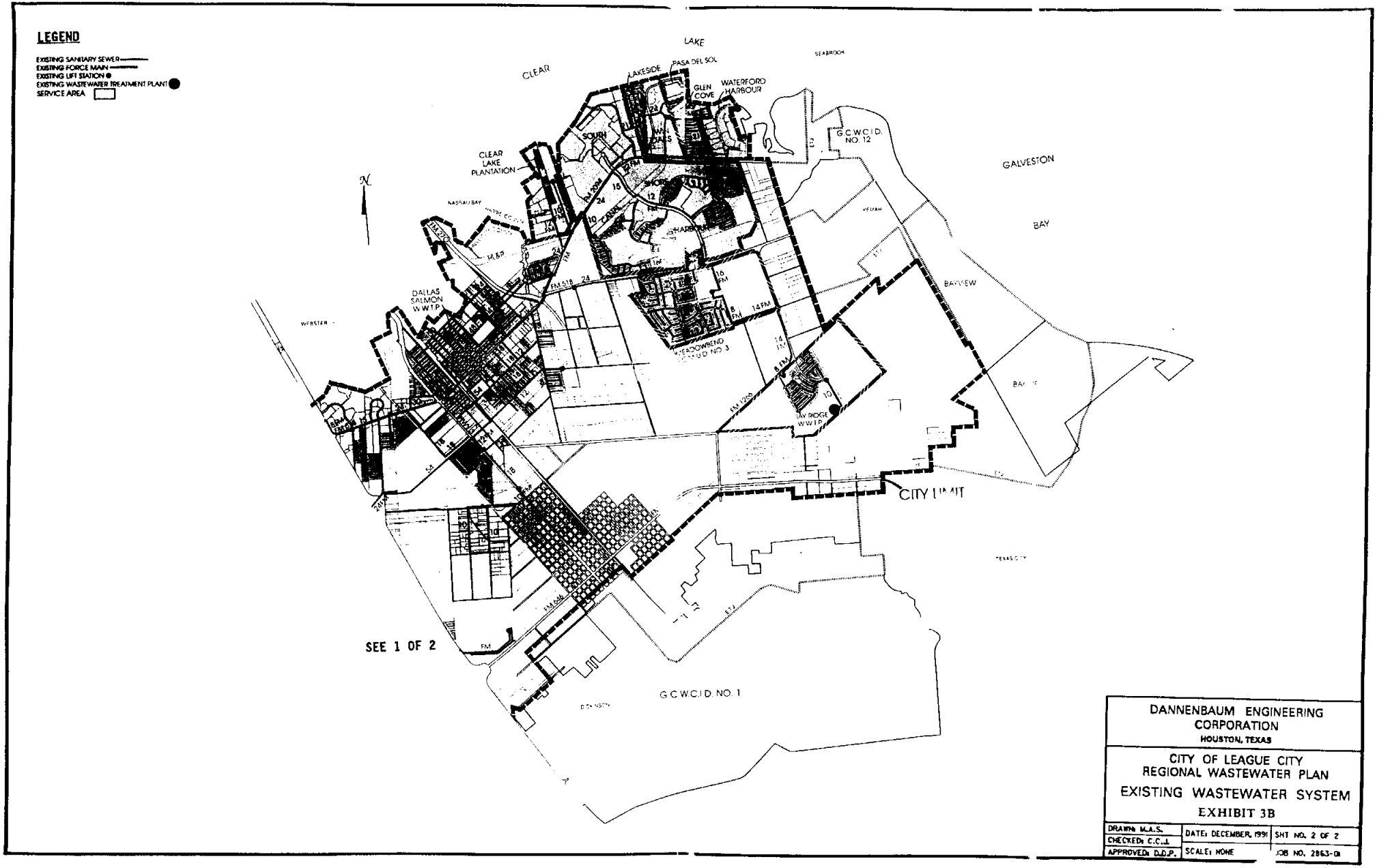
EXISTING SANITARY SEWER
EXISTING FORCE MAIN
EXISTING LIFT STATION
EXISTING WASTEWATER TREATMENT PLANT
SERVICE AREA



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
EXISTING WASTEWATER SYSTEM
EXHIBIT 3A

DRAWN M.A.S.	DATE: DECEMBER, 1991	SHT NO. 1 OF 2
CHECKED C.C.L.		
APPROVED D.D.P.	SCALE: NONE	JOB NO. 2863-01



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
EXISTING WASTEWATER SYSTEM
EXHIBIT 3B

DRAWN: M.A.S.	DATE: DECEMBER, 1991	SHT NO. 2 OF 2
CHECKED: C.C.J.		
APPROVED: D.D.P.	SCALE: NONE	JOB NO. 2863-01

capacities are from the list of "City of League City Lift Station Pumps". Older deteriorating lines may need to be replaced or repaired, and were not included in the Plan unless specifically requested and identified by the City.

B. Treatment System.

Wastewater flows from the service area are currently being treated with three City plants (Dallas-Salmon, Countryside and temporary Bay Ridge plants), and with the GCWCID No. 1 plant in Dickinson. In addition, several areas have septic systems. Older inefficient plants may need to be abandoned if continued operations and maintenance is not economically feasible. Plant expansion costs and operation and maintenance costs are considered when evaluating treatment options. These costs are defined further, later in the report.

The Dallas-Salmon plant, built in 1983, is the largest City wastewater plant. It is located in the north portion of the central downtown City area, and currently takes flows from the north and central regions. It has a current capacity of 4.5 million gallons per day and has relatively low operations and maintenance costs. Expansion is a practical option for this plant and will extend its useful life indefinately, even though additional trunk lines may be required. The plant site plan shows existing and expansion facilities and is attached as Appendix F.

The City's Countryside plant is located in the northwest portion of the City and currently takes flows from that region. The Countryside plant has a current capacity of 660,000 gallons per day and has relatively high operations and maintenance costs. The economic feasibility of plant expansion is questionable. The plant was built in 1976 and has reached the end of its useful life.

The temporary Bay Ridge Plant is located in the southeast portion of the City and currently takes flows from the Bay Ridge Utility District. It has a current capacity of 150,000 gallons per day. The existing wastewater lines provide the required flexibility to abandon the plant. The plant was built in 1975 and has reached the end of its useful life.

The GCWCID No. 1 owns and operates a wastewater plant for the City of Dickinson. Its close proximity to a relatively small area of development in the south central portion of League City, makes it a cost effective temporary treatment option for initial development in that area. The plant was constructed in the 1950's. At present, flows from the League City subdivisions of Dove Meadows and Bay Colony are treated by GCWCID No. 1.

The GCWDA owns and operates the Blackhawk wastewater plant. Contracting parties for wastewater service include the City of Friendswood, Houston, Baybrook Municipal Utility District No. 1 and Harris County Municipal Utility District No. 55. It is located just north of Clear Creek, relatively close to the north and northwest

portions of League City. The plant is treating approximately one-third of its existing 9.25 million gallon per day capacity with relatively high efficiency. No League City flows are treated at Blackhawk at this time. The Blackhawk facility can easily be expanded to accommodate flows from League City. Its location, ability to expand, and low operations and maintenance costs make it a feasible alternative for wastewater treatment for the north and northwest regions of the City. New wastewater trunk lines across Clear Creek are required. Additional plant information for the Blackhawk facilities is included in Appendix G.

IV. WATER CONSERVATION PLAN

Continued emphasis is being given to the conscientious use of our water resources. As this trend continues, water use and wastewater demands will decrease. These changes in usage factors effect the Plan and have been estimated earlier in the report.

The City is currently encouraging water conservation of its residents. A water conservation plan was adopted by resolution in 1987. A drought contingency plan was adopted by ordinance in 1987 and a resolution was adopted in 1989 establishing relatively high water and wastewater rates. (Refer to the Bibliography for the titles and dates.) These documents are in general compliance with the TWDB's guidelines for water conservation and drought contingency. The City's three documents, suggest ways of efficient water use practices, encourage water use reductions with an appropriate rate structure, and mandate water use reductions in emergency drought situations. The Water Conservation Plan and Drought Contingency Plan are attached as Appendixes D and E, respectively.

V. ALTERNATE WASTEWATER SYSTEMS

Several alternate wastewater systems can adequately serve the area. Various service area sizes with alternate plant locations are evaluated. In order to optimize the previous investments made into the existing wastewater system, the existing wastewater facilities were included in the analysis, whenever possible.

A. Criteria.

All of the existing plants were evaluated. New plants are considered for the south and southwest regions of the City. In addition, contracted use of the GCWCID No. 1 plant and the GCWDA Blackhawk plant is considered.

Current discharge permit requirements for these plants include effluent limit ranges of 5-10 mg/l BOD_5, 10-15 mg/l total suspended solids, and 2-3 mg/l ammonia nitrogen. Discharge permits for new plants, or changes to existing permits, which place lower limits on these effluent parameters are not likely. All of the existing plants utilize the activated sludge treatment process. The activated sludge process, consisting of trains of aeration basins, secondary clarifiers, final filters, and disinfection, is a proven, environmentally and socially acceptable method of reliable and economically treating the type of wastewater produced in the planning area, and allows flexibility in plant operations and expansions. Activated sludge process wastewater treatment plants are therefore used in the wastewater system evaluations.

The existing wastewater trunk lines are evaluated for access and capacity. Several are oversized to handle future development. Some lines are temporary, yet they are not excluded from the evaluation.

There are several natural and manmade service area divides. Some of the natural divides include Clear Creek, Dickinson Bayou, and the ridge line in between the two watersheds. Some of the manmade divides include Interstate 45 and several districts. The divides are shown on the exhibits.

B. Systems.

Six alternate systems were evaluated. Various plant sizes and service area boundaries were created to provide a relatively wide range of service options for evaluation. In all of these alternatives the north area, located on the north side of Clear Creek, is most effectively served by the GCWDA Blackhawk plant.

Alternate 1, with six service areas, breaks the City into the largest number of service areas. The three existing City wastewater plants (Dallas-Salmon, Countryside, and Bay Ridge), two proposed City plants (South and Southwest) and use of the GCWDA plant are implemented. This alternate is consistent with the current wastewater master plan.

Alternate 2, with 5 service areas, utilizes 2 of the 3 City wastewater plants (Dallas-Salmon and Countryside). The temporary Bay Ridge plant is abandoned. A proposed plant serves the southwest area. Areas to the north and south flow to the GCWDA plant and the

GCWCID No. 1 plant, respectively. This alternative is created to evaluate the continued use of the Dallas-Salmon and Countryside plants and the benefit of contracted wastewater treatment services.

Alternate 3, with 3 service areas, breaks the City into the least number of service areas. The natural ridge line in between Clear Creek and Dickinson Bayou is used to divide the City in half. Of the existing City plants, only the Dallas-Salmon plant remains in service. A proposed plant serves the south, and the north area flows to the GCWDA plant. This alternate is created to evaluate the cost efficiency of larger wastewater plants, using the ridge line as the service area divide.

Alternate 4 creates 4 service areas, and utilizes 2 of the 3 City wastewater plants (Dallas-Salmon and Countryside). The temporary Bay Ridge plant is abandoned. A proposed plant serves the southwest area. The north area flows to the GCWDA plant. This alternate is similar to alternate 2 with the exception that no flows are taken to the GCWCID No. 1 plant. This alternate evaluates the benefits of continued use of the Dallas-Salmon and Countryside plants.

Alternate 5, with 4 service areas, utilizes 2 of the 3 City wastewater plants (Dallas-Salmon and Countryside). The temporary Bay Ridge plant is abandoned. A proposed plant serves the south area. The north area flows to the GCWDA plant. This alternative is created to evaluate the benefit of the continued use of the Dallas-Salmon plant, and the continued and expanded use of the Countryside plant.

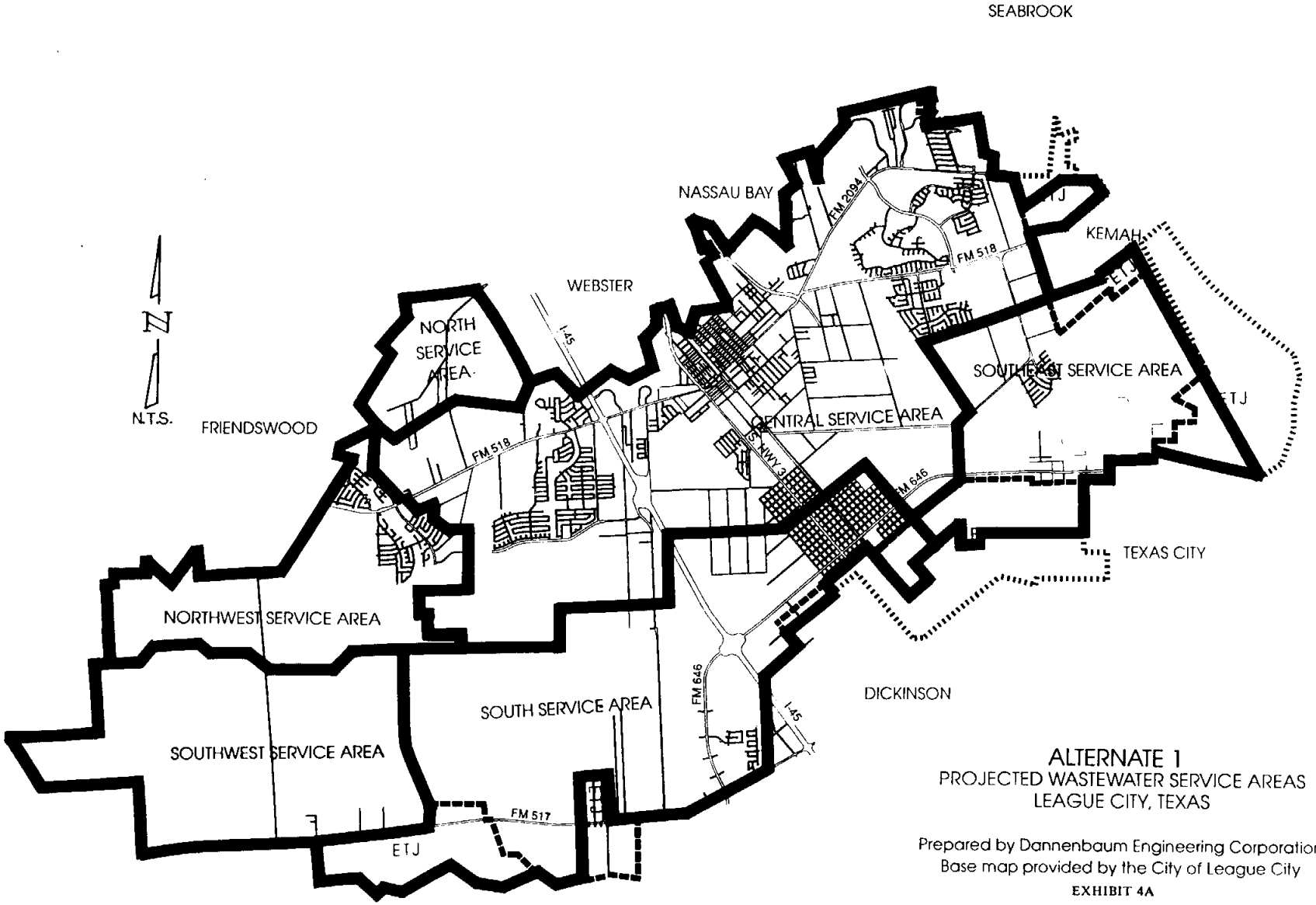
Alternate 6, like alternate 3, with 3 service areas, breaks the City into the least number of service area. In this alternate, the manmade boundary of Interstate 45 is used to divide the City in half. Of the existing City plants, only the Dallas-Salmon plant remains in service. A proposed plant serves the area south of Interstate 45, the Dallas-Salmon plant serves the area north of Interstate 45, and the area north of Clear Creek flows to the GCWDA plant. This alternate is created to evaluate the cost efficiency of larger wastewater plants, using Interstate 45 as the divide.

Exhibits 4A through 4F show alternates 1 through 6, respectively. The boundary lines are approximated. Existing and proposed facilities are not shown on the alternate exhibits. Each alternate evaluation uses similar facilities which are shown on the exhibits for the selected alternative. Table 7 identifies the wastewater plants, with approximated ultimate flows, utilized in each of the alternate systems. The boundaries and flows are relative to the alternate system evaluation and may vary from those used in the recommended plan.

