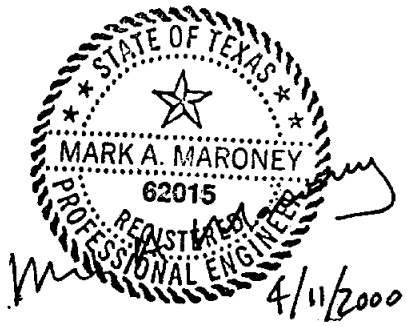
# LIVE OAK COUNTY WATER AND WASTEWATER REGIONAL FACILITY PLAN



FOR:
THREE RIVERS WATER DISTRICT
P. O. BOX 398
THREE RIVERS, TEXAS 78071




APRIL, 2000

JOB NO. 36953.00.00

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# I. INTRODUCTION

## A. PURPOSE OF THE PLAN

The purpose of the facility plan is to analyze existing conditions in the planning area for potable water treatment and use, groundwater use and recharge and wastewater treatment/discharge and to develop recommendations and strategies for ensuring future water supply and protection of the environment. The planning area is the northwestern portion of Live Oak County.

## B. BACKGROUND

Live Oak County is considered an environmentally sensitive area for water due to dependence on groundwater pumping and surface water use from the Choke Canyon Reservoir. This area is part of the "Coastal Bend Region" of Texas that consists of Live Oak County and eleven other counties. Currently seven of the twelve counties in this region have entities that depend on the water supply from the Choke Canyon/Lake Corpus Christi Reservoir System and the water delivery system provided by the Frio and Nueces Rivers. The Nueces River Authority (NRA) is responsible for the surface water resources in the Nueces River drainage area. In 1998, NRA filed an objection with the Texas Natural Resource Conservation Commission (TNRCC) regarding the proposed permit renewal/amendment submitted by Ultramar Diamond Shamrock (UDS) Three Rivers refinery for their existing wastewater treatment, discharge and land application facilities. This action coincided with the request of UDS to the City of Three Rivers to increase their water purchases from the City. Further developments were as follows:

- The Live Oak Underground Water Conservation District (LOUWCD) is charged with groundwater monitoring and protection and with developing methods for groundwater recharge in Live Oak County. The LOUWCD is concerned that the local groundwater recharge zone is somewhere in the vicinity of the existing UDS effluent land application site. The LOUWCD is interested in what affect the effluent irrigation is having on local groundwater and if there may be alternative methods for effluent disposal.

- The City of Three Rivers and the City of Corpus Christi are concerned with the quantity and quality of direct releases into the Nueces River, the water supply for the entire Coastal Bend Region, or its tributaries and/or any groundwater that is migrating from any current or proposed municipal or industrial wastewater systems. A method of monitoring and control needs to be developed.

- The City of Corpus Christi presently owns water wells along the Atascosa River north of the City of Three Rivers near the City of Campbellton. These wells are not being utilized and have a combined capacity of approximately 4.5 million gallons per day (MGD). The City of Three Rivers has an interest in these wells since they represent a source of water for the City during drought conditions.

- Live Oak County is under contract with the Texas Community Development Program for construction of a rural water system in the area. No ground water is available that meets primary and secondary drinking water standards. There are some rural areas presently using water in the county that does not meet all requirements of the drinking water quality standards. The State has allowed use of this water since there are presently no other economical sources available. Other sources or treatment systems should be investigated.

- The Choke Canyon Water System utilizes well water for its customers west of the City of Three Rivers and for the Federal Prison. This system is experiencing difficulty meeting minimum water quality standards.

- Dynegy Corporation, an electrical power cogeneration business, was planning the development of a cogeneration plant in conjunction with UDS. Their water consumption would be in the range of 2 MGD and their anticipated wastewater flow would be commensurate with that of UDS. They would, however, be required to obtain permits and operate their own facility.

This study was undertaken to evaluate all of these issues and develop a comprehensive plan to address the most feasible alternatives to meet water supply and wastewater facility needs for the area.

## C. STATE WATER PLAN

In 1997 the Texas Legislature passed Senate Bill 1 (SB1), which requires the Texas Water Development Board (TWDB) to develop a state water plan. This plan is to include regional water plans developed by designated regional planning areas. Live Oak County is in Regional Water Planning Area N and the Coastal Bend Regional Water Planning Group is developing the plan for this area. Regional plans must be completed by the end of 2000 and the TWDB must then incorporate the regional plans into a state water plan during 2001. This area's regional water plan is being done concurrently with the Live Oak County Water and Wastewater Regional Facility Plan, although the regional water plan is still in the preliminary phases. Information developed in the Regional Facility Plan is being coordinated with the Nueces River Authority, co-sponsor of the Regional Facility Plan and facilitator of the regional water plan for the Coast Bend Regional Water Planning Group.

# II. GENERAL INFORMATION

## A. DESCRIPTION OF PLANNING AREA

1. Geographic Boundaries:

The planning area encompasses the northwest quadrant of Live Oak County. Live Oak County is located in south-central Texas as shown on Figure No. 1. The boundaries of the planning area are from Interstate Highway 37 at the north county line, westward to the west county line, southward to a point above the City of George West, eastward to IH 37 and then northward along IH 37 to the north county line (See Figure No. 2).