VI. COSTS

A. Criteria.

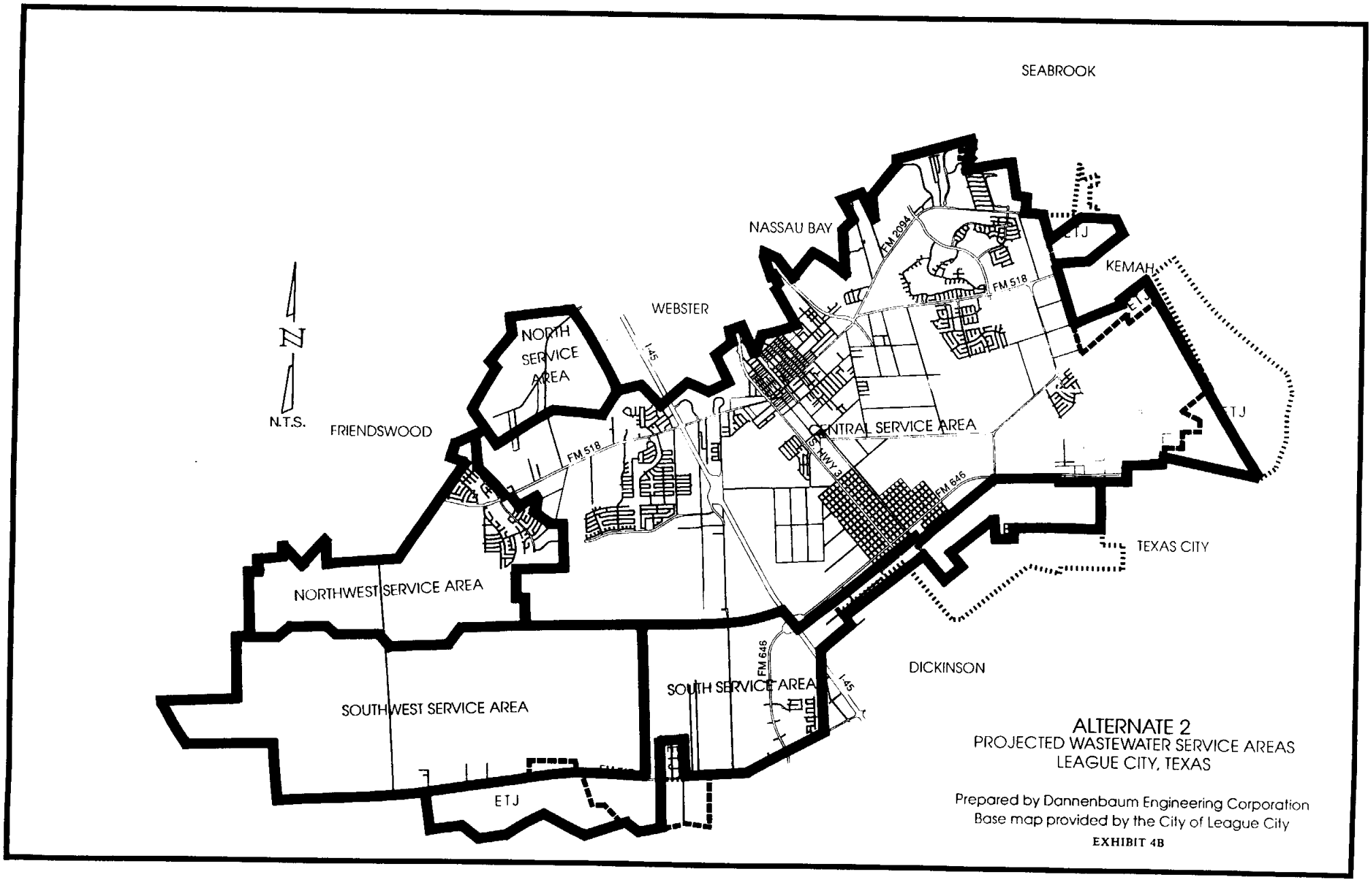
The preliminary construction cost estimate for League City wastewater study for the year 2000, 2010, 2020 and ultimate was compiled using fourth quarter 1991 prices. This estimate was based on average present day construction methods, techniques and materials readily available to contractors. Unit prices used to compile the



ALTERNATE 1
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS

Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City

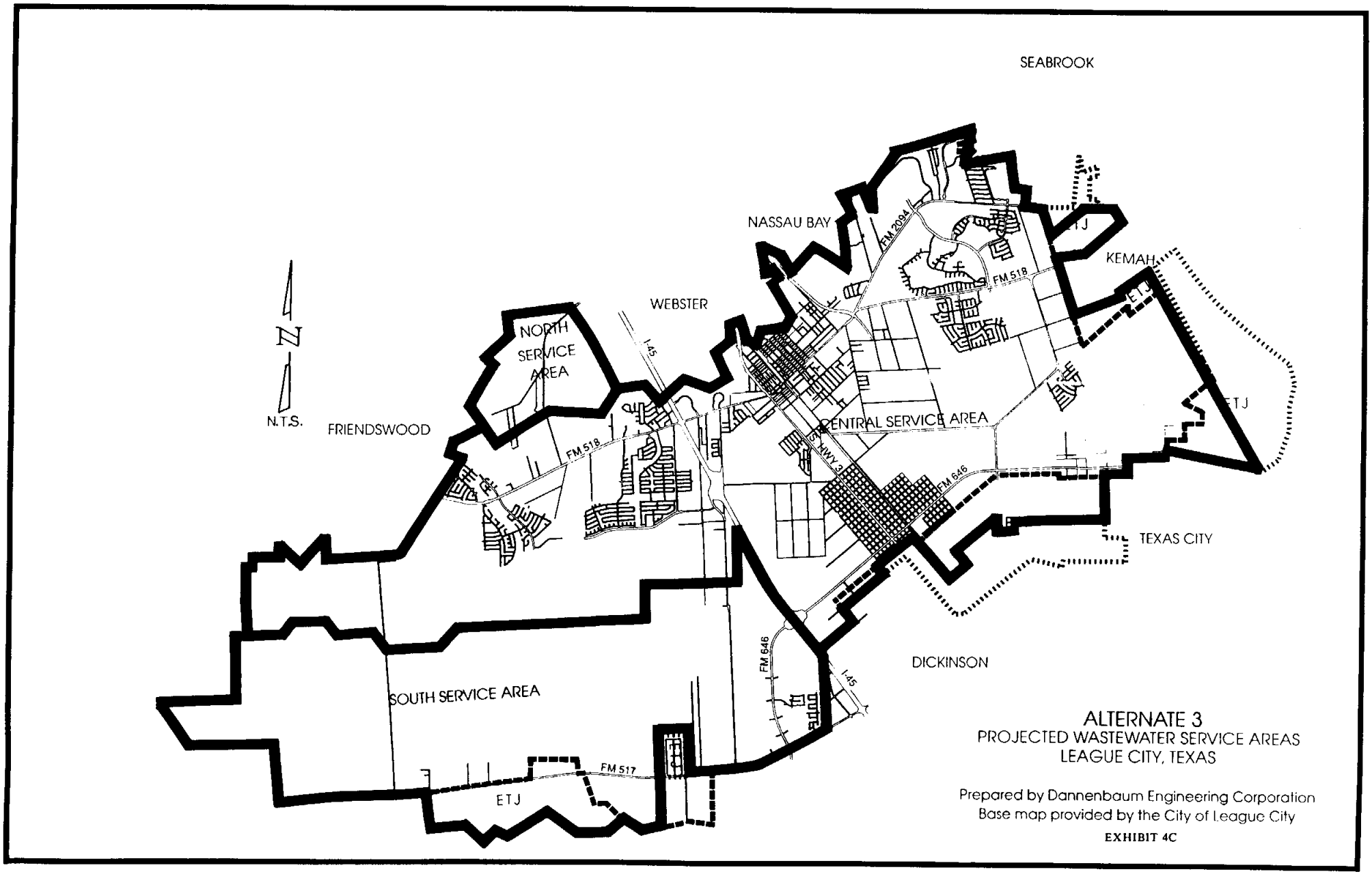
EXHIBIT 4A

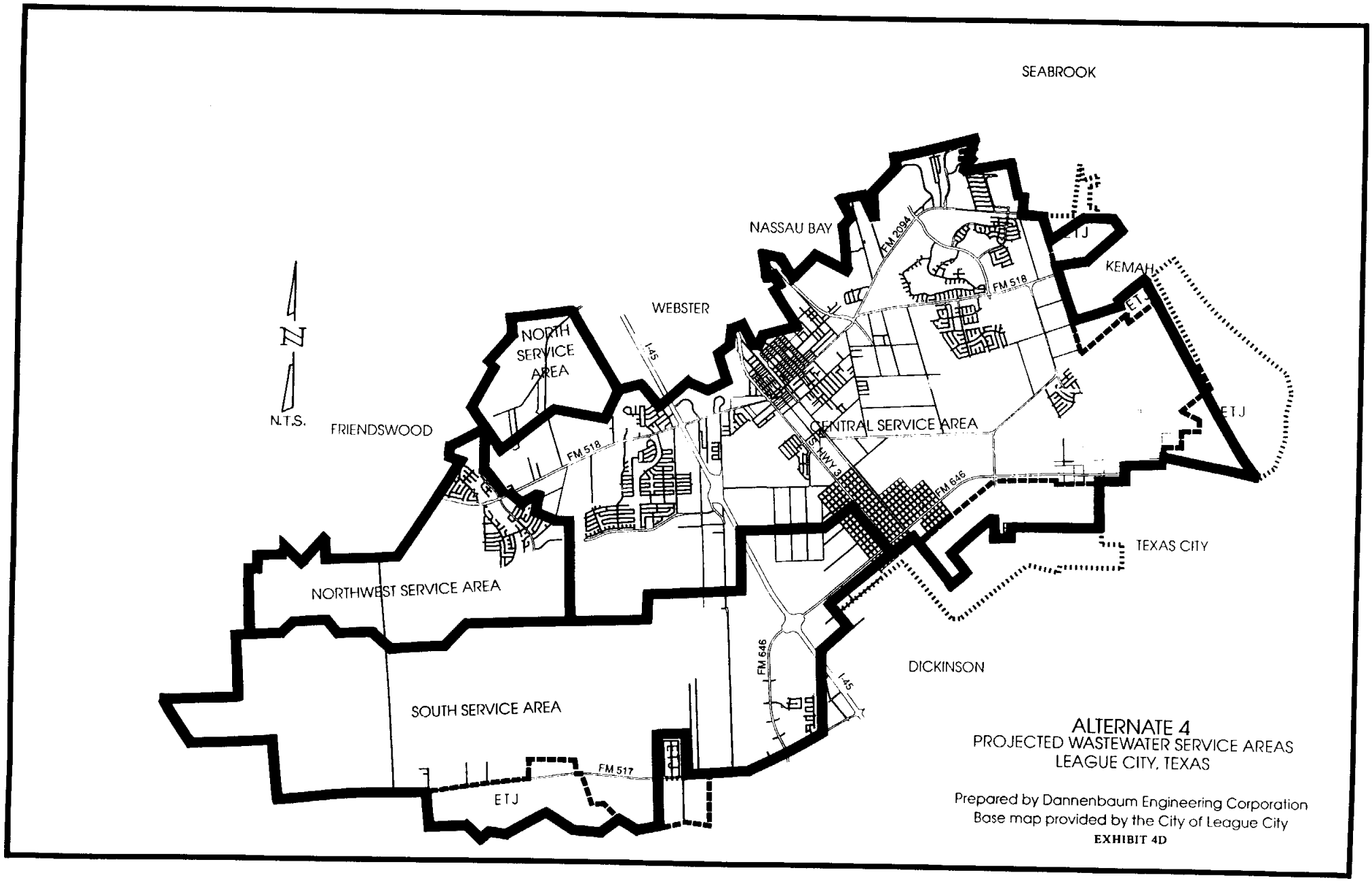


ALTERNATE 2
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS

Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City

EXHIBIT 4B

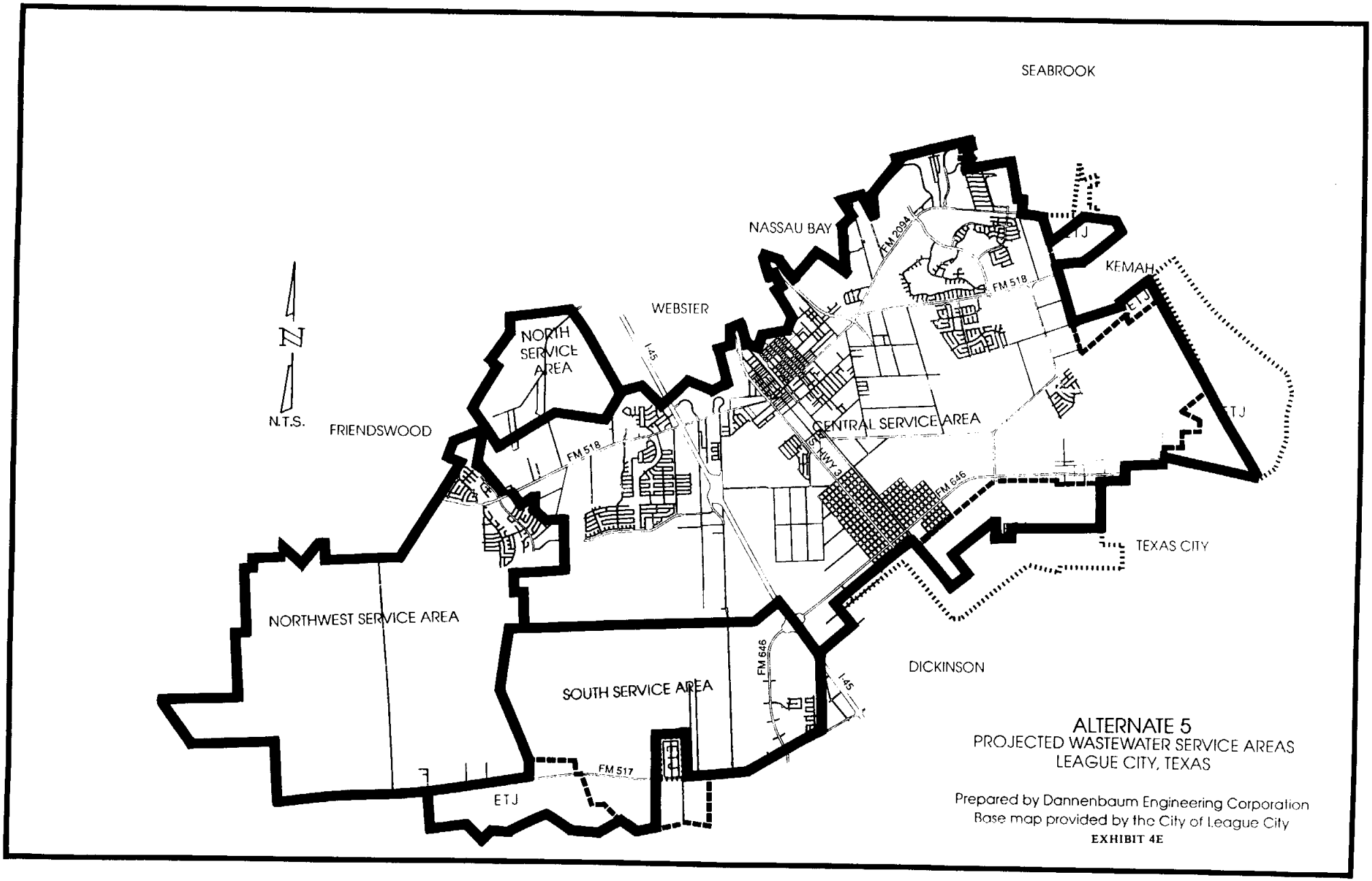

SEABROOK
NASSAU BAY
FM 2094
ETJ
KEMAH
FM 518
ETJ
WEBSTER
NORTH SERVICE AREA
I-45
N
N.T.S.
FRIENDSWOOD
CENTRAL SERVICE AREA
FM 518
HWY 3
FM 646
ETJ
TEXAS CITY
DICKINSON
FM 646
I-45
SOUTH SERVICE AREA
FM 517
ETJ
ALTERNATE 3
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS
Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City
EXHIBIT 4C



ALTERNATE 4
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS

Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City

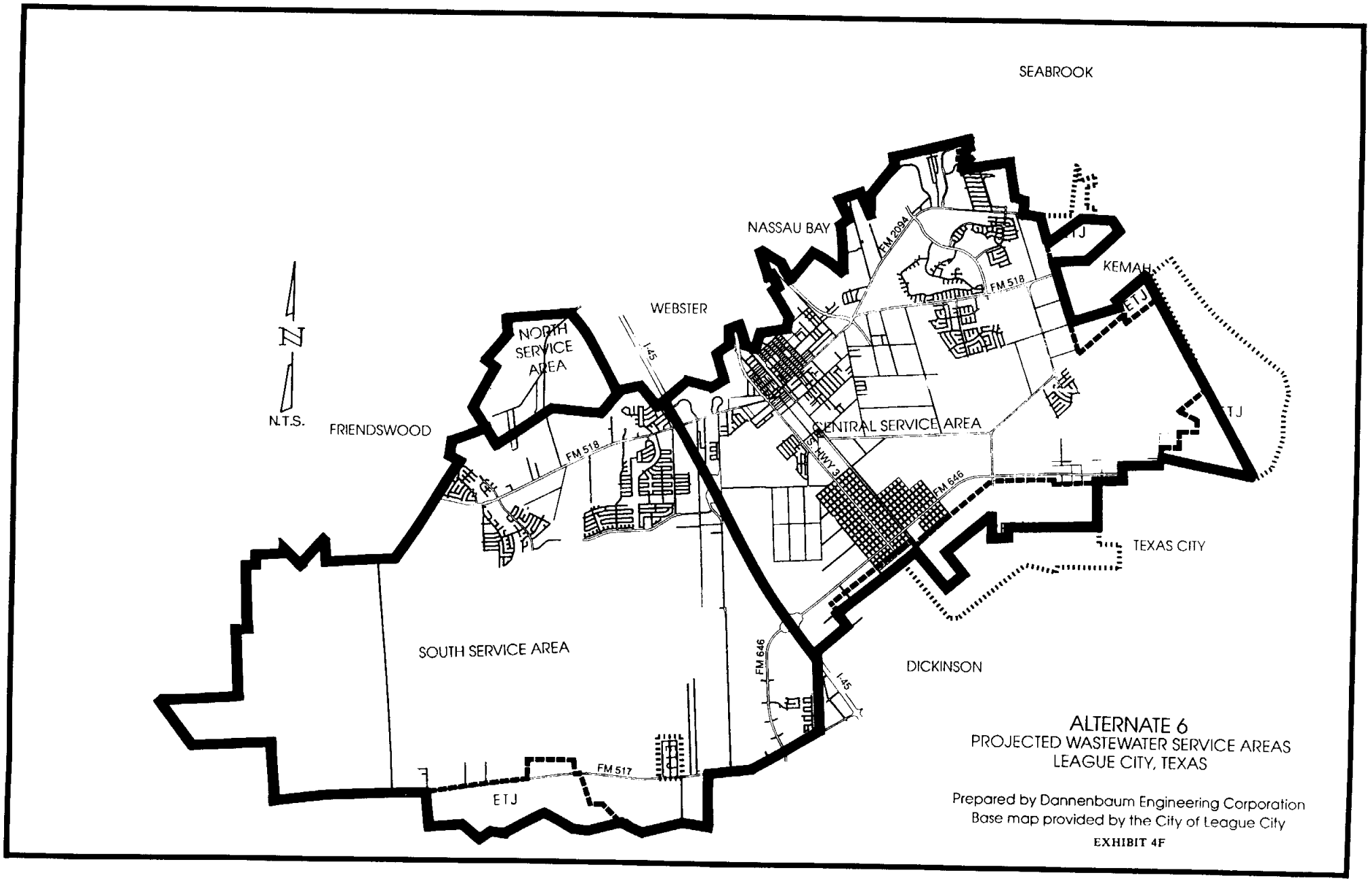
EXHIBIT 4D



ALTERNATE 5
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS

Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City

EXHIBIT 4E



ALTERNATE 6
PROJECTED WASTEWATER SERVICE AREAS
LEAGUE CITY, TEXAS

Prepared by Dannenbaum Engineering Corporation
Base map provided by the City of League City

EXHIBIT 4F

TABLE 7

ALTERNATE PLANT FLOWS

(Service Area) Plant	Alternate Flows (million gallons per day)						
	Existing	1	2	3	4	5	6
(Central) Dallas-Salmon	4.5	15.1	22.2	28.1	23.8	23.3	18.0
(Northwest) Countryside	0.66	3.5	3.5	0	3.5	8.4	0
(North) GCWDA Blackhawk	--	1.1	1.1	1.1	1.1	1.1	1.1
(Southeast) Temporary Bayridge	0.15	5.9	0	0	0	0	0
(South) GCWCID No.1 Dickinson	N/A	0	4.9	0	0	0	0
(South) South	--	8.3	0	9.1	10.0	5.5	19.2
(Southwest) Southwest	--	4.5	6.8	0	0	0	0

preliminary construction cost estimate were justified by seeking quotes from vendors and construction contractors who have or had worked on similar projects in scope and size.

The preliminary construction cost estimate for this wastewater study will vary with inflation, cost of materials and labor, and the actual construction condition encountered. Variations or revisions of the utility locations will also cause changes in the cost of this estimate. Therefore, the comparison of this wastewater study with other studies should include the above mentioned variables.

B. Unit Prices.

The preliminary construction cost estimate contains unit prices for gravity lines, manholes, force mains, lift stations and wastewater treatment plants. The unit prices are shown on Table 8.

The gravity line unit prices include materials, bedding, excavations and dewatering. The unit price reflects the installation of pipe to be placed by open cut, 15 to 25 feet in depth. Lift stations were proposed and located to eliminate gravity lines being installed deeper than 25 feet. In the South Service Area, lift stations were proposed to eliminate gravity lines not being installed deeper than 20 feet to avoid possible wet sand conditions. The cost estimate for the Central Service Area does include an additional unit price for sheet piling where construction is to occur in heavy developed areas. For the proposed manholes needed, a uniform percentage of 2% of total gravity line cost was used. This is for the construction of

TABLE 8

UNIT PRICES

Sanitary Sewer		Force Main		Lift Station	
Size (Inches)	Cost/ Linear Foot ($)	Size (Inches)	Cost/ Linear Foot ($)	Size (mgd)	Cost/Station ($)
18	94	8	15	1	125,000
21	106	10	18	3	140,000
24	122	12	21	5	155,000
30	150	18	25	8	170,000
36	220	24	35	10	185,000
42	273	30	50	15	210,000
48	330	36	70	20	250,000
54	385	42	90	30	300,000
60	450	48	105		
66	517	54	120		
72	607	60	160		
78	685	66	180		
84	765				

Wastewater Treatment Plant
Construction Costs
$3/gallon - new plant
$1.5/gallon - expanding existing plant

1.5 acres needed per 1 million gallons

costs include onsite lift station

Operations and Maintenance
$0.85/1000 gallons - plant <5 mgd
$0.50/1000 gallons - plant >5 mgd

Miscellaneous Construction Costs
36-inch casing - $200/linear foot

2863-01/D:3857

the minimal manholes required by the City of League City and not intended to estimate any future manholes needed for future development connections to the wastewater system. The force main unit prices include materials, bedding and excavation.

The lift station unit prices are for complete and operational lift stations. The lift station unit prices are based on the compiled quotes from vendors, contractors, and past completed lift station costs. As part of the construction phasing for the proposed lift stations, the initial phase will only include pumps to service the projected demands; however, the structural dimensions and site planning will be planned to handle future service loads. The existing lift stations will only require the increase of pump sizing. The phases in year 2000, 2010, 2020 should not require structural dimension changes.

The wastewater treatment plant prices are based on average costs per gallon within this region of the state. The new plant unit price does include a lift station on site. An additional unit price was used for land requirements needed to build or expand the plant. For plants to be expanded, an average base rate was used per gallon using past costs within the region as the basis.

The operations and maintenance cost for the plants are based on historical data on existing League City wastewater plants. This unit price is given to allow one to compare the daily and substaining cost of the wastewater system.

C. Funding.

The sources of funding for this study include grants, loans, user fees, taxes, and capital recovery impact fees. The use of grants to fund projects is not a reliable source of revenue because there is no reasonable way to predict if the grant will be given. However, it is the best interest of the City to actively pursue the use of grants to fund the capital improvements in this study.

Application for loans from the Texas Water Development Board can partially fund the proposed improvements. The TWDB manages the State Revolving Fund (SRF) program which provides low interest loans for most aspects of wastewater projects, including the collection systems, interceptors, treatment and discharge facilities. Land costs and unjustifiable system capacity are not eligible for SRF loan assistance. Customers outside of the City limits but being provided wastewater services from a TWDB funded project, will be required to adopt or be subject to provisions of the City's water conservation program. Other potential funding sources may include Community Development Block Grants (HUD), the Economic Development Administration, and the Farmers Home Administration.

The use of user fees and taxes is a reliable source of revenue. However, the approval of additional taxes could be met with opposition by the community depending on the political climate of the community. The City overlapping tax rate for 1990 was one of the highest tax rates in the region.

In addition, the local municipal utility districts within the City limits have an overlapping tax rate which is high compared to other local tax rates.

The Capital Recovery Impact Fee adopted by League City is in place for use in raising funds for capital improvement projects on the incoming development. The improvement of the City wastewater system will benefit all users in the community. Thus, if grants are not available for revenue to fund capital improvements, the use of user fee and tax rate increases with the continuation of the capital recovery impact fee is the most equitable funding for the proposed capital improvements.

VII. ALTERNATE EVALUATION

The cost for each of the six alternate wastewater systems was determined. The alternate systems and cost assumptions are defined, previously in the report. The alternate costs were evaluated for plant cost, collection system cost, and variable operation and maintenance costs. The costs of Alternate 1 through 6 are given in Tables 9 through 14, respectively. Table 15 summarizes these costs.

In general, it was found that a limited number of larger plants was more cost effective than a larger number of smaller plants, that the plants with low efficiencies should be eliminated, and that those alternates using existing trunks, or oversized trunks were more cost effective than those alternates requiring new trunklines. Alternate

TABLE 9

ALTERNATE 1 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	120,000	149,000	269,000	935	1
Northwest	12,600,000	1,085,280	7,000	162,000	13,854,280	2,975	1
South	29,651,161	9,604,830	429,000	322,000	40,006,991	4,150	2
Southwest	16,347,015	2,425,866	58,000	410,000	19,240,881	3,200	2
Southeast	21,427,852	4,199,748	--	--	25,627,600	2,950	-
Central	19,080,000	2,924,584	563,800	935,500	23,503,884	7,550	6
Subtotal	99,106,028	20,240,308	1,177,800	1,978,500	122,502,636	21,760	12
Eng. and Cont.(1)	19,821,205	4,048,061	235,560	395,700	24,500,527	--	-
TOTAL	118,927,233	24,288,369	1,413,360	2,374,200	147,003,163	21,760	12

(1) Engineering and contingencies estimated at 20% of the subtotal.

2863-01/D:3857

TABLE 10

ALTERNATE 2 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	120,000	149,000	269,000	935	1
Northwest	12,600,000	1,085,280	7,000	162,000	13,854,280	2,975	1
South	--	6,454,407	330,750	320,000	7,105,157	8,825	2
Southwest	24,702,156	7,016,070	126,000	250,000	32,091,226	3,400	1
Southeast	--	--	--	--	--	--	-
Central	33,016,518	11,493,043	1,206,250	495,000	46,210,811	11,100	2
Subtotal	70,318,674	26,048,800	1,197,000	1,376,000	99,533,474	27,235	7
Eng. and Cont. (1)	14,063,734	5,209,760	358,000	275,200	19,906,694	--	-
TOTAL	84,382,408	31,258,560	2,148,000	1,651,200	119,440,168	27,235	7

(1) Engineering and contingencies estimated at 20% of the subtotal.

2863-01/D:3857

TABLE 11

ALTERNATE 3 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	120,000	149,000	269,000	935	1
Northwest	--	--	--	--	--	--	-
South	33,057,297	10,283,742	124,000	710,000	44,175,039	4,550	3
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	44,022,024	17,816,136	1,553,500	1,503,000	45,574,792	14,050	8
Subtotal	77,079,321	28,099,878	1,797,500	2,362,000	109,338,699	19,535	12
Eng. and Cont.(1)	15,415,864	5,619,975	359,500	472,400	21,867,739	--	-
TOTAL	92,495,185	33,719,853	2,157,000	2,834,400	131,206,438	19,535	12

(1) Engineering and contingencies estimated at 20% of the subtotal.

TABLE 12

ALTERNATE 4 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	1,980,000	--	120,000	149,000	2,249,000	792	1
Northwest	12,600,000	1,085,280	7,000	162,000	13,854,280	4,750	1
South	36,326,700	10,283,742	124,000	710,000	47,444,442	3,800	3
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	36,001,062	13,348,536	1,181,250	994,000	51,524,848	16,422	5
Subtotal	86,907,762	24,717,558	1,432,250	2,015,000	115,072,570	25,764	10
Eng. and Cont.(1)	17,381,552	4,943,511	286,450	403,000	23,014,514	--	-
TOTAL	104,289,314	29,661,069	1,718,700	2,418,000	138,087,084	25,764	10

(1) Engineering and contingencies estimated at 20% of the subtotal.

TABLE 13

ALTERNATE 5 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	120,000	149,000	269,000	935	1
Northwest	30,494,826	5,595,414	1,003,500	575,000	37,668,740	4,200	2
South	19,979,685	7,203,087	21,600	130,000	27,334,372	2,750	1
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	35,068,392	13,348,536	1,181,250	994,000	50,592,178	11,650	5
Subtotal	85,542,903	26,147,037	2,326,350	1,848,000	115,864,290	19,535	9
Eng. and Cont.(1)	17,108,580	5,229,407	465,270	369,600	23,172,858	--	-
TOTAL	102,651,483	31,376,444	2,791,620	2,217,600	139,037,148	19,535	9

(1) Engineering and contingencies estimated at 20% of the subtotal.

TOTAL 14

ALTERNATE 6 COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	120,000	149,000	269,000	935	1
Northwest	--	--	--	--	--	--	-
South	69,747,264	22,728,966	639,400	944,000	94,056,630	9,600	6
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	28,212,090	15,611,508	291,300	1,079,000	45,193,898	9,000	5
Subtotal	97,959,354	38,340,474	1,050,700	2,172,000	139,519,528	19,535	12
Eng. and Cont.(1)	19,591,870	7,668,094	210,140	434,400	27,903,905	--	-
TOTAL	117,551,224	46,008,568	1,260,840	2,606,400	167,423,433	19,535	12

(1) Engineering and contingencies estimated at 20% of the subtotal.

2863-01/D:3857

TABLE 15

ALTERNATE COST SUMMARY

Alternate	Treatment System		Collection System		Total Cost ($)
	Construction Cost ($)	O & M Cost ($/Day)	Construction Cost ($)	Number of Lift Stations	
1	118,927,233	21,760	28,075,930	12	147,003,163
2	84,382,408	27,235	35,057,760	7	119,440,168
3	92,495,185	19,535	33,711,254	12	131,206,438
4	104,289,314	25,764	33,797,770	10	138,087,084
5	102,651,483	19,535	36,385,665	9	139,037,148
6	117,551,224	19,535	49,872,209	12	167,423,433

All costs include engineering and contingency.

2863-01/D:3857

1, with the most number of plants, was eliminated. Alternate 6, requiring substantial reconstruction of the trunklines, was eliminated.

Alternates 2, 3, 4 and 5 were then evaluated for flexibility, public acceptance, and environmental and social impacts. It was found that over reliance on contracted wastewater treatment was not desirable, and that flexibility to address varied changes in development locations was needed. Alternate 2, relying heavily on contracted capacities for treatment, was eliminated. Alternate 3 was eliminated since it does not provide adequate flexibility. Alternates 4 and 5 have comparable flexibility. Alternate 4 was recommended over Alternate 5 since it is marginally more cost effective.

Alternate 4 was presented as the recommended plan at the October 28, 1991 public hearing. All of the previously identified jurisdictions were individually invited to the hearing. The public was notified in the local newspaper. There was a general consensus that the contracted use of the GCWDA Blackhawk plant should either be eliminated or expanded.

Continuing with the evaluation, three more alternates were created, Alternates 4A, 4B and 4C. Each takes the base analysis of Alternate 4 and expands on it to evaluate the merits of contracted use of the GCWDA Blackhawk plant. In Alternate 4, the north area goes to the GCWDA plant. In Alternate 4A and 4B, no areas go to the GCWDA plant, but service is provided by expanded use of either the Dallas-Salmon plant or the Countryside plant, respectively. Alternate 4C evaluates the fuller use of the GCWDA plant by taking both the north and northwest areas of

TABLE 16

ALTERNATE 4 PLANT FLOWS

(Service Area) Plant	Alternate Flows (million gallons per day)				
	Existing	4	4A	4B	4C
(Central) Dallas-Salmon	4.5	23.8	28.4	23.8	23.8
(Northwest) Countryside	0.66	3.5	0	4.6	0
(North) GCWDA Blackhawk	--	1.1	0	0	4.6
(Southeast) Temporary Bayridge	0.15	0	0	0	0
(South) GCWCID No. 1 Dickinson	N/A	0	0	0	0
(South) South	--	10.0	10.0	10.0	10.0
(Southwest) Southwest	--	0	0	0	0

the City to that plant. Table 16 gives the plant flows for each of the alternatives.

Each of these alternatives were evaluated for economic feasibility. Tables 17 through 19 give the costs per service area and the results are summarized in Table 20. Alternate 4A has higher line costs since the trunklines to Dallas-Salmon are at capacity and would have to be expanded. Alternate 4B has higher plant costs due to the existing high operation and maintenance costs at the Countryside plant. Alternate 4C optimizes the contracted use of the GCWDA Blackhawk plant and is herein recommended as the proposed wastewater plan.

VIII. WASTEWATER PLAN

A. Ultimate.

This League City Wastewater Plan is to conceptually recommend the gravity lines, lift stations, force mains, and wastewater treatment plant size requirements and locations for the year 2000, 2010, 2020 and the further development to ultimate conditions.

The recommended gravity line sizes and grades were based on the projected wastewater loading from land use demands. The routing of gravity lines incorporates the existing gravity lines and a proposed central network of gravity lines to service League City. The depth of lines was kept below 15 feet to allow future development to connect to the wastewater system by gravity flow.

Proposed lift stations were located to not allow the depth of gravity lines to exceed 25 feet. The existing lift stations in League City

TABLE 17

ALTERNATE 4A COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	1,980,000	--	142,000	149,000	2,271,000	759	1
Northwest	6,300,000	7,293,750	560,750	522,000	14,676,500	2,415	2
South	36,326,700	10,283,742	124,000	710,000	47,444,442	3,800	3
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	44,581,626	13,348,536	1,181,250	994,000	60,105,412	16,422	6
Subtotal	89,188,326	30,926,028	2,008,000	2,375,000	124,497,354	23,396	12
Eng. and Cont.(1)	17,837,665	6,185,206	401,600	475,000	24,899,471	--	-
TOTAL	107,025,991	37,111,234	2,409,600	2,850,000	149,396,825	23,396	12

(1) Engineering and contingencies estimated at 20% of the subtotal.

2863-01/D:3857

TABLE 18

ALTERNATE 4B COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	--	--	127,200	149,000	276,200	1,493	1
Northwest	16,690,680	1,085,280	7,000	162,000	17,944,960	6,242	1
South	36,326,700	10,283,742	124,000	710,000	47,444,442	3,800	3
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	36,001,062	13,348,536	1,181,250	994,000	51,524,848	16,422	5
Subtotal	89,018,442	24,717,558	1,439,450	2,015,000	117,190,450	27,957	10
Eng. and Cont.(1)	16,985,552	4,943,511	286,450	403,000	22,618,514	--	-
TOTAL	106,822,130	29,661,069	1,727,347	2,418,000	140,628,540	27,957	10

(1) Engineering and contingencies estimated at 20% of the subtotal.