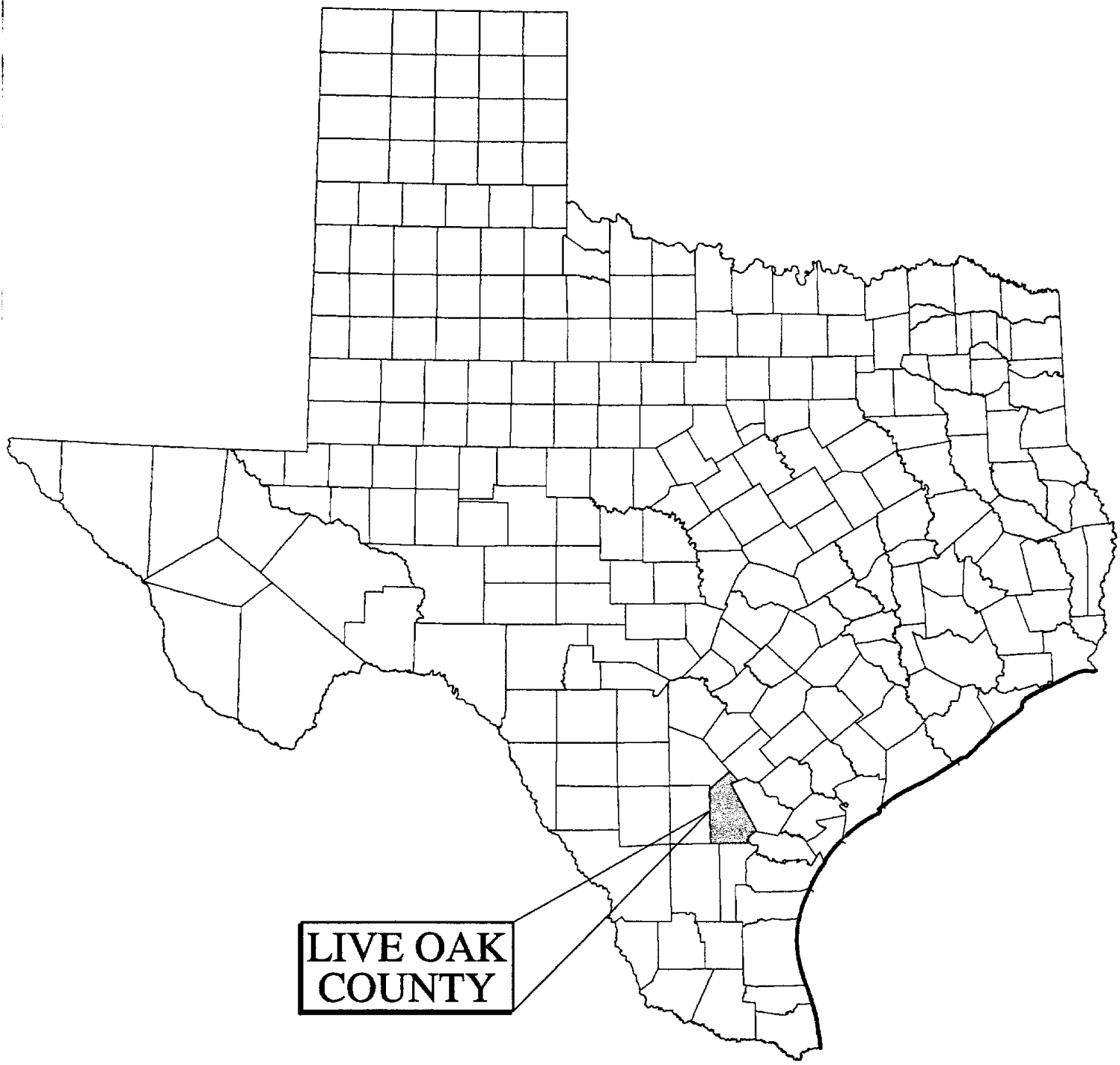
2. Political Jurisdictions and Boundaries:

a. Three Rivers Water District (See Figure No. 3). The water district boundary encompasses the City of Three Rivers and is centrally located within the planning area.

b. City of Three Rivers (See Figure No. 4). The City of Three Rivers provides water and wastewater service to customers within the City including the Ultramar Diamond Shamrock refinery. The City is centrally located within the planning area (Water CCN 12642 and Wastewater CCN 20761).

c. Nueces River Authority (NRA). NRA has authority to preserve, protect and develop surface water resources for the drainage area of the Nueces River and its tributaries and adjoining coastal basins and is the lead agency for the Texas Clean Rivers Program in the Nueces River Basin. NRA is a co-sponsor of the Choke Canyon Reservoir and owns 20% of the water rights. NRA offices are located in the Cities of Uvalde and Corpus Christi.

d. Live Oak Underground Water Conservation District (LOUWCD). The LOUWCD encompasses Live Oak County. The District's office is located in George West, Texas. The District monitors ground water quality through sampling and testing on numerous wells spread throughout the county.

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## COUNTY LOCATION MAP

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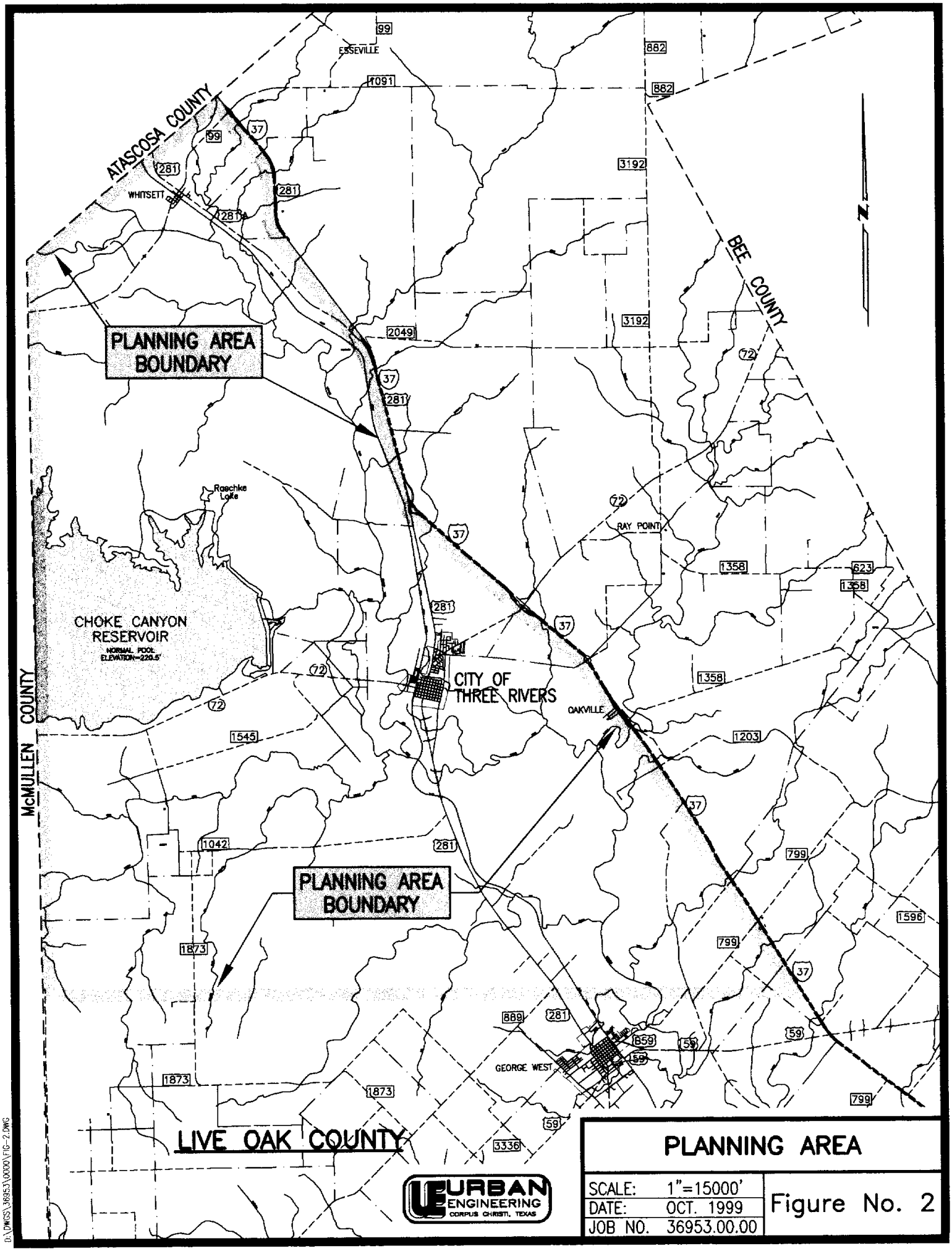
Figure No. 1