TABLE 19

ALTERNATE 4C COST

District	Treatment System Construction Cost ($)	Collection System			Total Cost ($)	Variables	
		Line Cost ($)	Force Main Cost ($)	Lift Station Cost ($)		Plant O & M Cost ($/Day)	Number of Lift Stations
North	1,980,000	--	120,000	149,000	2,249,000	792	1
Northwest	6,300,000	1,064,000	396,000	362,000	8,122,000	2,520	2
South	36,326,700	10,283,742	124,000	710,000	47,444,442	3,800	3
Southwest	--	--	--	--	--	--	-
Southeast	--	--	--	--	--	--	-
Central	36,001,062	13,348,536	1,181,250	994,000	51,524,848	16,422	5
Subtotal	80,607,762	24,696,278	1,821,250	2,215,000	109,340,290	23,534	11
Eng. and Cont.(1)	16,985,552	4,943,511	286,450	403,000	22,618,514	--	-
TOTAL	96,729,314	29,635,534	2,185,500	2,658,000	131,208,348	23,534	11

(1) Engineering and contingencies estimated at 20% of the subtotal.

2863-01/D:3857

TABLE 20

ALTERNATE 4 COST SUMMARY

Alternate	Treatment System		Collection System		Total Cost ($)
	Construction Cost ($)	O & M Cost ($/Day)	Construction Cost ($)	Number of Lift Stations	
4	104,289,314	25,764	33,797,770	10	138,087,084
4A	107,025,991	23,396	42,370,834	12	149,396,825
4B	106,822,130	27,957	33,806,416	10	140,628,540
4C	96,729,314	23,534	34,479,034	11	131,208,348

All costs include engineering and contingency.

2863-01/D:3857

were used to determine the routing of force mains and gravity lines. This allowed the proposed wastewater system to incorporate existing facilities. Thus, the lift stations play an integral part in the phasing and routing of gravity lines to the wastewater treatment plants.

Wastewater treatment plants proposed in this study limit the number of treatment plants to create an effective wastewater system. The Dallas-Salmon plant in the Central Service Area will stay on line and be expanded to serve future demands. A new South wastewater treatment plant will be proposed in the South Service Area. The Countryside treatment plant is recommended to be taken off line with the North Service Area using the Blackhawk facilities in Friendswood, Texas.

1. North Service Area - Ultimate Wastewater System.

   This Service Area has an existing wastewater treatment plant located at Galveston County Municipal Utility District (GCMUD) No. 2 in Countryside. This plant has been recommended to be taken off line due to its high operation and maintenance costs. The use of the Blackhawk facilities in Friendswood, Texas will create a more ideal regional wastewater system for both League City and Friendswood. When the Countryside plant is taken off line, the load on this plant will be routed using a 30-inch force main. The region north of Clear Creek will be served by an

18-inch force main and lift station. This 18-inch force main will join with the 30-inch force main from the abandoned Countryside plant. From this point a 36-inch force main will take the service flow to the Blackhawk wastewater treatment plant.

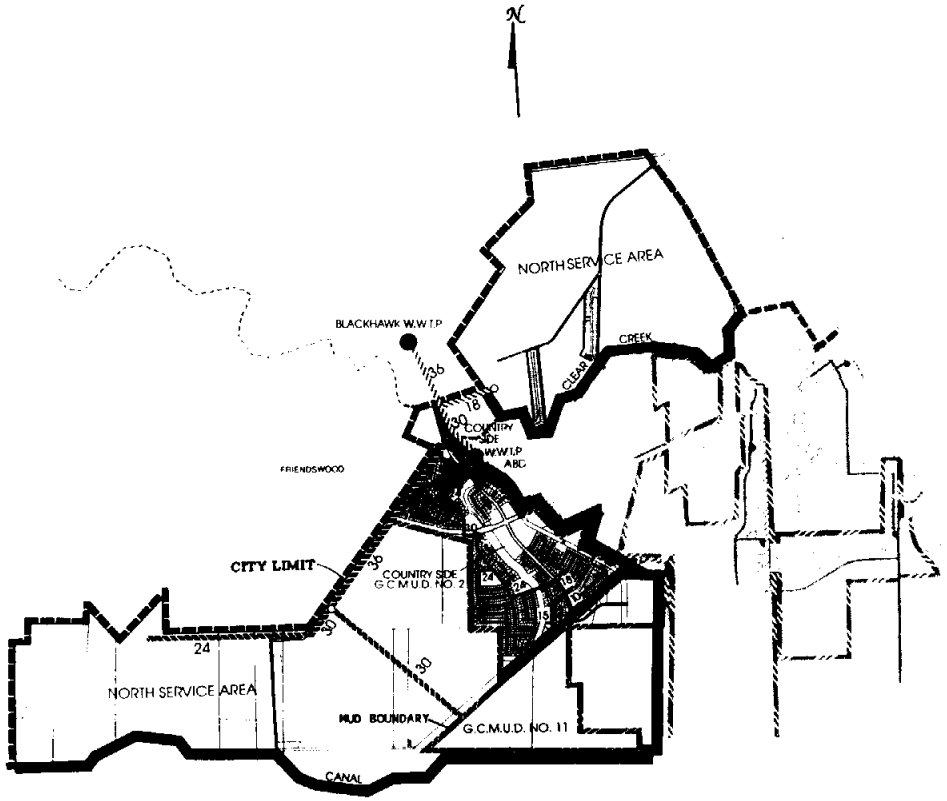
The gravity lines in the west region will run along the north boundary of the north service area and southeast of GCMUD No. 11. These gravity lines will serve the west region and the southern region of GCMUD No. 11. The northern region of GCMUD No. 11 will be served by the existing collection system in GCMUD No. 2. Refer to Exhibit 5A for the ultimate north service area and facilities.

2. South Service Area - Ultimate Wastewater System.

The South Service Area presently has its wastewater serviced by GCWCID No. 1 and the Dallas-Salmon plant. It is the recommendation of this study to build a new plant to service this service area located on Dickinson Bayou. The westerly most region is mainly raw acreage with little development. This region will be serviced by gravity lines crossing the Dickinson Bayou in two locations by a 30-inch and 36-inch force mains. This service load will be collected by a 48-inch gravity line along the League City south City limit. With the additional service load of the ETJ region, this trunkline will increase to a 54-inch gravity line.

LEGEND

EXISTING SANITARY SEWER
EXISTING FORCE MAIN
EXISTING LIFT STATION
EXISTING WASTEWATER TREATMENT PLANT
PROPOSED SANITARY SEWER
PROPOSED FORCE MAIN
PROPOSED LIFT STATION
PROPOSED WASTEWATER TREATMENT PLANT



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
NORTH SERVICE AREA
EXHIBIT 5A

DRAWN: M.A.S.	DATE: DECEMBER, 1991	SHT NO. 1 OF 3
CHECKED: C.C.J.		
APPROVED: D.D.P.	SCALE: NONE	JOB NO. 2863-01

The central region also has limited development. This region is collected and routed by a 54-inch line to the wastewater treatment plant which not only services the central region but also the easterly incoming service load of the region of this service area.

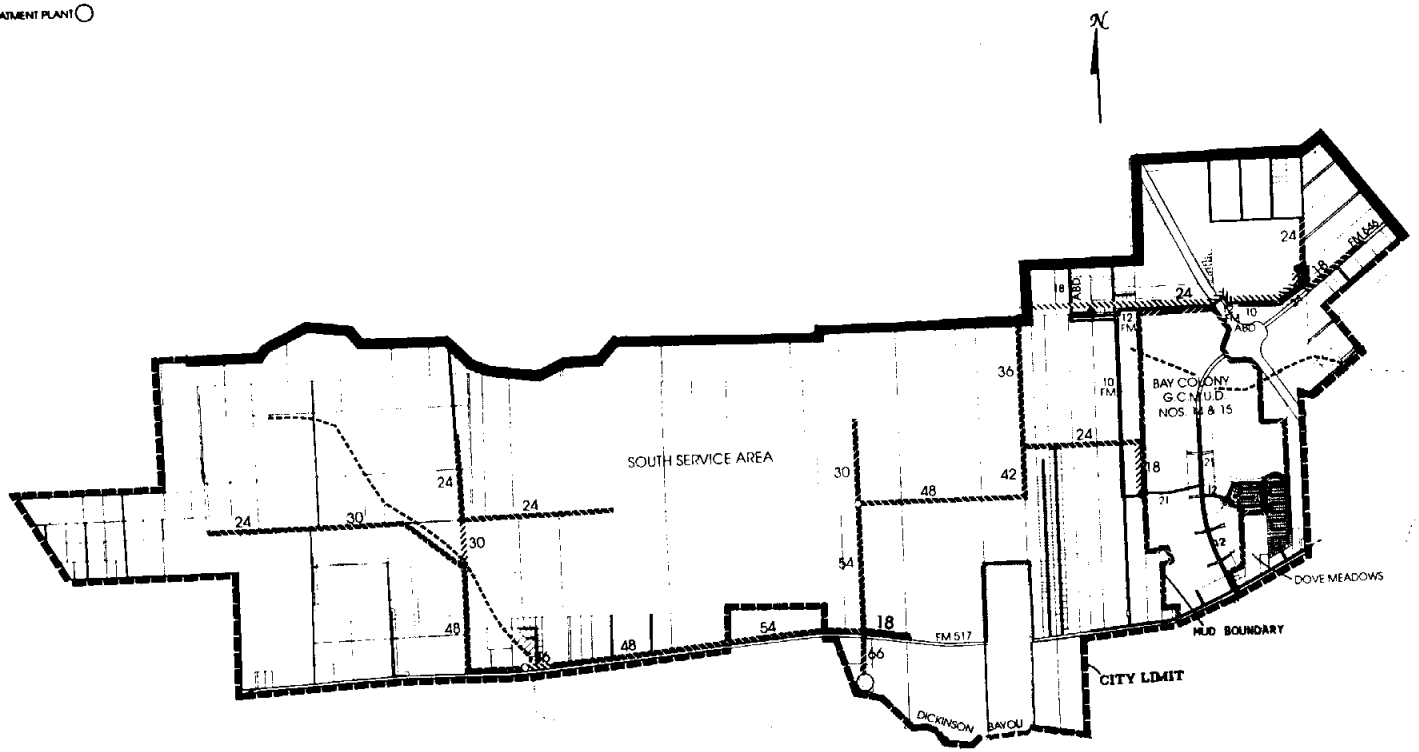
The easterly region is divided by Interstate 45. The area east of Interstate 45 currently crosses under the freeway in a 12-inch force main through a 36-inch steel casing. The ultimate system will also use this 36-inch steel casing crossing with a 24-inch force main which will discharge into the 36-inch gravity line in the central region. The area west of Interstate 45 will use the existing lift station at Bay Colony to discharge this region into a proposed 24-inch gravity which will connect to the central region. Currently the existing lift station at Bay Colony discharges into the Central Service Area Dallas-Salmon plant by a 10-inch force main. Refer to Exhibit 5B for the ultimate south service area and facilities.

3. Central Service Area - Ultimate Wastewater System

This service area can be broken up into five regions. This service area development is from heavy to none, and also has the majority of existing facilities maintained by League City. This study uses the existing facilities in its recommended ultimate wastewater system.

LEGEND

EXISTING SANITARY SEWER
EXISTING FORCE MAIN
EXISTING LIFT STATION
EXISTING WASTEWATER TREATMENT PLANT
PROPOSED SANITARY SEWER
PROPOSED FORCE MAIN
PROPOSED LIFT STATION
PROPOSED WASTEWATER TREATMENT PLANT



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
SOUTH SERVICE AREA
EXHIBIT 5B

DRAWN: G.A.S.	DATE: DECEMBER, 1991	SHT NO. 2 OF 3
CHECKED: C.F.A.	SCALE: NONE	JOB NO. 2863-01
APPROVED: D.A.D.		

The first region of the service area is west of Interstate 45. In this region the northern area is collected by a 21-inch force main routed along FM 518 and the south along the east boundary of GCMUD No. 6. The 21-inch force main will connect to the existing 21-inch force main in GCMUD No. 6. A proposed 12-inch force main will run parallel to the 21-inch force main to service GCMUD No. 6. These two force mains will discharge into the existing 36-inch gravity line. This will in turn travel to the existing lift station by Interstate 45. A proposed 21-inch force main along with the existing 24-inch force main will cross under the freeway to the existing 54-inch trunkline discharging into Dallas-Salmon ultimate wastewater treatment plant.

The second region is east of Interstate 45 and flows to the Dallas-Salmon wastewater treatment plant. The northern most area of this region along FM 518 will be served by the existing 30-inch gravity line. The southwest area of the region will be serviced by the existing 54-inch gravity line. The southeast areas of this region will be serviced by the existing 10-inch and 18-inch gravity lines and a proposed parallel gravity line to the east. This proposed gravity line will serve the adjacent land, and the ETJ along the southeast City limit boundary of this region.

The third region is in the most southeasterly area of the Central Service Area which includes the ETJ. This area will be served by a gravity line that runs along the south boundary of Bay Ridge Municipal Utility District (Bay Ridge MUD). This trunkline travels westerly and turns to the northwest toward the wastewater treatment plant along the existing 18-inch gravity line. The existing 18-inch gravity line will be replaced with the proposed 48-inch line upgrading the capacity and removing the existing deteriorating line.

The fourth region includes Bay Ridge MUD, the airport, and GCMUD No. 3. The existing lift station and force main in Bay Ridge MUD will be upgraded and discharged into the existing lift station at GCMUD No. 3. From GCMUD No. 3, the 21-inch force main will discharge into the existing lift station along FM 518. This lift station will be expanded and a proposed 10-inch force main will run parallel to the existing 24-inch force main discharging into a 42-inch gravity line. This 42-inch gravity will then discharge into the wastewater treatment plant. The airport and surrounding area will be serviced by a 36-inch gravity line discharging into the existing lift station at FM 518.

The fifth region will include the area north of FM 518 and east of Dallas-Salmon. The most easterly area, including the ETJ will be served by an 18-inch gravity line. This line will

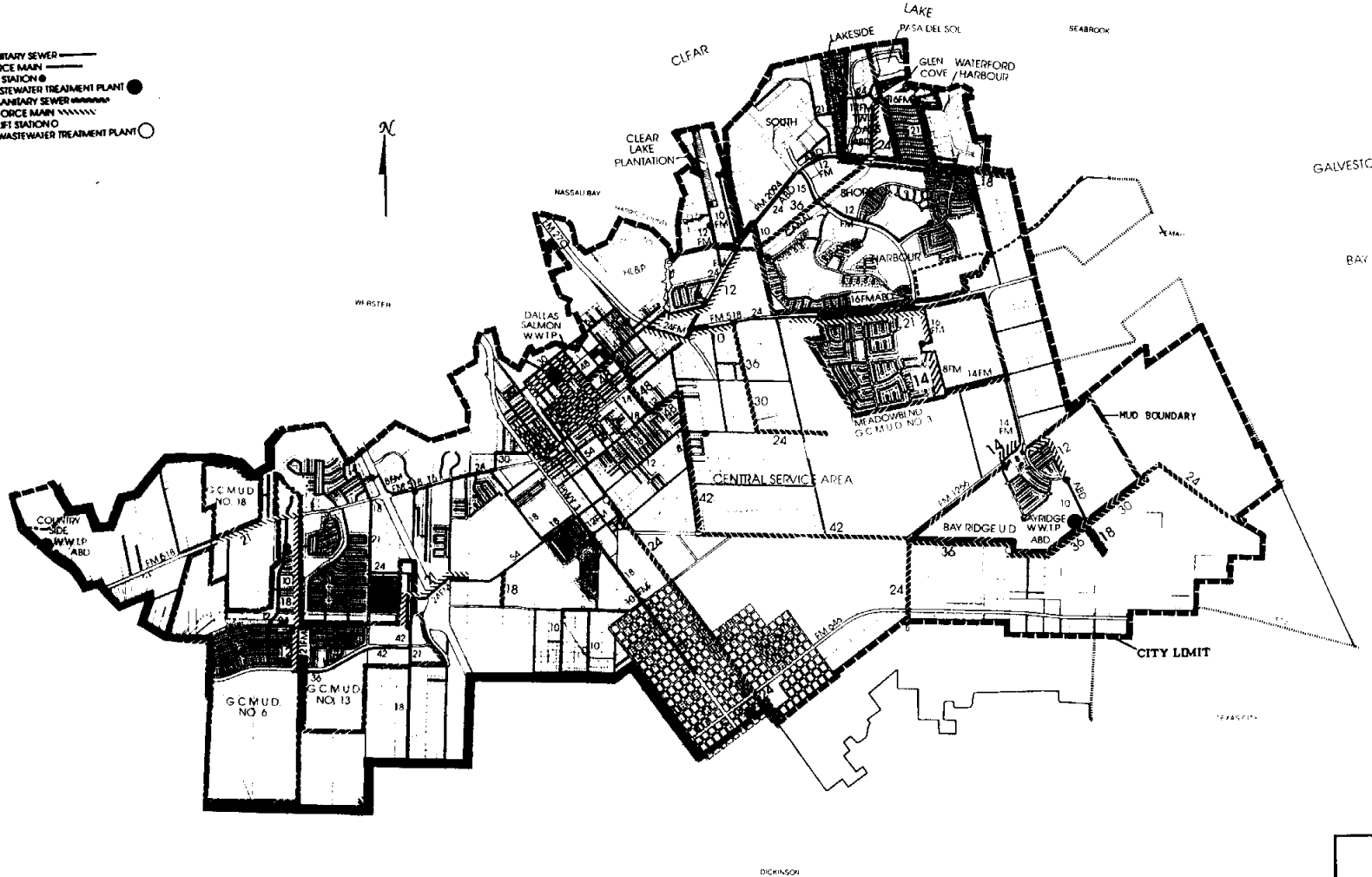
discharge into the existing 21-inch gravity line at Glen Cove. The existing lift station at Glen Cove will be upgraded and discharged into the existing lift station in Twin Oaks by a 16-inch force main. This lift station will be upgraded and a 24-inch force main installed. At this point, the collection system along FM 2094 will be abandoned and a new 36-inch gravity line along the Houston Lighting & Power discharge canal will be recommended. This 36-inch gravity line will replace the existing 24-inch gravity line on FM 2094 which serves South Shore Harbour south of FM 2094 and the easterly area of South Shore Harbour north of FM 2094. The westerly area north of FM 2094 will be serviced by a 24-inch gravity line. The 36-inch gravity line will discharge into an existing lift station at FM 2094. A proposed 12-inch force main running parallel to the existing 24-inch force main will discharge into the 42-inch gravity line leading to the wastewater treatment plant. Refer to Exhibit 5C for the ultimate central service area and facilities.