# PLANNING AREA

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Figure No. 2

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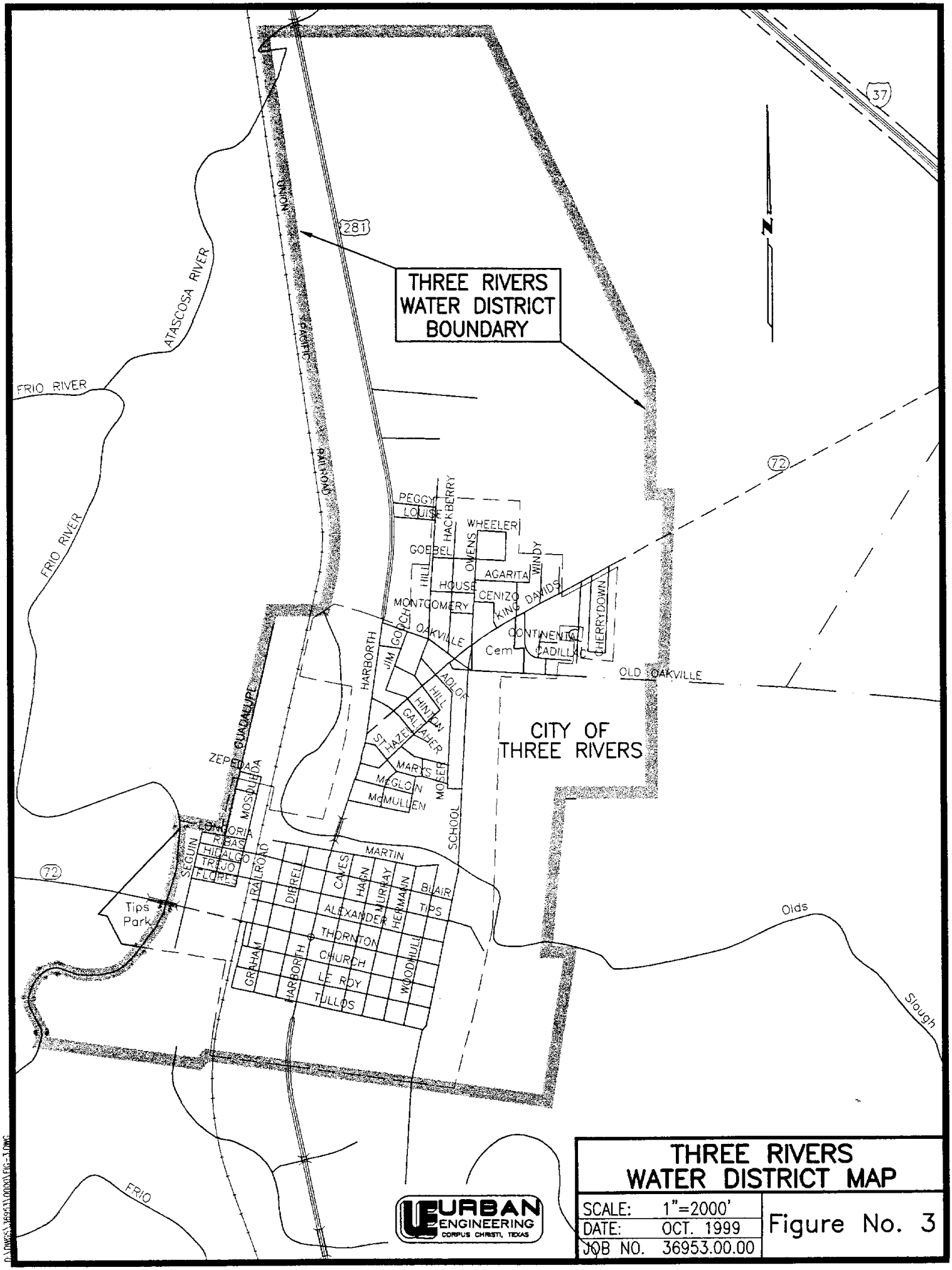


# THREE RIVERS WATER DISTRICT MAP

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Figure No. 3

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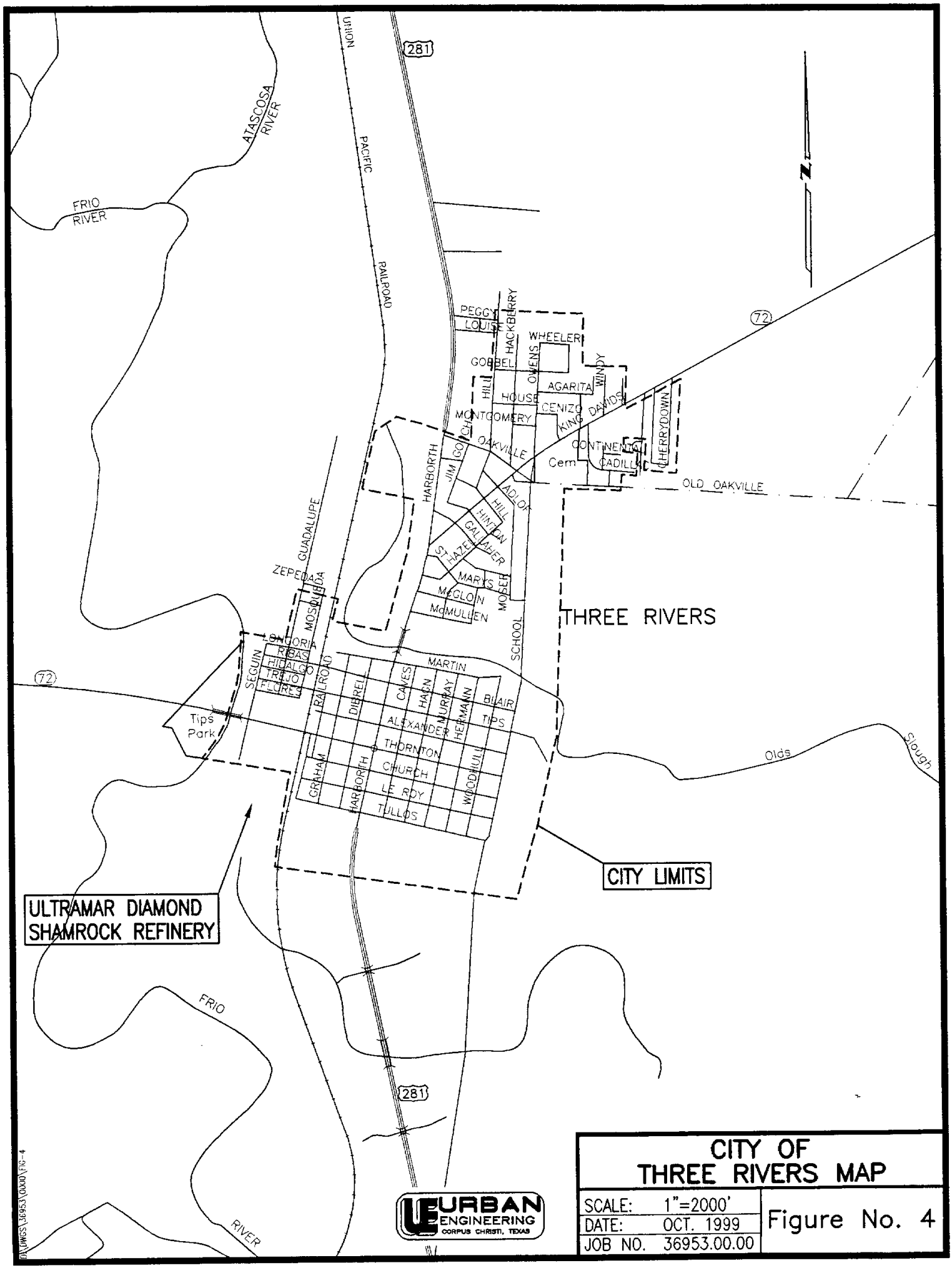
D:\PROJECTS\36953\00000\FIG-1.DWG




# CITY OF THREE RIVERS MAP

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Figure No. 4

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D:\DWGS\36953\00\FIG-4

e. Others. There are three other entities that have jurisdictions within the planning area. The Choke Canyon Water System (CCN 12012), the El Oso Water Supply Corporation (CCN 10570) and the McCoy Water Supply Corporation (CCN 10649) each have a Certificate of Convenience and Necessity (CCN) for supplying water in different regions of the planning area. (See Figure No. 5).

## B. POPULATION

1. Historic Growth:

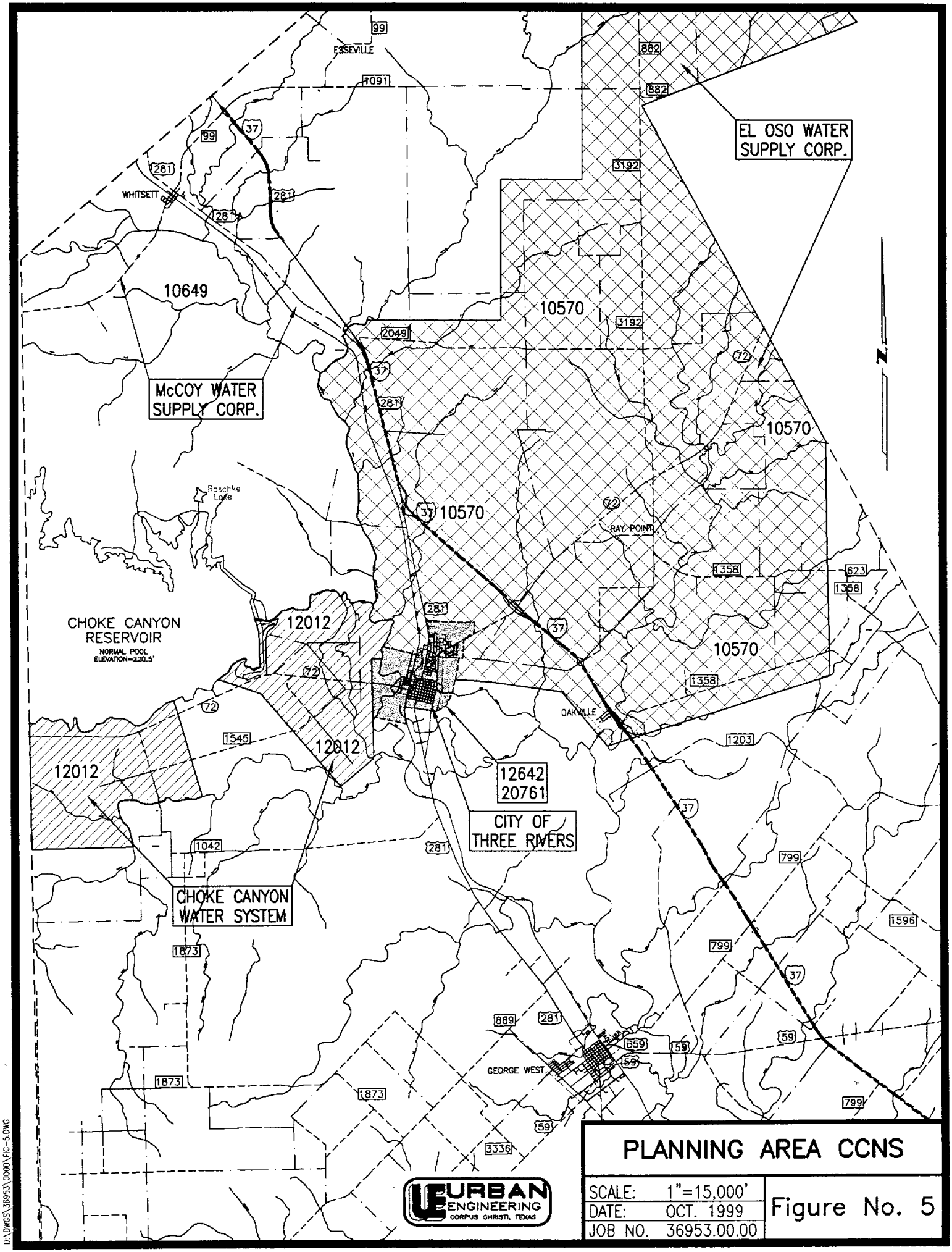
Live Oak County experienced some population growth between 1930 and 1940, a decline in population from the 1940s to the 1970s, a rebound in population between 1970 and 1980 and has maintained a population just above 9500 since the 1980s. In the 1990 census, 20% of the county population was found in the City of Three Rivers and 24% in the City of George West.

The following table shows the historic growth of the area and relationship of the population changes for the City of Three Rivers and the county.