B. Cost

The cost of this ultimate wastewater system is shown on Table 21 through Table 24. The cost of this system is approximately $124,000,000. This is slightly higher than the cost comparison of the six alternates. The variation lies with the conceptual idea of comparing six alternatives. The unit costs for the alternatives

LEGEND

EXISTING SANITARY SEWER
EXISTING FORCE MAIN
EXISTING LIFT STATION
EXISTING WASTEWATER TREATMENT PLANT
PROPOSED SANITARY SEWER
PROPOSED FORCE MAIN
PROPOSED LIFT STATION
PROPOSED WASTEWATER TREATMENT PLANT



DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
CENTRAL SERVICE AREA
EXHIBIT 5C

DRAWN M.A.S.	DATE: DECEMBER, 1991	SHT NO. 3 OF 3
CHECKED C.C.J.	SCALE: NONE	JOB NO. 2863-01
APPROVED D.B.P.		

TABLE 21

ULTIMATE CONSTRUCTION COST
SUMMARY

Service Area	Construction Cost ($)	Operations and Maintenance		Number of Lift Stations
		$/day	$/year	
North	11,317,544	2,305	841,325	3
South	62,192,917	8,004	2,921,460	5
Central	50,482,001	14,145	5,162,925	11
TOTAL	123,992,462	24,454	8,925,710	19

2863-01/D:3857

TABLE 22

ULTIMATE PRELIMINARY COST ESTIMATE
NORTH SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)
Gravity Line				
24" pipe	L.F.	5,925	122	722,850
30" pipe	L.F.	6,750	150	1,012,500
36" pipe	L.F.	7,950	220	1,749,000
Manholes @ 2% of line cost				69,687
SUBTOTAL				3,554,037
Force Main				
18"	L.F.	1,950	25	48,750
30"	L.F.	2,250	50	112,500
36"	L.F.	2,300	70	161,000
SUBTOTAL				322,250
Lift Station				
Prop. 11.6 MGD	MGD	11.6	16,638	193,000
Prop. 4.2 MGD	MGD	4.2	35,476	149,000
Expand by 13.6 MGD to 15.4 MGD	MGD	13.6	14,926	203,000
SUBTOTAL				545,000
Blackhawk STP				
Expand by 13.6 MGD to 22.8 MGD	Gal.	3.34M	1.5	5,010,000
SUBTOTAL				5,010,000
SUBTOTAL				9,431,287
20% Engineering and Contingencies				1,886,257
TOTAL				11,317,544
Operation and Maintenance				
STP	1000 gal.	3,340	0.69	2,305/day
Lift Station	Ea.	3		3

2863-01/D:3857

TABLE 23
ULTIMATE PRELIMINARY COST ESTIMATE
SOUTH SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)
Gravity Line				
18" pipe	L.F.	9,200	94	488,800
24" pipe	L.F.	16,650	122	2,031,300
30" pipe	L.F.	9,400	150	1,410,000
36" pipe	L.F.	4,575	220	1,006,500
42" pipe	L.F.	1,750	273	477,750
48" pipe	L.F.	17,080	330	5,636,400
54" pipe	L.F.	9,150	385	3,522,750
66" pipe	L.F.	750	517	387,750
Manholes @ 2% of line cost				299,225
SUBTOTAL				15,260,475
Force Main				
18"	L.F.	2,025	25	50,625
24"	L.F.	10,425	35	364,875
30"	L.F.	1,650	50	82,500
36"	L.F.	900	70	63,000
SUBTOTAL				561,000
Lift Station				
Expand by 3.5 MGD to 4.7	MGD	3.5	42,143	147,500
Prop. 9.5 MGD	MGD	9.5	19,079	181,250
Prop. 16.6 MGD	MGD	16.6	13,422	222,800
Prop. 17.9 MGD	MGD	17.9		233,200
Prop. 20.7 MGD	MGD	20.7	12,246	253,500
SUBTOTAL				1,838,250
South Wastewater Treatment Plant				
Prop. 11.6 MGD	Gal.	11.6M	3	34,800,000
7.7 Acres	Ac.	7.7	21,780	167,706
SUBTOTAL				34,967,706
SUBTOTAL				51,827,431
20% Engineering and Contingencies				10,365,486
TOTAL				62,192,917

TABLE 23
ULTIMATE PRELIMINARY COST ESTIMATE
SOUTH SERVICE AREA
(continued)

South Service Area

Item	Unit	Quantity	Price ($)	Total ($)
Operation and Maintenance				
STP	1000 gal.	11,600	0.69	8,004/day
Lift Station	Ea.	5		5

2863-01/D:3857

TABLE 24

ULTIMATE PRELIMINARY COST ESTIMATE
CENTRAL SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)
Gravity Line				
18" pipe	L.F.	5,400	94	507,600
24" pipe	L.F.	21,675	122	2,644,350
30" pipe	L.F.	5,625	150	843,750
36" pipe	L.F.	16,725	220	3,679,500
42" pipe	L.F.	12,975	273	3,542,175
48" pipe	L.F.	4,125	330	1,361,250
Manholes @ 2% of line cost				228,189
Sheet pile trench safety in heavy development	L.F.	6,125	400	2,450,000
SUBTOTAL				15,107,614
Force Main				
10"	L.F.	3,950	25	71,100
12"	L.F.	11,420	35	239,820
21"	L.F.	21,750	50	652,500
24"	L.F.	2,250	35	78,750
36" casing	L.F.	400	200	80,000
SUBTOTAL				1,122,170
Lift Station				
Expand by 18.6 MGD to 18.9 MGD	MGD	18.6	12,839	238,800
Expand by 9.3 MGD to 14.8 MGD	MGD	9.3	20,941	194,750
Expand by 7.8 MGD to 13.5 MGD	MGD	7.8	21,667	169,000
Expand by 6.5 MGD to 6.8 MGD	MGD	6.5	25,000	162,500
Expand by 4.0 MGD to 4.7 MGD	MGD	4.0	36,875	147,500
Expand by 1.6 MGD to 2.3 MGD	MGD	1.6	80,938	129,500
Expand by 1.6 MGD to 2.2 MGD	MGD	1.6	80,938	129,500
Prop. 12.8 MGD	MGD	12.8	15,547	199,000
Prop. 8.5 MGD	MGD	8.5	20,441	173,750
Prop. 4.5 MGD	MGD	4.5	33,611	151,250
Prop. 3.4 MGD	MGD	3.4	42,059	143,000
SUBTOTAL				1,838,550
Wastewater Treatment Plant				
Expand by 16 MGD to 20.5	Gal.	11.6M	1.5	24,000,000
SUBTOTAL				24,000,000

TABLE 24

ULTIMATE PRELIMINARY COST ESTIMATE
CENTRAL SERVICE AREA
(continued)

Item	Unit	Quantity	Price ($)	Total ($)
SUBTOTAL				42,068,334
20% Engineering and Contingencies				8,413,667
TOTAL				50,482,001
Operation and Maintenance				
STP	1000 gal.	20,500	0.69	14,145/day
Lift Station	Ea.	11		11

2863-01/D:3857

were general and considered to be equivalent in all the alternatives. This will allow one to compare the economic merit of the alternatives. Once the selected alternative was selected a detailed cost analysis was performed. Upon the completion of this detail cost analysis, there was a slight increase in the cost estimate for the ultimate wastewater system.

An estimate of monthly rates for wastewater service customers, attributable to the recommended improvements, can only be approximated. The availability and timing of grants and loans will affect the costs of the improvements, as will actual growth patterns and construction schedules. The sewer capital recivery fee system will insure that wastewater service customers are not subjected to sudden, significant increases in service rates.

C. Phasing

The phasing in the Plan is based on the projected growth rates and locations interpreted from existing planning documents and information. The phasing can be modified as the actual growth rates and locations in the coming years are observed. This Plan will assume that the projected growth rates and locations will occur as interpreted. Further growth analysis will be required depending upon actual growth rates and locations. Table 25 summarizes the phasing costs.

TABLE 25
PHASING COST
SUMMARY

	Phase I Year 2000	Phase II Year 2010	Phase III Year 2020
North	3,188,750	1,339,250	1,036,500
Central	3,584,220	2,199,700	1,620,750
South	765,000	8,672,425	275,000
TOTAL	7,537,970	12,211,375	2,932,250

2863-01/D:3857

1. North Service Area

a. Phase One - Year 2000

The service area has 1202 existing ESFC. The 1202 ESFC includes 51 septic ESFC which are excluded from the flow calculations. In the year 2000, the service area will have 3702 ESFC. This is an increase of 2500 ESFC. This development could occur in GCMUD No. 2 or the adjacent land southeast and southwest of GCMUD No. 2. The initial development should occur in GCMUD No. 2 where 950 ESFC are available. 600 ESFC can be developed in the northern area of GCMUD No. 11 and the remaining 950 ESFC will most likely be developed adjacent to GCMUD No. 2. With this development, a portion of the proposed 36-inch gravity, 4500 feet, will need to be built to service the development southwest of GCMUD No. 2. The developing northern area of GCMUD No. 11 will be serviced by the existing gravity line collection system in GCMUD No. 2. In this phase the Countryside wastewater treatment plant will be taken off line and the existing lift station be expanded to allow existing and future flows to be discharged to the Blackhawk wastewater treatment plant. A temporary 21-inch force main will be built between the lift station and the Blackhawk wastewater plant for this phase.

b. Phase Two - Year 2010

The service area will increase 1500 ESFC to 5202 ESFC. The area north of Clear Creek should have a growth of 500 ESFC

and the remaining 1000 ESFC to be developed southwest of GCMUD No. 2. This will require the construction of an additional 2000 feet of the 36-inch gravity line. The proposed lift station located in the area north of Clear Creek is needed with a temporary 8-inch force main. The lift station at Countryside will need to have increased pump capacity. The 21-inch force main will not need to be changed at this phase.

c. Phase Three - Year 2020

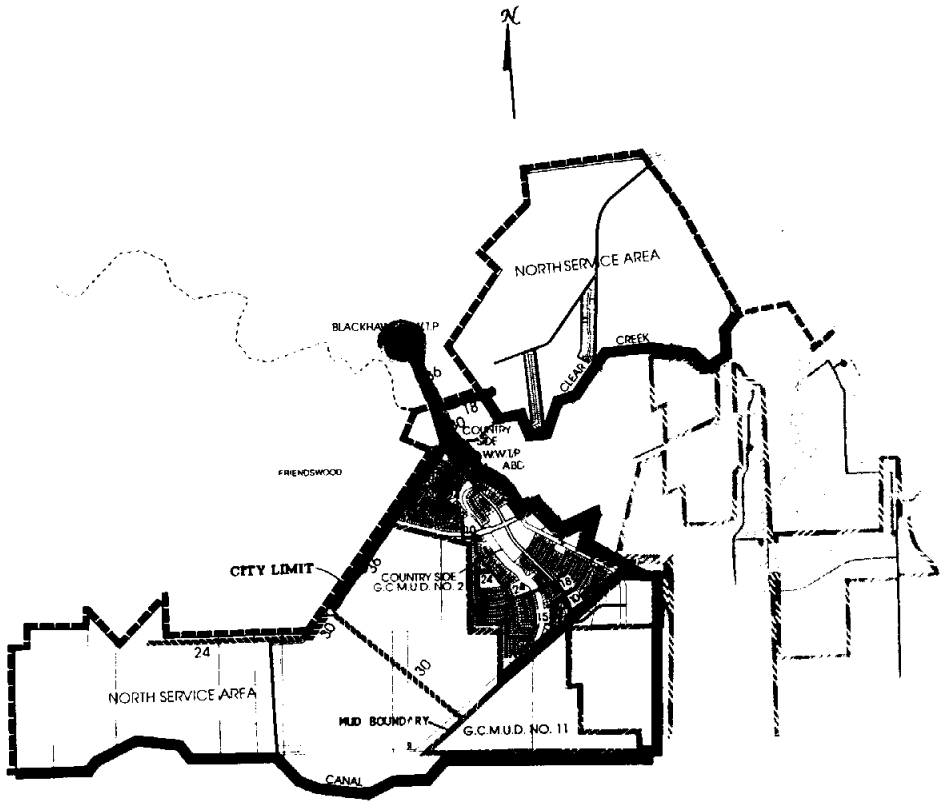
The service area will increase to 6202 ESFC. This increase of ESFC will result in the completion of the 36-inch gravity line. The lift station at the Countryside wastewater treatment plant need to be expanded with the 21-inch force main replaced to a 30-inch force main.

In conclusion, the growth pattern will decide ultimately the necessary construction needs for the future. If increased growth is seen in the GCMUD No. 11 southern region, the 30-inch gravity connection to the 36-inch gravity on the northwest service area boundary may need to be built.

The improvements and costs for each phase are shown on Exhibit 5A-P and Table 26, respectively.

LEGEND

EXISTING SANITARY SEWER ———
EXISTING FORCE MAIN ———
EXISTING LIFT STATION ●
EXISTING WASTEWATER TREATMENT PLANT ●
PROPOSED SANITARY SEWER ~~~~~
PROPOSED FORCE MAIN ~~~~~
PROPOSED LIFT STATION ○
PROPOSED WASTEWATER TREATMENT PLANT ○
PHASE I
PHASE II
PHASE III



PHASED

DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
NORTH SERVICE AREA
EXHIBIT 5A-P

DRAWN: M.A.S.	DATE: DECEMBER, 1991	SHT NO. 1 OF 3
CHECKED: C.C.L.		
APPROVED: D.D.P.	SCALE: NONE	JOB NO. 2863-01

TABLE 26
PHASING COST
NORTH SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)	Demand* (MGD)	Supply* (MGD)	Capacity* (Supply - Demand) (MGD)
PHASE 1 - Year 2000					0.40	0.60	0.20
36" Pipe	L.F.	4,500	220.00	990,000			
Expand Lift Station (Countryside)	MGD	3.3	43,106.00	142,250			
Temporary 21" Force Main	L.F.	4,550	30.00	136,500			
Expand Blackhawk Wastewater Treatment Plant	Gal.	1.28	1.50	1,920,000	1.28	1.28	0.00
TOTAL				3,188,750			
PHASE 2 - Year 2010					1.28	1.77	0.49
36" Pipe	L.F.	2,000	220.00	440,000			
Proposed Lift Station (Country Side)	MGD	0.7	--	110,000			
Temporary 8" Force Main	L.F.	1,950	15.00	29,250			
Expand Lift Station Pumps	MGD	1.4	25,000.00	25,000			
Expand Blackhawk Wastewater Treatment Plant	Gal.	0.49	1.50	735,000	1.77	1.77	0.00
TOTAL				1,339,250			
PHASE 3 - Year 2020					1.77	2.03	0.31
36" Pipe	L.F.	1,450	220.00	319,000			
30" Force Main	L.F.	4,550	50.00	227,500			
Expand Lift Station Pumps	MGD	1.3	25,000.00	25,000			
Expand Blackhawk Wastewater Treatment Plant	Gal.	0.31	1.50	465,000	2.08	2.08	0.00
TOTAL				1,036,500			

*The top number in each row is at the beginning of each phase. The bottom number in each row is at the end of each phase.

2. South Service Area

a. Phase One - Year 2000

The South District has 350 existing ESFC. The existing 350 ESFC includes 49 septic ESFC which are excluded from the flow calculations. This is currently being serviced by GCWCID No. 1 and the Dallas-Salmon plants. The existing 18-inch gravity line northwest of Bay Colony currently serves Bay Colony by a 10-inch force main and the area east of Interstate 45 by a 12-inch force main.

This existing 18-inch gravity line discharges into Dallas-Salmon. The capacity available in this 18-inch gravity line is 1.9 MGD. The increased development in this area of service of 1500 ESFC to 1850 ESFC can be served by this existing 18-inch gravity line. However, the 1850 ESFC service demands would cause the 18-inch line to reach capacity. If the Central Service Area causes additional service load to this line then the force mains will need to be diverted to the proposed south wastewater treatment plant.

b. Phase Two - Year 2010

With the addition of 500 ESFC to 2350 ESFC, the South wastewater plant will need to be built along with the central trunklines, if this was not done for year 2000. The force mains will need to be diverted if not already done so for year 2000. The 12-inch force main under Interstate 45

can be diverted to the proposed 36-inch gravity line, and the 10-inch force main from Bay Colony can be diverted to the proposed 24-inch gravity line. The lift stations east of Interstate 45 and at Bay Colony will need to be upgraded.

c. Phase Three - Year 2020

The ESFC at this time will be 2850 ESFC. This development should still take place in the eastern area on either side of Interstate 45. The lift stations will need to be expanded but the force mains are to remain the same size. The South wastewater treatment plant will have to be expanded to 2.08 MGD.

The improvements and costs for each phase are shown on Exhibit 5B-P and Table 27, respectively.