**HISTORIC POPULATION TRENDS**

| | YEAR | | | | | | |
|---|---|---|---|---|---|---|---|
| TOTAL POPULATION | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 |
| City of Three Rivers | 1,275 | 1,337 | 2,026 | 1,932 | 1,761 | 2,133 | 1,889 |
| Live Oak County Total | 8,956 | 9,799 | 9,054 | 7,846 | 6,697 | 9,606 | 9,556 |

Source: U.S. Bureau of Census




# PLANNING AREA CCNS

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Figure No. 5

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2. Population projections:

The Texas Water Development Board's population projections' most likely series for the County of Live Oak, the City of George West and for the City of Three Rivers shows relatively minor growth over the next fifty years, 18% for the City of Three Rivers and an overall 17% for the County. The projections are presented in ten year increments as follows:

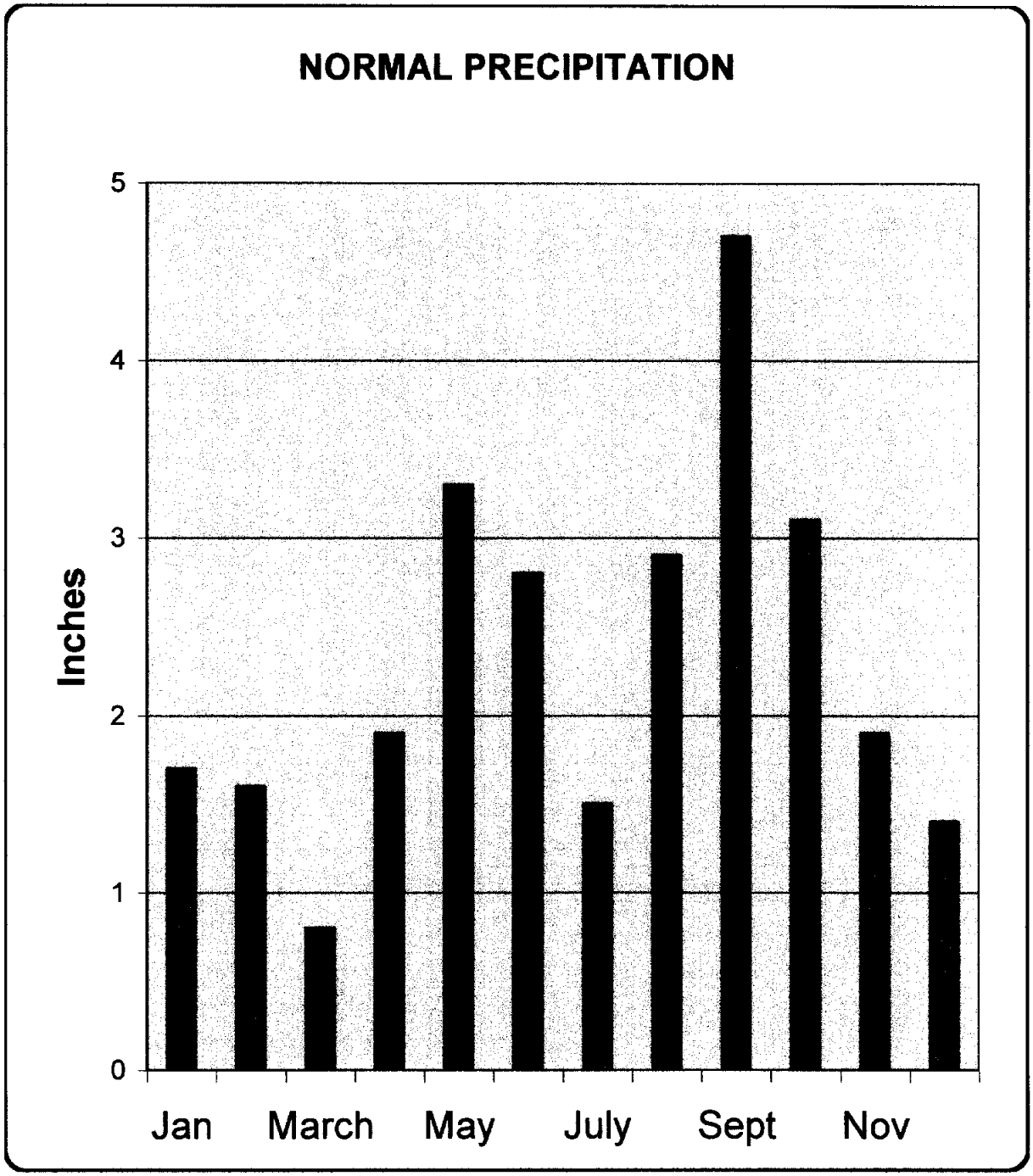
**POPULATION PROJECTIONS**

| TOTAL POPULATION | YEAR | | | | | |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
| City of Three Rivers | 1,978 | 2,078 | 2,163 | 2,224 | 2,287 | 2,341 |
| City of George West | 2,872 | 3,066 | 3,204 | 3,304 | 3,400 | 3,499 |
| Balance of County | 2,297 | 2,316 | 2,383 | 2,434 | 2,496 | 2,518 |
| Live Oak County Total | 7,147 | 7,460 | 7,750 | 7,962 | 8,183 | 8,358 |

## C. ENVIRONMENT

1. Climate:

Live Oak County is located in the dry subhumid region between the dry subhumid and semiarid regions of Texas. The climate can range from arid to wet subhumid. Summers are hot with little variation in the day-to-day weather except for occasional showers or a tropical storm and winters are mild with a mean minimum January temperature of 41° F. Total annual precipitation is normally 27.6 inches. Average monthly rainfall totals are shown on Figure No. 6.




| NORMAL PRECIPITATION | |
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From 1998 - 1999 Texas Almanac, based on period 1961 - 1990

2. Topography:

Live Oak County is located in south-central Texas in the Rio Grande Plain in the Gulf Coastal Plains Physical region. This region extends from the Gulf of Mexico to the Balcones Fault and escarpment system. The Rio Grande Plain is partly prairie and partly covered with a dense growth of prickly pear, cactus, mesquite, dwarf oak, catclaw, quajillo, blackrush, huisache, cenizo and other wild shrubs. This area is sometimes referred to as the Texas brush country. The county is rolling to moderately hilly with some flat areas. Elevations vary from El. 460 in the southwestern portion of the county to El. 90 near Lake Corpus Christi. The county is drained by the Nueces River and its tributaries, the Atascosa River and Frio River, except for a portion along the eastern boundary that is drained by the Aransas River. Drainage is southward.

3. Geology:

The planning area lies within the boundaries of the Central Rio Grande Plain soils region. The parent materials of the soils in the planning area are of the Tertiary systems, ranging in age from Eocene to Recent. The formations that outcrop in the planning area are of the Oligocene and Miocene Series. These formations, in order of decreasing age, are the Jackson Group, Frio Clay, Catahoula Formation, Oakville Sandstone, Lagarto Clay and Goliad Formation. These formations cross the county in a general northeast to southwest direction. Figure No. 7 on the following page shows the stratigraphic units of the formations along with the series name and hydrogeologic units and Figure No. 8 shows the formation outcrop location in the planning area. The rocks in the formations are all of sedimentary origin and consist of alternating layers of sand, silt and clay that dip toward the coast at rates ranging from about 20 feet per mile for the younger formations to more than 140 feet per mile for the older formations (See Figure No. 9).