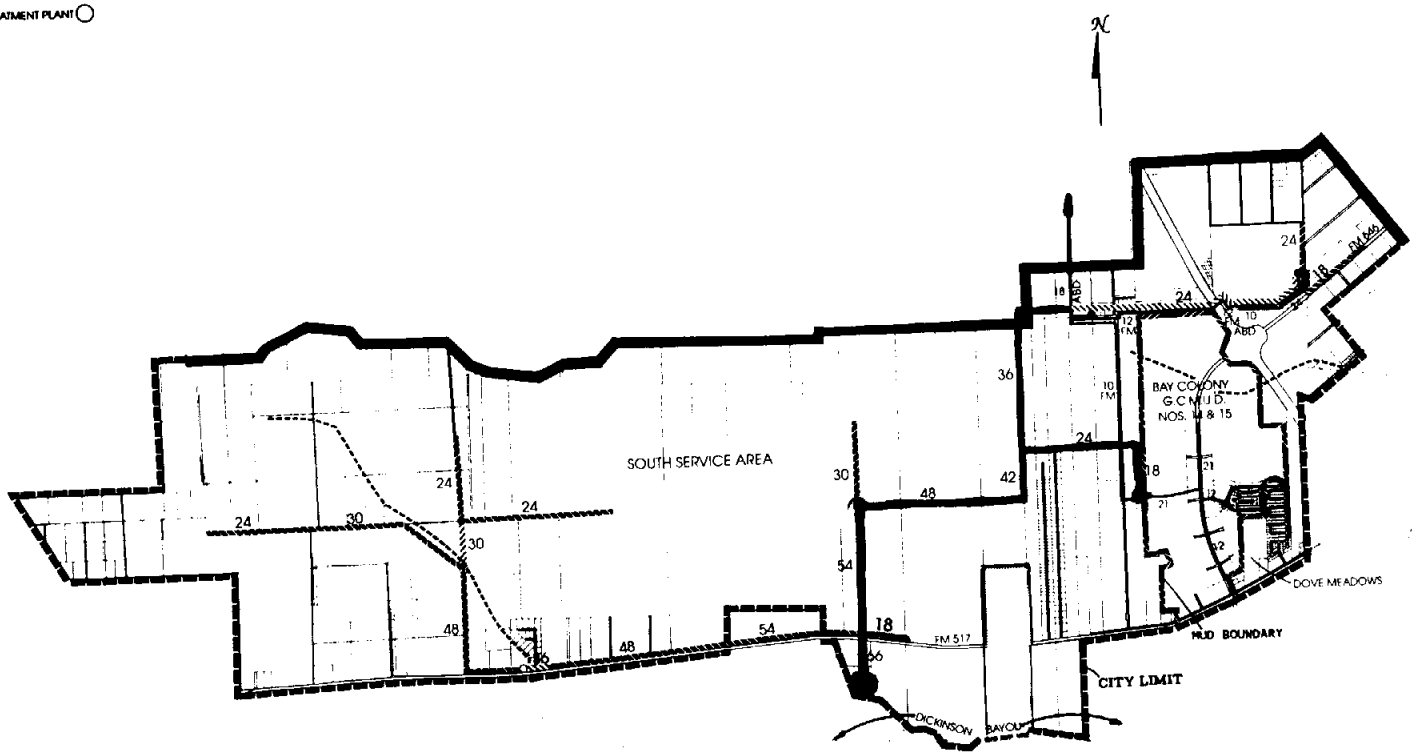
3. Central Service Area

a. Phase One - Year 2000

The service area currently has 10,083 ESFC. By the year 2000, the ESFC will have risen to 16,210, an increase of 6,127 ESFC. The projected 6,127 ESFC includes 354 septic ESFC which are excluded from the flow calculations. With this development taking place in the northwestern region, the proposed 18-inch gravity line on FM 2094 will need to be constructed as well as the 36-inch gravity line along the Houston Lighting & Power discharge channel in South Shore

LEGEND

EXISTING SANITARY SEWER
EXISTING FORCE MAIN
EXISTING LIFT STATION
EXISTING WASTEWATER TREATMENT PLANT
PROPOSED SANITARY SEWER
PROPOSED FORCE MAIN
PROPOSED LIFT STATION
PROPOSED WASTEWATER TREATMENT PLANT
PHASE I
PHASE II
PHASE III



PHASED

DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
SOUTH SERVICE AREA
EXHIBIT 5B-P

DRAWN: M.A.S.	DATE: DECEMBER, 1991	SHT NO. 2 OF 3
CHECKED: C.C.J.	SCALE: NONE	JOB NO. 2863-01
APPROVED: D.W.D.		

TABLE 27
PHASING COST
SOUTH SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)	Demand* (MGD)	Supply* (MGD)	Capacity* (Supply-Demand (MGD)
PHASE 1 - Year 2000					0.11	0.62	0.51
Expand Dallas-Salmon Waste-water Treatment Plant	MGD	0.51M	1.50	765,000	0.62	0.62	0.00
TOTAL				765,000			
PHASE 2 - Year 2010					0.62	0.80	0.18
24" Pipe	L.F.	4,100	122.00	500,200			
36" Pipe	L.F.	4,575	220.00	1,006,500			
42" Pipe	L.F.	1,750	273.00	477,750			
48" Pipe	L.F.	5,830	330.00	1,923,900			
54" Pipe	L.F.	4,500	385.00	1,732,500			
66" Pipe	L.F.	750	517.00	387,750			
Extend 12" Force Main	L.F.	1,875	21.00	39,375			
Wastewater Treatment Plant	MGD	0.8M	3.00	2,400,000			
Temporary 10" Force Main	L.F.	2,025	18.00	36,450			
Lift Station	MGD	3.2	44,687.00	143,000			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000	0.80	0.80	0.00
TOTAL				8,672,425			
PHASE 3 - Year 2020					0.80	0.95	0.15
Expand Wastewater Treatment Plant	MGD	0.15M	1.50	225,000			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000	0.95	0.95	0.00
TOTAL				275,000			

*The top number in each row is at the beginning of each phase. The bottom number in each row is at the end of each phase.

Harbour. South Shore Harbour development should be completed by the year 2000 leaving the remainder of 1994 ESFC to be developed in the area northeast of South Shore Harbour and southeast of South Shore Harbour. This development will result in the expansion of the existing lift stations located in Glen Cove and Twin Oaks. The proposed 24-inch force main will be built from the Twin Oaks lift station to the proposed 36-inch gravity line. The proposed 12-inch force main along FM 2094 will also need to be constructed with the lift station being expanded to meet service demands. The Dallas-Salmon plant will also need to be expanded from 4.5 MGD to 5.47 MGD. The Bay Ridge wastewater treatment plant will be abandoned and a temporary 8-inch force main will be built to reverse the flow direction toward the north.

b. Phase Two - Year 2010

The second phase increases the ESFC by 3226 to 19,436 ESFC. The Dallas-Salmon plant will need to be expanded to 6.61 MGD. This development should take place in GCMUD No. 3, the adjacent land to the east, and along FM 518 west of Interstate 45. This development will cause the expansion of the lift station in GCMUD No. 3 with the existing 16-inch force main to remain along FM 518. The proposed lift station will be built with a tempoary 12-inch force main to be constructed along FM 518 and along the east boundary of GCMUD No. 6 to the existing 36-inch gravity line.

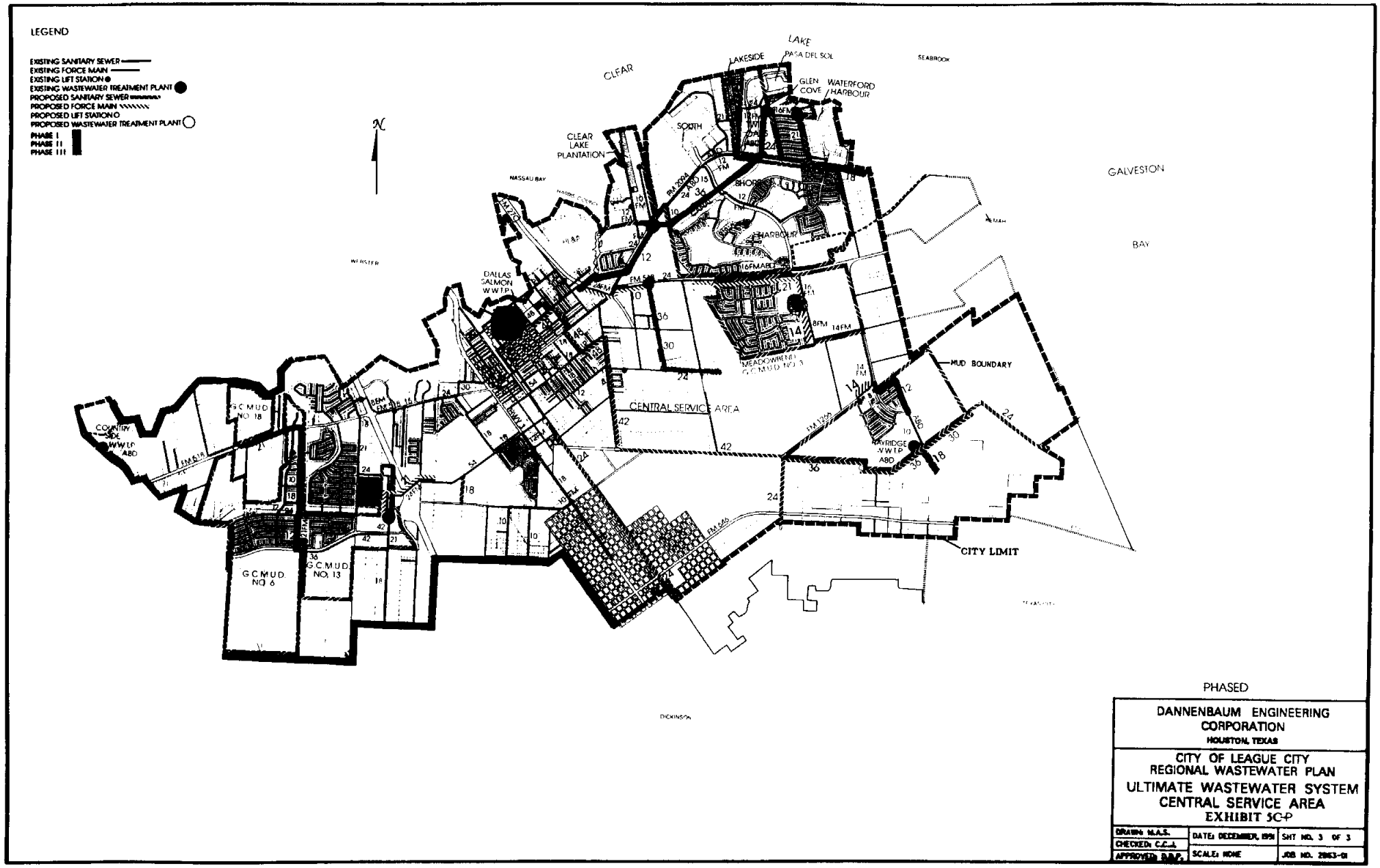
c. Phase Three - Year 2020

The service area will have 20,549 ESFC. This is an increase of 1113 ESFC from year 2010. The development should take place along FM 518 west of Interstate 45 and the raw acreage west of GCMUD No. 3. This will result in the construction of the gravity trunkline south of the lift station on FM 518. Thus the lift station would be expanded. The lift stations located in GCMUD No. 6 and GCMUD No. 13 will also need to be expanded. The Dallas-Salmon wastewater treatment plant will need to be expanded to 6.88 MGD.

The improvements and costs for each phase are shown on Exhibit 5C-P and Table 28, respectively.

D. Funding

The funding for the wastewater improvements has several options. Revenue can be raised by grants, loans, user fees, taxes, and capital recovery fees. Judging the merits of each option (See Section 6.), it is recommended that capital recovery fees be used to fund the proposed improved wastewater system. The use of grants and loans, if available, and taxes should be periodically reevaluated for feasibility.



PHASED

DANNENBAUM ENGINEERING CORPORATION
HOUSTON, TEXAS

CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN
ULTIMATE WASTEWATER SYSTEM
CENTRAL SERVICE AREA
EXHIBIT SC-P

DRAWN: M.A.S.	DATE: DECEMBER, 1991	SHT NO. 3 OF 3
CHECKED: C.C.J.	SCALE: NONE	JOB NO. 2983-01
APPROVED: B.M.D.		

TABLE 28
PHASING COST
CENTRAL SERVICE AREA

Item	Unit	Quantity	Price ($)	Total ($)	Demand* (MGD)	Supply* (MGD)	Capacity* (Supply-Demand) (MGD)
PHASE 1 - Year 2000					3.41	4.50	1.09
18" Pipe	L.F.	2,100	94.00	197,400			
36" Pipe	L.F.	6,150	220.00	1,353,000			
8" Force Main	L.F.	4,200	15.00	63,000			
12" Force Main	L.F.	5,420	21.00	113,820			
24" Force Main	L.F.	2,250	35.00	78,750			
Expand Lift Station (Glen Cove)	MGD	1.6	80,938.00	129,500			
Expand Lift Station (Twin Oaks)	MGD	6.5	25,000.00	162,500			
Expand Lift Station (FM 2094)	MGD	2.5	54,500.00	136,250			
Expand Wastewater Treatment Plant 0.6	Gal.	0.9M	1.50	1,350,000	5.47	5.47	0.00
TOTAL				3,584,220			
PHASE 2 - Year 2010					5.47	6.61	1.14
Expand Wastewater Treatment Plant	Gal.	1.14M	1.50	1,710,000			
Expand Lift Station (GCMUD 3)	MGD	1.8	72,777.00	131,000			
Lift Station	MGD	1.5	85,833.00	128,750			
Temporary 12" Force Main	L.F.	10,950	21.00	229,950	6.61	6.61	0.00
TOTAL				2,199,700			
PHASE 3 - Year 2020					6.61	6.88	0.27
24" Pipe	L.F.	3,000	122.00	336,000			
30" Pipe	L.F.	2,175	150.00	326,250			
36" Pipe	L.F.	2,175	220.00	478,500			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000			
Expand Lift Station Pumps	L.S.	1	25,000.00	25,000			
Expand Wastewater Treatment Plant	MGD	0.27	1.50	405,000	6.88	6.88	0.00
TOTAL				1,620,750			

*The top number in each row is at the beginning of each phase. The bottom number in each row is at the end of each phase.

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APPENDIX A

WASTEWATER PEAK DESIGN FACTOR

Source: Appendix C, "City of Sugar Land, Design Standards", Nov. 1989.

APPENDIX C

SANITARY SEWER - PEAK DESIGN FACTOR

All gravity sewers will be designed to accommodate the peak flow from the contributing drainage area. The peak flow will be computed using the appropriate peaking factor, F, multiplied by the average day flow for the contributing area. For non-residential areas, the peak flow should include consideration of flow characteristics from the anticipated development. In all cases, the design peaking factor, F, shall meet or exceed the values as follows:

An equivalent population less than 5,000 persons,

$$F = 4$$

An equivalent population greater than or equal to 5,000 persons,

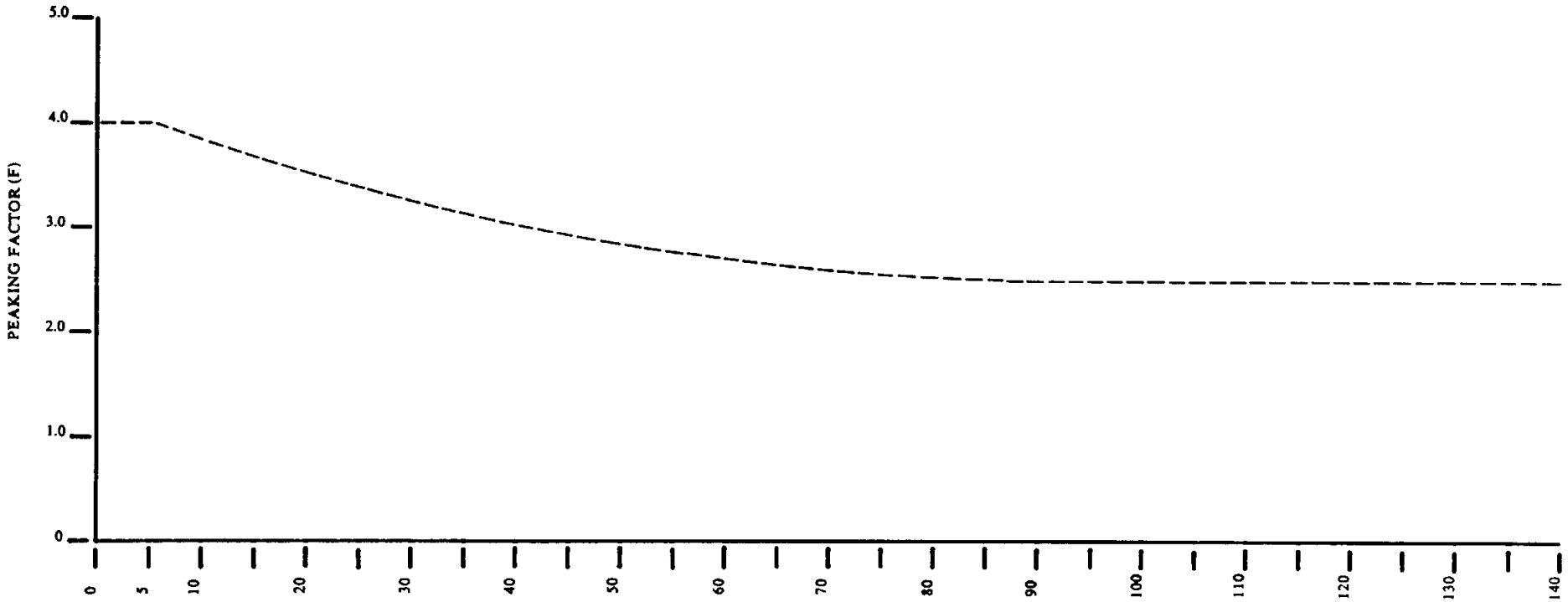
$$F = (14/(3.316 + P^{0.5})) + 1.5$$

for, P = equivalent population in thousands

Additional consideration of peak flow shall be given for design of pumping stations. The impact of pumping stations on the upstream and downstream sanitary sewer system shall be evaluated. The peak flow for design of a pumping station shall be based on the actual flow into the station. A reduced peak flow, based on the peaking factor presented above, may be used for design of larger pumping stations provided a detailed hydraulic analysis is performed on the sanitary sewer system. Specific approval by the Department of Public Works shall be required prior to use of a reduced peak flow for the design of a pumping station and related sanitary sewer system.