Table 1.--Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas

| Era | System | Series | Stratigraphic Units | Hydrogeologic Units | Remarks |
|---|---|---|---|---|---|
| CENOZOIC | Quaternary | Holocene | Alluvium | Chicot aquifer | Quaternary System undifferentiated on sections. |
| | | Pleistocene | Beaumont Clay | | |
| | | | Montgomery Formation | | |
| | | | Bentley Formation | | |
| | | | Willis Sand | | |
| | Tertiary | Pliocene | Goliad Sand | Evangeline aquifer | Goliad Sand overlapped east of Lavaca County. |
| | | Miocene | Fleming Formation | Burkeville confining system | |
| | | | Oakville Sandstone | Jasper aquifer | Oakville Sandstone included in Fleming Formation east of Washington County. |
| | | | Surface: Catahoula Tuff or Sandstone / Subsurface: Upper part of Catahoula Tuff or Sandstone | Catahoula confining system (restricted) | Catahoula Tuff designated as Catahoula Sandstone east of Lavaca County. |
| | | | Subsurface: Anahuac Formation | | Anahuac and "Frio" Formations may be Oligocene in age. |
| | | | Subsurface: "Frio" Formation | | |
| | | Oligocene(?) | Surface: Frio Clay / Subsurface: Vicksburg Group equivalent | Not discussed as hydrologic units in this report. | Frio Clay overlapped or not recognized on surface east of Live Oak County. |
| | | Eocene | Jackson Group: Whitsett Formation: Fashing Clay Member | | Indicated members of Whitsett Formation apply to south-central Texas. Whitsett Formation east of Karnes County may be, in part or in whole, Oligocene in age. |
| | | | Jackson Group: Whitsett Formation: Calliham Sandstone Member or Tordilla Sandstone Member | | |
| | | | Jackson Group: Whitsett Formation: Dubose Member | | |
| | | | Jackson Group: Whitsett Formation: Deweesville Sandstone Member | | |
| | | | Jackson Group: Whitsett Formation: Conquista Clay Member | | |
| | | | Jackson Group: Whitsett Formation: Dilworth Sandstone Member | | |
| | | | Jackson Group: Manning Clay | | |
| | | | Jackson Group: Wellborn Sandstone | | |
| | | | Jackson Group: Caddell Formation | | |
| | | | Claiborne Group: Yegua Formation | | |
| | | | Claiborne Group: Cook Mountain Formation | | |
| | | | Claiborne Group: Sparta Sand | | |
| | | | Claiborne Group: Weches Formation | | |
| | | | Claiborne Group: Queen City Sand | | |
| | | | Claiborne Group: Reklaw Formation | | |
| | | | Claiborne Group: Carrizo Sand | | |
| | | Paleocene | Wilcox Group | | |
| | | | Midway Group | | |

**STRATIGRAPHIC AND HYDROGEOLOGIC UNITS**

SCALE: NONE

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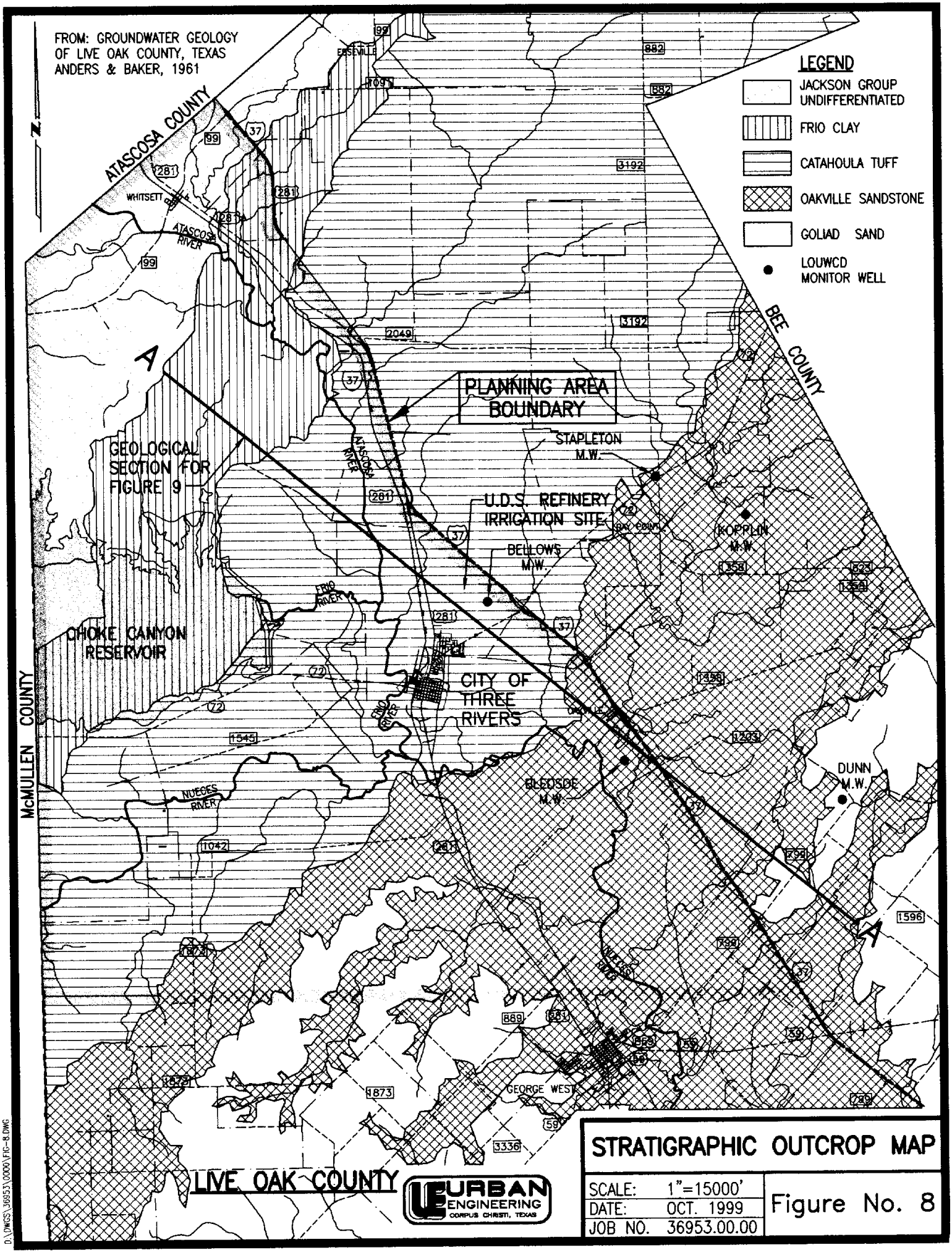
**Figure No. 7**

From Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas, T.D.W.R. Report 236, July, 1979




# STRATIGRAPHIC OUTCROP MAP

| | |
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Figure No. 8

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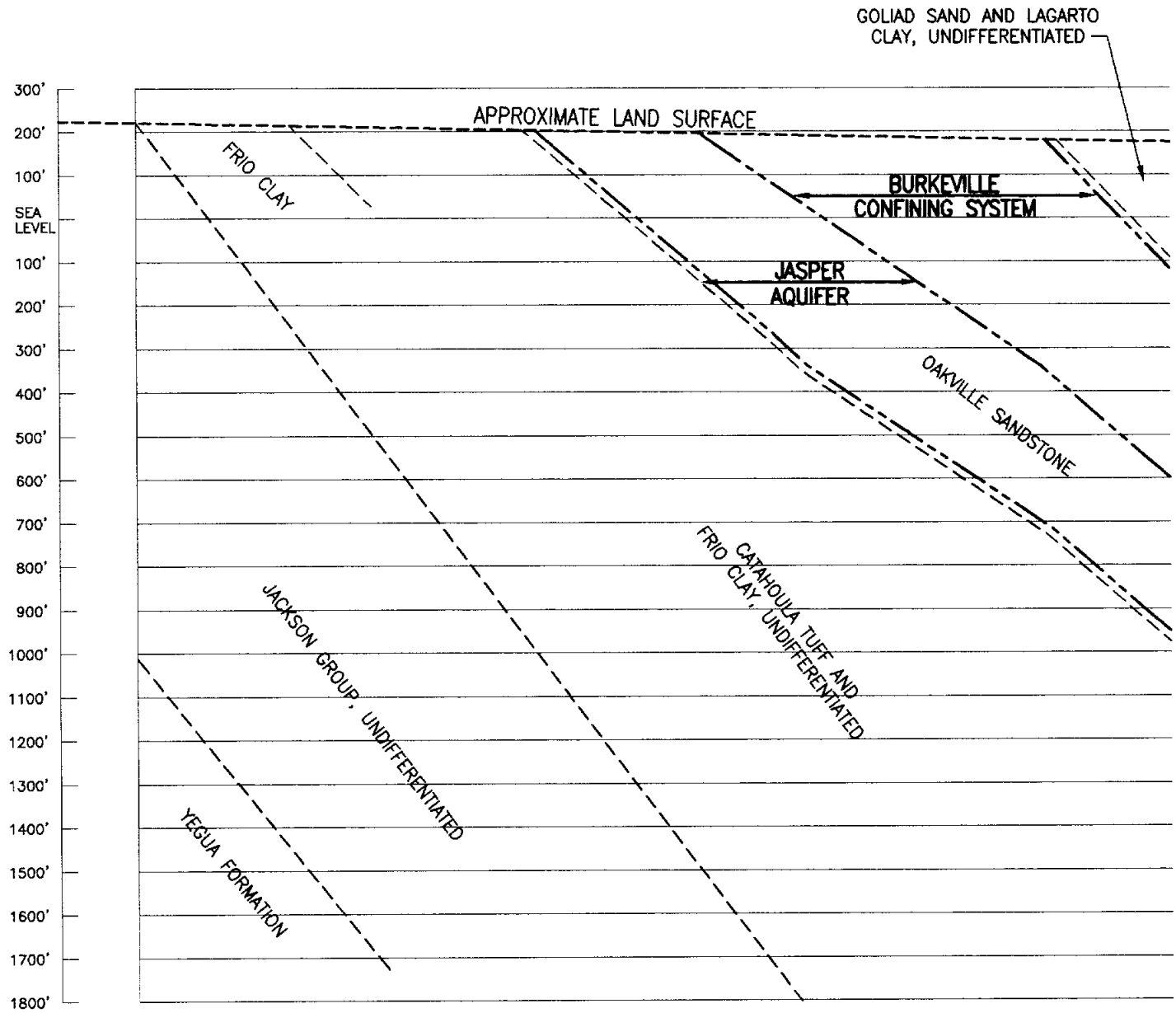


SEE FIGURE No. 8
FOR SECTION LOCATION

## SECTION A–A

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| GEOLOGICAL SECTION | | |
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Fluctuations of ancient sea levels and variations in the amount and source of sediments affected the environment of the outcropping formations, alternating terrestially deposited strata with marine or brackish-water deposits. During the late Tertiary time the sea withdrew toward the present coastline, leaving portions of the Tertiary formations exposed.

The Jackson Group is the stratigraphic unit of the Oligocene Series that outcrops along the northern boundary of the county. It is the oldest exposed formation in the planning area. The thickness of the Jackson Group in this area ranges from 1000 feet to 1200 feet. The outcrop consists primarily of sand, silt, clay, lignite and volcanic ash. The lower portion is made up of clay, bentonitic clay, sandy-silty clay, silt, thin sand beds and small amounts of lignite. Wells in the planning area of the Jackson group typically yield very small to small amounts of slightly to moderately saline water, with some thin strata yielding highly saline water. The Jackson group is generally considered a poor aquifer in Live Oak County.

The Frio Clay of the Oligocene Series is controversial as a separate stratigraphic unit with geologists disagreeing on its existence as a formation. Figure No. 9 shows separate Frio Clay at the surface but as undifferential from the Catahoula formation below ground. If it is a separate formation the clay unconformably overlies the Jackson group and is unconformably overlain by the Catahoula tuff. Where the Frio outcrops it is composed of clay and silty clay, small amounts of sand and selenite. The clay portion resembles the clays of the Jackson and Catahoula, making surface and subsurface mapping difficult. At the outcrop and for several miles downdip the sand occurs evenly distributed in some of the clay beds or as thin lenses typically less than a few feet thick. The sand lenses are mostly disconnected, allowing little opportunity for percolating water to flush out the salty water which they contain. The sand layers thicken in the downdip and are known to produce large quantities of oil and gas. The Frio clay is not known to yield water to wells in Live Oak County.

The Catahoula Formation outcrops in Live Oak County along the Nueces River, through the City of Three Rivers and north of Highway 72. The Catahoula tuff overlaps the Frio clay and is composed predominantly of sandy clay, ashy sand and clay, bentonitic clay, thin sand beds and conglomerate beds. Sand and gravel beds have been charted many miles downdip but tuff (a fragmental rock consisting of smaller kinds of volcanic detritus) found in the gravel restricts the movement of water, resulting in a yield to wells of only small quantities of highly mineralized water or no yield of water at all. The Catahoula tuff in Live Oak County has been described as a poor aquifer. It generally yields small amounts of water ranging in quality from slightly saline to very saline.