Population <5,000 F=4

Population ≥5,000 $F=(14/3.316 + (P^{0.5})) + 1.5$



Plotted from equations per Appendix C, "*City of Sugar Land Design Standards*", November 1989.

REVISIONS		DANNENBAUM ENGINEERING CORPORATION		
No.	Date	HOUSTON, TEXAS		
		CITY OF LEAGUE CITY REGIONAL WASTEWATER PLAN WASTEWATER PEAK DESIGN FACTOR APPENDIX A		
		Drawn By: R.A.S.	Date DEC. 1991	Job No. 2863-01
		Checked By: C.C.J.	Date DEC. 1991	Drawing No.
		Approved By: D.D.P.	Date DEC. 1991	Sht. 1 of 1

TELEDYNE POST N30930

APPENDIX B

1990 CENSUS

Source: U.S. Bureau of Census, Table 1 "Selected Population and Housing Characteristics: 1990 League City, Texas".

Table 1. Selected Population and Housing Characteristics: 1990
League City city, Texas

The population counts set forth herein are subject to possible correction for undercount or overcount. The United States Department of Commerce is considering whether to correct these counts and will publish corrected counts, if any, not later than July 1, 1991.

Total population	30,159
SEX	
Male	15,111
Female	15,048
AGE	
Under 5 years	2,746
5 to 17 years	6,361
18 to 20 years	1,077
21 to 24 years	1,374
25 to 44 years	12,429
45 to 54 years	3,078
55 to 59 years	939
60 to 64 years	747
65 to 74 years	855
75 to 84 years	420
85 years and over	133
Median age	30.6
Under 18 years	9,107
Percent of total population	30.2
65 years and over	1,408
Percent of total population	4.7
HOUSEHOLDS BY TYPE	
Total households	10,586
Family households (families)	8,290
Married-couple families	7,117
Percent of total households	67.2
Other family, male householder	339
Other family, female householder	834
Nonfamily households	2,296
Percent of total households	21.7
Householder living alone	1,812
Householder 65 years and over	255
Persons living in households	30,016
Persons per household	2.84
GROUP QUARTERS	
Persons living in group quarters	143
Institutionalized persons	141
Other persons in group quarters	2
RACE AND HISPANIC ORIGIN	
White	26,575
Black	1,547
Percent of total population	5.1
American Indian, Eskimo, or Aleut	103
Percent of total population	0.3
Asian or Pacific Islander	699
Percent of total population	2.3
Other race	1,235
Hispanic origin (of any race)	3,540
Percent of total population	11.7

Total housing units	11,381
OCCUPANCY AND TENURE	
Occupied housing units	10,586
Owner occupied	7,512
Percent owner occupied	71.0
Renter occupied	3,074
Vacant housing units	795
For seasonal, recreational, or occasional use	47
Homeowner vacancy rate (percent)	2.0
Rental vacancy rate (percent)	11.3
Persons per owner-occupied unit	2.96
Persons per renter-occupied unit	2.52
Units with over 1 person per room	456
UNITS IN STRUCTURE	
1-unit, detached	8,377
1-unit, attached	236
2 to 4 units	458
5 to 9 units	257
10 or more units	1,376
Mobile home, trailer, other	677
VALUE	
Specified owner-occupied units	6,637
Less than $50,000	875
$50,000 to $99,999	4,503
$100,000 to $149,999	765
$150,000 to $199,999	323
$200,000 to $299,999	133
$300,000 or more	38
Median (dollars)	69,100
CONTRACT RENT	
Specified renter-occupied units paying cash rent	2,966
Less than $250	222
$250 to $499	1,565
$500 to $749	1,015
$750 to $999	106
$1,000 or more	58
Median (dollars)	457
RACE AND HISPANIC ORIGIN OF HOUSEHOLDER	
Occupied housing units	10,586
White	9,577
Black	471
Percent of occupied units	4.4
American Indian, Eskimo, or Aleut	46
Percent of occupied units	0.4
Asian or Pacific Islander	169
Percent of occupied units	1.6
Other race	323
Hispanic origin (of any race)	903
Percent of occupied units	8.5

The user should note that there are limitations to many of these data. Please refer to the technical documentation provided with Summary Tape File 1A for a further explanation on the limitations of the data.

APPENDIX C

MONTHLY ACTIVE ACCOUNTS

Source: Customer Service Department, City of League City, "Monthly Active Accounts", March, 1990.

CUSTOMER SERVICE DEPARTMENT

MONTHLY ACTIVE ACCOUNTS

MONTH: March 1990

WATER

	RESIDENTIAL	MULT. UNIT	COMMERCIAL	TOTAL
Cycle I:	2123		18	2141
Cycle II:	1849	28	127	2004
Cycle III:	1812	71	161	2044
Cycle IV:	2451	26	145	2622
TOTAL:	8238	125	451	8811

INCREASE: 20 DECREASE: _____

SEWER

	RESIDENTIAL	MULT. UNIT	COMMERCIAL	TOTAL
Cycle I:	2105		9	2114
Cycle II:	1791	28	105	1924
Cycle III:	1705	71	157	1933
Cycle IV:	2366	25	44	2435
TOTAL:	7967	124	315	8406

INCREASE: 10 DECREASE: _____

APPENDIX D

WATER CONSERVATION PLAN

Source: City of League City "Resolution No. 87-09: A Resolution Adopting a Water Conservation Plan for the City of League City, Texas", June 11, 1987.

RESOLUTION NO. 87-09

A RESOLUTION ADOPTING A WATER CONSERVATION PLAN FOR THE CITY OF LEAGUE CITY, TEXAS

WHEREAS, the City Council of the City of League City, Texas (the "City") deems it necessary and proper and in the best interests of the citizens of the City to adopt a water conservation plan for the City in substantially the form attached hereto as Exhibit A;

NOW, THEREFORE, BE IT RESOLVED BY THE CITY OF LEAGUE CITY, as follows:

Section 1. That City Council hereby adopts a water conservation plan for the City, in substantially the form attached hereto as Exhibit A.

PASSED AND APPROVED the 11th day of June, 1987.

Joe L. Lamb
JOE L. LAMB, Mayor

ATTEST:

Leta F Willoughby
LETA F. WILLOUGHBY, City Secretary
CF

APPROVED AS TO FORM:

Roliff H Purrington Jr
ROLIFF H. PURRINGTON, JR.
City Attorney
CF

LEAGUE/015

EXHIBIT "A"

1. WATER CONSERVATION PLAN

1.1 PURPOSE

(1) This plan sets forth uniform requirements, guidelines and recommendations for water conservation and drought contingency for the City of League City, Texas and it will enable the City to comply with all applicable requirements and recommendations of the Texas Water Development Board.

(2) The objectives of this plan are:

(a) To inform and educate the public about water conservation and drought contingency aspects and methods;

(b) To improve water use efficiency in existing buildings by recommending guidelines;

(c) To maintain a water rate structure for the City in order to encourage users to conserve water;

(d) To require Utility personnel to inspect, repair and replace water meters throughout the City for accurate water meter reading;

(e) To encourage water conserving landscaping;

(f) To require Utility personnel to detect water leaks in the City water pipes and find other sources of unaccountable water;

(g) To encourage the City and commercial and industrial establishments to recycle and reuse water in aesthetic ponds, fountains and for irrigation when possible; and

(h) To set a minimal water pressure level for the City's distribution system in order to conserve water.

1.2 GOALS

The goal of the City is to reduce water consumption by its citizens and facilities by using water-conserving fixtures and encouraging conservation-type use habits.

If the goal is obtained it should reduce our seasonal peaks and help the City stay within their contract obligations.

The City's per capita use over the last three (3) years is 102 gallons per day, which is well below the State average of 170 gallons per day. It is the City's goal to reduce per capita usage to a lower figure.

The City's water supply consists primarily of surface water which is derived from the City of Houston. The cost per thousand gallons is higher than most sources which in itself is a conservation measure.

1.3 DEFINITIONS

Unless the context specifically indicates otherwise, the following terms and phrases shall have the meaning hereinafter designated.

(a)	City:	The City of League City, Texas, in the Counties of Galveston and Harris, and any authorized person acting in its behalf.
(b)	City Personnel:	Authorized employees of the City of League City, Texas.
(c)	Customer:	A person or establishment which purchases water from the City of League City inside or outside the corporate limits.
(d)	Director:	The City's Director of Utilities, or his authorized representative.
(e)	GCWA:	The Galveston County Water Authority.
(f)	GPM:	Gallons per minute.
(g)	MGD:	Million gallons per day.
(h)	Water Utilities Department:	Water Utilities Department of the City of League City.
(i)	Plan:	City of League City's Water Conservation Plan.

(j) Water User: A person or any entity which purchases water from the City of League City inside or outside the corporate limits.

1.4 PUBLIC PARTICIPATION

1.4.1 General Program

In recognition of the importance of public participation in water conservation, all City water users shall be informed about methods to save water in their daily use, for landscaping, lawn use, and in recreational use. The City shall provide public education programs utilizing the following methods:

(a) Quarterly direct mailings of brochures or newsletters on water conservation program to water users (the first distribution shall describe the plan in detail and provide insight into the future of the program). Consequent mailouts shall cover water conservation tips for outdoors and irrigation usage, indoor usage, and retro fitting water conservation devices for all fixtures as well as plumbing codes.

(b) Public meetings and speakers bureau;

(c) Two newspaper articles per year on water conservation (one published prior to the City's high usage season and one published six months later), television or radio announcements;

(d) Posters and public displays; and

(e) School programs.

(f) New customer water conservation package to be given to all new customers when they sign up for services: contents will give tips on conserving water during all usage and describe water-conserving fixtures that can be retro-fitted to house plumbing. This package shall also be sent to any customer that may have a complaint about a water bill or high water usage.

1.4.2 Suggested Tips for Consumers

In all public participation programs, customers will be encouraged to use the following water conservation techniques:

(a) In the Bathroom:

1. Take a short shower instead of filling the tub and taking a bath. Showers usually use less water than tub baths. Long showers will use more water than tub 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 install a cutoff valve or turn the water off while soaping and back on again only to rinse.

4. Do not use hot water when cold will do. Water and energy can be saved by washing hands with soap and cold water; hot water should only be used when hands are especially dirty.

5. Reduce the level of the water being used in a bath tub by one or two inches if a shower is not available.

6. Turn water off when brushing teeth until it is time to rinse.

7. Do not let the water run when washing hands. Instead, hands should be wet, and water should be turned off while soaping and scrubbing and turned on again to rinse. A cutoff valve may also be installed on the faucet.

8. Shampoo hair in the shower. Shampooing in the shower takes only a little more water than is used to shampoo hair during a bath and much less than shampooing and bathing separately.

9. Hold hot water in the basin when shaving instead of letting the faucet continue to run.

10. Test toilets for leaks. To test for a leak, a few drops of food coloring can be added to the water in the tank. The toilet should not be flushed. The customer can then watch to see if the coloring appears in the bowl within a few minutes. If it does, the fixture needs adjustment or repair.

11. Use a toilet tank displacement device. A one-gallon plastic milk bottle can be filled with stones or with water, recapped, and placed in the

toilet tank. This will reduce the amount of water in the tank but still provide enough for flushing.

12. Install faucet aerators to reduce water consumption.

13. Never use the toilet to dispose of cleaning tissues, cigarette butts, or other trash. This can waste a great deal of water and also places an unnecessary load on the sewage treatment plant or septic tank.

14. Install a new low-volume flush toilet that uses 3.5 gallons or less per flush when building a new home or remodeling a bathroom.

(b) In the Kitchen:

1. Use a pan of water (or place a stopper in the sink) for rinsing pots and pans and cooking implements when cooking rather than turning on the water faucet each time a rinse is needed.

2. Never run the dishwasher without a full load. In addition to saving water, expensive detergent will last longer and a significant energy savings will appear on the utility bill.

3. Use the sink disposal sparingly, and never use it for just a few scraps.

4. Keep a container of drinking water in the refrigerator. Running water from the tap until it is cool is wasteful. Better still, both water and energy can be saved by keeping cold water in a picnic jug on a kitchen counter to avoid opening the refrigerator door frequently.

5. Use a small pan of cold water when cleaning vegetables rather than letting the faucet run.

6. Use only a little water in the pot and put a lid on it for cooking most food. Not only does this method save water, but 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 when hand washing dishes rather than a running faucet.

8. Always keep water conservation in mind, and think of other ways to save in the kitchen. Small kitchen savings from not making too much coffee or letting ice cubes melt in a sink can add up in a year's time.

(c) In the Laundry:

1. Wash only a full load when using an automatic washing machine (32 to 59 gallons are required per load).

2. Use the lowest water level setting on the washing machine for light loads whenever possible.

3. Use cold water as often as possible to save energy and to conserve the hot water for uses which cold water cannot serve.

(d) For Appliances and Plumbing:

1. Check water requirement of various models and brands when considering purchasing any new appliance that uses water. Some use less water than others.

2. Check all water line connections and faucets for leaks if the water bill is unusually high.

3. Learn to replace faucet washers so that drips can be corrected promptly. It can represent a substantial amount saved in plumbing and water bills.

4. Check for water leakage that the customer may be entirely unaware of, such as a leak between the water meter and the house. To check, all indoor and outdoor faucets should be off, and the water meter should be checked. If it continues to run or turn, a leak probably exists and needs to be located.

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 hot water heater thermostat is not set too high. Extremely hot 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. More plants die from overwatering than from being on the dry side.

(e) For Outdoor Use:

1. Water lawns early in the morning during the hotter summer months. Much of the water used on the lawn can simply evaporate between the sprinkler and the grass.

2. Use a sprinkler that produces large drops of water, rather than a fine mist, to avoid evaporation.

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

4. Water slowly for better absorption, and never water on windy days.

5. Do not water the street, walks or driveways.

6. Condition the soil with compost before planting grass or flower beds so that water will soak in, rather than run off.

7. Fertilize lawns at least twice a year for root stimulation. Grass with a good root system makes better use of less water.

8. Learn to know when grass needs watering. If it has turned a dull grey-green or if footprints remain visible, it is time to water.

9. Do not water lawns too frequently. Too much water can overload the soil so that air cannot get to the roots and can encourage plant diseases.

10. Do not overwater. Soil can absorb only so much moisture and the rest simply runs off. A timer will help, and either a kitchen timer or an alarm clock will do. An inch and one-half of water applied once a week will keep most Texas grasses alive and healthy.

11. Operate automatic sprinkler systems only when the demand on the City's water supply is lowest: set the system to operate between four and six a.m.

12. Do not 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. A better-looking law will result.

13. Use a watering can or hand water with the hose in small areas of the lawn that need more frequent watering (those near walks or driveways or in especially hot, sunny spots).

14. Learn what types of grass, shrubbery, and plants do best in the area and in which parts of the lawn, and then plant accordingly. For example, if one has a heavily shaded yard, no amount of water will make roses bloom.

15. Consider decorating areas of the lawn with rocks, gravel, wood chips, or other materials now available that require no water at all.

16. Do not "sweep" walks and driveways with the hose. Use a broom or rake instead.

17. Use a bucket of soapy water and use cut off nozzle on the hose for rinsing when washing the car.

1.5 WATER CONSERVATION LANDSCAPING

1.5.1 Permits

When issuing building permits, the City shall encourage:

(a) Landscape architects to use adaptive,, low water using plants and grasses and efficient irrigation systems in preparing all site and facility plans.

(b) Nurseries and local business to offer adaptive, low water using plants and grasses and efficient landscape watering devices, such as drip irrigation systems, and encourage the use of timing devices for watering during low-demand periods.

(c) Residential property owners to design and construct a water conserving system, using guidelines furnished by the City.

1.5.2 Irrigation

In order to reduce demand placed on a water system by landscaping watering, the City encourages:

(a) Licensed irrigation contractors to use drip irrigation systems when possible and to design all irrigation systems with water conservation features, such as sprinklers that emit large drops rather than a fine mist and a sprinkler layout that accommodates prevailing wind direction.

(b) Commercial establishments to use drip irrigation for landscape watering when possible and to install only ornamental fountains that recycle and use the minimum amount of water.

1.6 PRESSURE REDUCTION

The water pressure in the City Distribution System shall be regulated so that customer pressure does not exceed 60 PSI under normal circumstances. Annual checks shall be performed by means of computer model analysis and field inspection by the City personnel to confirm the 60 PSI limit.

Where customer water distribution pressure exceeds 60 PSI, the City may install reducing valves at the customer meter or by regulating pressures in the overall distribution system.

1.7 RETROFIT OF EXISTING STRUCTURES

The City shall make information available through its public participation program (Section 1.4) for plumbers and customers to utilize when purchasing and installing plumbing fixtures, lawn-watering equipment or water using appliances. Information regarding retrofit devices, such as low-flow shower heads or toilet dams, that reduce water use by replacing or modifying existing fixtures or appliances shall be provided. The City shall also encourage the use of the following water conserving devices: toilet displacement bottles, water closet dams, dual-flush, flow restrictors, reduce-flow shower heads, shower cut-off valves, faucet aerators, pipe insulators, and water hook-up pressure reducing valves.

1.8 WATER METER INSPECTION, REPAIR, AND REPLACEMENT

All water users, including the municipal utility districts and other City establishments, shall be metered by the City if feasible.

A regularly scheduled maintenance program of meter repair and replacement will be established in accordance with the following time intervals:

(a) Production (master) meters: Test once a year.

(b) Meters larger than Six (6) inch: Test once a year.

(c) Meters larger than three (3) inches but less than six (6) inches: Test every two years.

(d) Meters larger than one (1) inch but less than three (3) inches: Test every three years.

(e) Meters one (1) inch or smaller: Test every 5 years or one million gallons.

The utility meters and the customer meters shall be checked and compared periodically. In cases of discrepancy between their sums, action shall be taken for detecting and stopping leaks or repairing/replacing meters.

1.9 WATER RATES STRUCTURE

The City shall maintain a conservation-oriented water rate structure, as shown in the attached rate resolution.

1.10 LEAK DETECTION AND REPAIR

The City shall be responsible for an annual water accounting program.

City personnel shall detect unaccountable water sources such as defective hydrants, abandoned services, unmetered water used for fire fighting or other municipal uses, inaccurate or leaking meters, illegal hook-ups, unauthorized use of fire hydrants, and leaks in mains and services. The City shall detect leaks in distribution pipes on an annual basis by means of ultra sonic or other devices. Ultra sonic equipment will be borrowed from GCWA per agreement until such time as the frequency of use warrants the City's purchase of such equipment. Once such leaks are detected, corrective repairs shall be undertaken. The City shall provide detailed data to manage and record all leaks in the distribution system. A progress report shall be prepared and water lines with excess number of leaks shall be replaced.

1.11 RECYCLING AND RE-USE

Currently the City pumps its processed wastewater at the Dallas Salmon Treatment Plant to the South Shore Harbor Golf Course for irrigation of plants and grass. The City shall also evaluate the potential of recycling and reuse of water for irrigation in other City facilities.

2. IMPLEMENTATION

The City shall have full authority and means to implement the provisions of the Plan.

The City shall provide all reports requested by the GCWA and Texas Water Development Board related to this water conservation plan. Such reports shall include at least one annual report, which describes, among other information, the following: (1) progress on implementation of the Plan (2) status of the Plan (3) public response and (4) quantitative effectiveness.

All political subdivisions that are wholesale water customers of the City will be required through the supply contracts to adopt the provisions of the City's water conservation and drought contingency plans or to adopt their own board-approved water conservation and drought contingency plans within one year of the release of loan funds from the State of Texas to the City. Such requirements shall be included in all contracts hereafter entered into by the City, and the City shall exercise its best efforts to amend existing contracts to include such requirements.

LEAGUE/016

APPENDIX E

DROUGHT CONTINGENCY PLAN

Source: City of League City, "Ordinance No. 87-30: An Ordinance Establishing a Drought Contingency Plan, Regulating and Prohibiting the Use of Water Under Certain Conditions, Providing a Penalty for Violating the Provisions Hereof; Containing Other Provisions; and Providing a Savings Clause", June 11, 1987.

ORDINANCE NO. 87-30

AN ORDINANCE ESTABLISHING A DROUGHT CONTINGENCY PLAN, REGULATING AND PROHIBITING THE USE OF WATER UNDER CERTAIN CONDITIONS, PROVIDING A PENALTY FOR VIOLATING THE PROVISIONS HEREOF; CONTAINING OTHER PROVISIONS; AND PROVIDING A SAVINGS CLAUSE.

WHEREAS, the City Council of the City of League City, Texas, (the "City") finds that drought, or a number of other circumstances beyond the control of the City, can disrupt the normal availability of the City's water supplies;

WHEREAS, even though the City may have an adequate water supply, the supply could become contaminated or a disaster could destroy the supply;

WHEREAS, during drought periods, consumer demand is often significantly higher than normal, and parts of the City's water supply system may not have the capacity to meet higher than average demands without system failure or other unwanted consequences;

WHEREAS, the City's system treatment, storage or distribution failures can present the City with an emergency demand management situation;

WHEREAS, in times of drought or other situations, water use in the City must be regulated or prohibited to ensure the health, safety and welfare of the citizens of the City;

WHEREAS, City Council deems it advisable to adopt a contingency plan as hereinafter set forth to be implemented in times of drought or under other conditions as hereinafter described;

NOW, THEREFORE, BE IT ORDAINED BY THE CITY OF LEAGUE CITY, as follows:

Section 1. Trigger Conditions. Actions shall be taken by the City when certain trigger conditions, as hereinafter described, are met. Trigger conditions for the City shall be based on the City's ability to receive water from the Galveston County Water Authority ("GCWA") from the City of Houston's Southeast Water Purification Plant; production amounts shall be based on a seven-day average daily demand. The following trigger conditions are hereby established:

1. Mild Conditions:

   a. Water demand for the City is 80% of the available contracted surface water sources per day for a seven-day average, or

   b. City wells are producing at 20% of their capacity to augment an inadequate supply of contracted surface water over a seven-day average.

2. Moderate Conditions:

   a. Water demand for the City is 87% of the available contracted surface water sources per day for a seven-day average, or

   b. City wells are producing at 30% of their capacity to augment an inadequate supply of contracted surface water over a seven-day average.

3. Severe Conditions:

a. Water demand for the City is 90% of the available contracted surface water sources per day for a seven-day average, or

b. City wells are producing at 40% of their capacity to augment an inadequate supply of contracted surface water over a seven-day average.

Section 2.

The following actions shall be taken by the City staff when each of the following trigger conditions are reached:

1. Mild Conditions:

a. Inform the public through the news media that a trigger condition has been reached, and that citizens should look for ways to voluntarily reduce water use. Specific steps which can be taken will be provided by the City through the news media;

b. Notify major commercial water users of the trigger condition and request voluntary water use reductions;

c. Publicize a voluntary lawn watering schedule; and

d. During winter months, request water users to insulate pipes rather than running water to prevent freezing.

2. Moderate Conditions:

a. Continue implementation of the actions under 1(a), 1(b) and 1(d).

b. Prohibit residential car washing, window washing, and pavement washing except when a bucket is used, without a running hose. These restrictions shall not apply to non-residential water users.

c. Enforce the following mandatory lawn watering schedule.

Customers with even-numbered addresses may water on even-numbered days of the month. Customers with odd-numbered addresses may water on odd days of the month. Watering shall occur only between the hours of 6-10 a.m. and 8-10 p.m. Any property owner who has a private well for irrigating, must have that well registered with the City and post a sign in plain view that such owner has a private water source.

d. Prohibit the following public water uses, which are hereby deemed not essential for public health or safety:

i. street washing

ii. water hydrant flushing

iii. filling pools

iv. athletic field watering

3. Severe Conditions:

a. Continue implementation of the actions under 1(a), 1(b), 1(d), and 2(d).

b. Prohibit all outdoor water usage by both residential and non-residential customers. Such use includes, but is not limited to the following: lawn watering, car washing, and pavement washing;

c. Charge all customers a user surcharge for water use in excess of the following amounts;

Up to 10,000 gallons per month:	No Change
10,000 to 20,000 gallons per month:	200% of Normal Rate
Above 20,000 gallons per month:	300% of Normal Rate

Any customer may be exempted by order of the Mayor from any or all of the requirements of this Section 2 if such customer establishes that compliance with such requirements would impair the health or safety of such customer or others or impose a financial hardship on a commercial customer that must utilize water in their everyday businesses, e.g. commercial nurseries, commercial car washes, and commercial laundries. A denial of an exemption by the Mayor may be appealed to City Council.

In the event the City's water distribution system fails due to physical failures or the loss of any contracted water source, the Mayor shall be empowered to enact any and all parts of the actions described in this Section 2 notwithstanding the fact that the trigger conditions set forth in Section 1 have not been met.

When the Mayor has been notified by the General Manager of GCWA that a trigger condition exists in their system as described in the Authority's Drought Contingency Plan, the Mayor shall enact the appropriate condition level for the City.

Section 3.

The purpose and effect of the contingency plan will be communicated to the public through articles which the City will request to be published in the League City News supplemented by pamphlets distributed at the same time.

When trigger conditions appear to be approaching, the public will be notified through articles requested to be published in the League City News with information on water conserving methods.

When trigger conditions have passed, the League City News will be asked to publish notification that drought contingency measures are abated for that condition, and if applicable, will outline measures necessary for the reduced condition.

Throughout the period of a trigger condition, the League City News will be asked to publish regular articles that will appear to explain and educate the public on the purpose, cause, and methods of conservation for that condition.

Section 4.

Additional actions to be take by the City's Director of Utilities in the event that any trigger condition is reached are as follows:

a. Galveston County Bay Ridge Utility District, the City's only wholesale customer, will be notified directly by telephone and kept appraised of the condition.

b. Notification would be given to all municipal utility districts within the City.

c. All homeowners' associations would be notified directly and asked to communicate information to their members through their information distribution systems.

d. All Department Heads within the City will be advised of the plan and condition in order that all City personnel will be aware of their responsibility and water usage during this period.

Section 5. Termination of Conditions

In general, each trigger condition shall be considered as cancellable when the preceding milder condition has existed for seven (7) consecutive days. For example, the moderate condition will be considered to be cancellable when the demand or water levels for the mild condition have prevailed for seven (7) consecutive days.

Notice to customers shall be given as follows:

Level	Notification
Severe Condition	Next newspaper edition and telephone previously telephoned customers.
Moderate Condition	Same As Above
Mild Condition	Next newspaper edition

Section 6.

All violations of the provisions hereof shall be punishable by a fine not to exceed the maximum allowed by law. Each day's violation shall be and constitute a separate offense.

Continued violation of these provisions may result in termination of water service for the violation at the discretion of City Council.

Section 7.

If any section, phrase or part of this Ordinance shall be held invalid or unenforceable, the remaining sections and other parts of this Ordinance shall remain in full force and effect.

PASSED AND APPROVED the 11 day of June, 1987.

Joe L. Lamb
JOE L. LAMB, Mayor

ATTEST:

Catherine J. Floyd
CATHERINE J. FLOYD,
Acting City Secretary

APPROVED AS TO FORM:

Roliff H Purrington Jr

ROLIFF H. PURRINGTON, JR.
City Attorney

SUSPENDED RULE

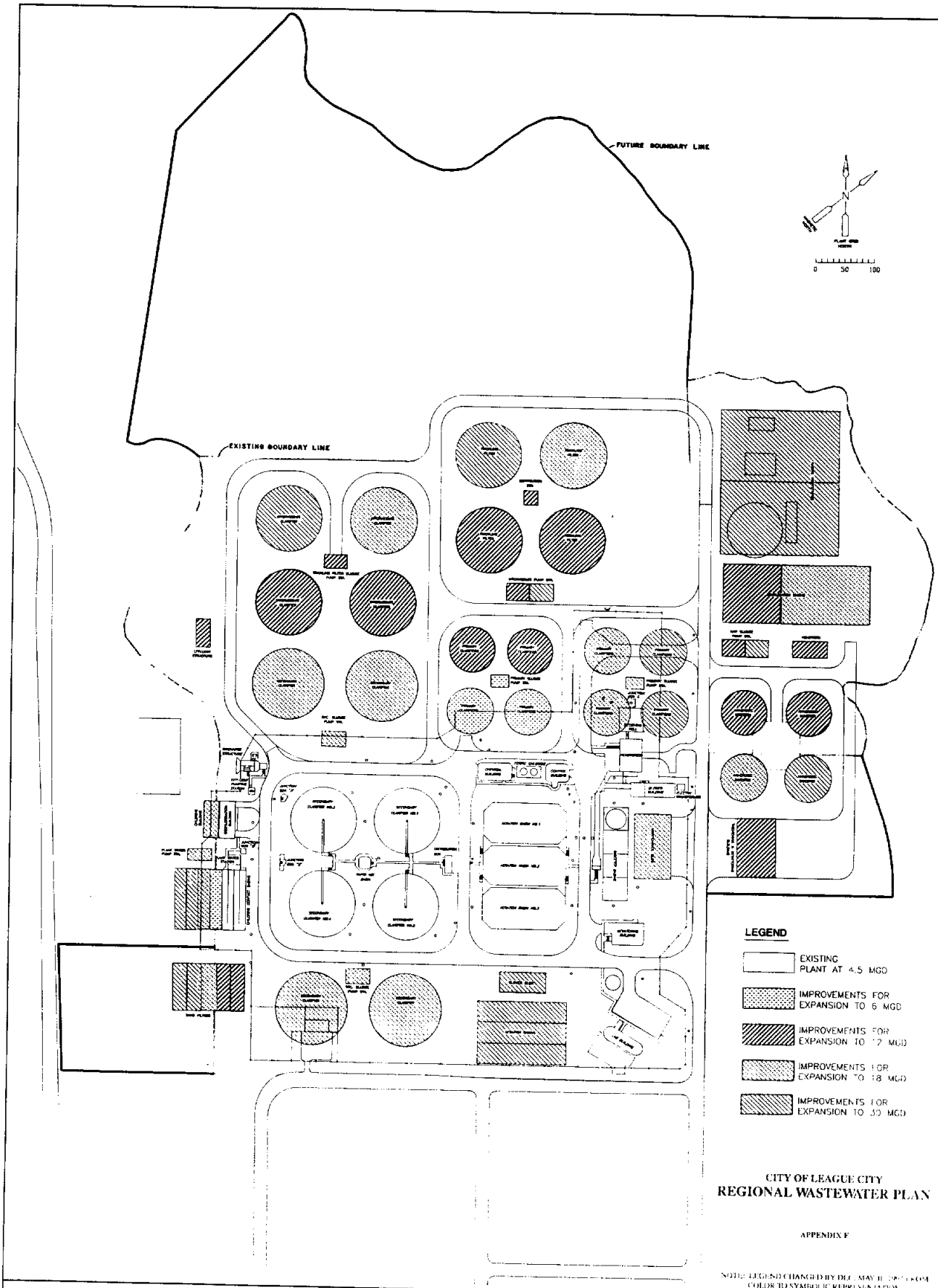
PASSED ON FIRST AND FINAL READING

LEAGUE/017

APPENDIX F

MASTER PLAN FOR EXPANSION AND UPGRADING DALLAS SALMON WASTEWATER TREATMENT PLANT

Source: Camp, Dresser & McKee, Inc., "Master Plan for Expansion and Upgrading Dallas Salmon Wastewater Treatment Plant", Revised by Dannenbaum Engineering Corporation, May 11, 1992.



CITY OF LEAGUE CITY
REGIONAL WASTEWATER PLAN

APPENDIX F

NOTE: LEGEND CHANGED BY DLG, MAY 11, 1987 FROM COLOR TO SYMBOLIC REPRESENTATION

MASTER PLAN FOR EXPANSION AND UPGRADING
DALLAS SALMON WASTEWATER TREATMENT PLANT
LEAGUE CITY, TEXAS

CAMP DRESSER & McKEE INC.
DALLAS, TEXAS

CDM

APPENDIX G

BLACKHAWK WASTEWATER TREATMENT PLANT INFORMATION

Source: Dannenbaum Engineering Corporation, "Inter-Office Memorandum on Blackhawk Wastewater Treatment Plant Information", November 11, 1991.

DANNENBAUM ENGINEERING CORPORATION

Inter-Office Memorandum

TO: FILE

DATE: November 11, 1991

FROM: Debbie Pena

JOB: League City Regional Wastewater Plan - DEC Job No. 2863-01

RE: Blackhawk Wastewater Treatment Plant Information

The following is a summary of the information provided by Vance Kemler, Director of Municipal Operations for Gulf Coast Waste Disposal Authority on their Blackhawk Wastewater Treatment Plant:

Plant expansion:

- available at any time
- no set minimum expansion requirement due to Blackhawk's flexibility
- if setting minimum, use 250,000 gal/day

Blackhawk capacities:

-	total plant design	9.25 mgd
-	headworks	37 mgd
-	5 aeration basins	105 mgd
-	2 clarifiers	28.6 mgd
-	thickener	
-	digesters	9.25 mgd with 20 day detention time (no expansions needed, they will change treatment method instead)
-	chlorine basins	16 mgd (expansions unknown, maybe they will change treatment method)
-	2 belt presses	in use 6 hr/day and 10-12 days/month
-	tertiary filters	8.3 mgd (additional capacity may be a problem)

Note that some components already oversized.

Blackhawk capacities contracted to:

-	Friendswood	4.875 mgd
-	Houston	1.475 mgd
-	Baybrook MUD 1	1.025 mgd
-	Harris County MUD 55	1.875 mgd
		9.250 mgd

Engineering Science did first Plant phase. Murray Stiver doing preliminary engineering report now for second phase.

Historical flows:

	1990	1991 (through October)
Average day	3.933 mgd*	3.495 mgd
Average monthly	120 mg	106.25 mg

*lots of rain, 3.495 mgd is a more realistic average

Historical construction cost for plant expansion is $1.50/gal.

Even though Blackhawk appears to have some components oversized, use the $1.50/gal because additional money may be needed to change some of the existing treatment processes to meet new State requirements.

O & M Costs (includes Tertiary or advanced secondary treatment):

1990	1991 (through August)
$.58/1000 gal	$.717/1000 gal.

The 1991 costs are more typical than the 1990 costs.

DDP/dc
2863-01/D:4019