The Oakville Sandstone outcrops in an irregular pattern in the southern portion of the planning area and unconformably overlies the Catahoula Formation. The Oakville Sandstone is composed almost entirely of terrigenous clastic sediments that formed sand and clay interbeds. The predominantly sand character of this formation makes it easily distinguished from the underlying Catahoula tuff. It is difficult, though, to differentiate the Oakville Sandstone with the Lagarto Clay. The Oakville dips toward the coast at an average rate of 80 feet per mile. The water in the Oakville sands differs from bed to bed within the formation, ranging from soft to moderately hard, slightly saline and can contain excessive amounts of Fluoride.

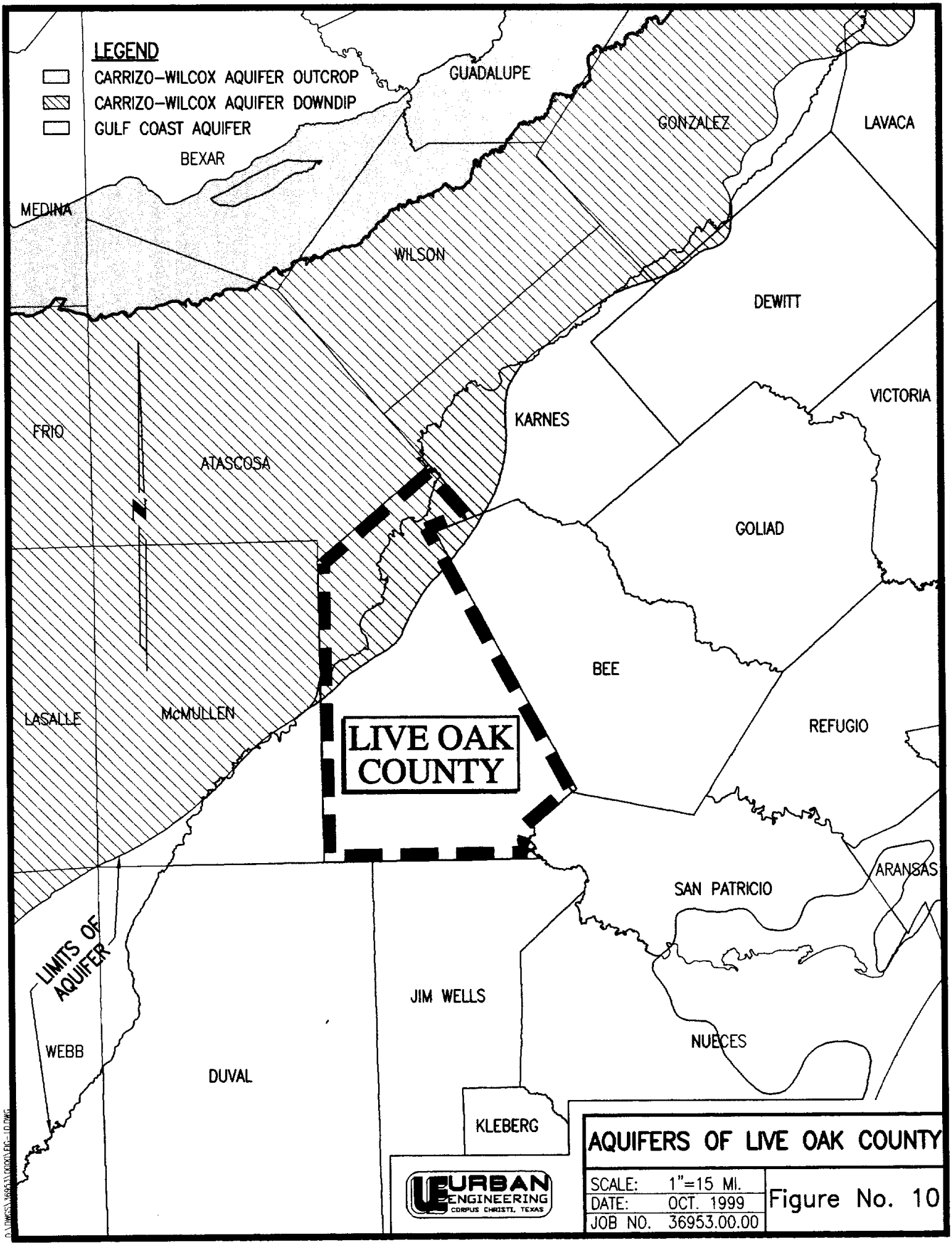
The Lagarto Clay unconformably overlies the Oakville Sandstone and underlies unconformably the Goliad Sand, but is poorly exposed in Live Oak County. The Lagarto Clay is similar to the Oakville Sandstone in some areas but can be easily separated by its greater proportion of clay in other areas. The formation consists of clay and silty calcareous clay, interbedded with lenses of sand and gravel, and with thick beds of caliche found in some areas.

Interspersed with the outcrop of the Oakville Sandstone in the very southern portion of the planning area is the Goliad Sand. The Goliad sand unconformably overlies the Lagarto Clay. The Goliad Sand is composed of fine to coarse-grained sand and sandstone, interbedded with clay and gravel. Where near the surface or exposed, the sand, clay and gravel can be cemented with caliche, sometimes containing as much as 70% to 90% caliche by volume.

4. Groundwater Resources:

Nine major aquifers and twenty minor aquifers have been identified in the State of Texas by the Texas Water Development Board. Major aquifers are characterized as supplying large quantities of water over a large area of the State and minor aquifers as supplying large quantities of water in small areas or small quantities of water over a large area. The Carrizo-Wilcox Aquifer and the Gulf Coast Aquifer systems are found in the planning area. The location of the aquifers within the county is shown on Figure No. 10. These aquifers lie in water bearing formations known as the Carrizo Sand, Oakville Sandstone, Lagarto Clay and Goliad Sand.

The Carrizo-Wilcox Aquifer parallels the Gulf Coast and extends from Arkansas and northern Louisiana southwesterly to the Rio Grande in South Texas (See Figure No. 10). The outcrop of this aquifer is a narrow band located north of Live Oak County along the northern boundaries of the counties of Frio, Atascosa and Wilson. The aquifer dips beneath the land surface toward the coast and ends in the northern portion of Live Oak County. The water of this aquifer is typically characterized as fresh to slightly saline. In the outcrop portion the water is hard and usually low in dissolved solids. In the downdip the water becomes softer, has a higher temperature, contains more dissolved solids and hydrogen sulfide and methane may be found.


LEGEND
CARRIZO–WILCOX AQUIFER OUTCROP
CARRIZO–WILCOX AQUIFER DOWNDIP
GULF COAST AQUIFER
GUADALUPE
GONZALEZ
LAVACA
BEXAR
MEDINA
WILSON
DEWITT
VICTORIA
KARNES
FRIO
ATASCOSA
GOLIAD
BEE
REFUGIO
LASALLE
McMULLEN
LIVE OAK COUNTY
ARANSAS
SAN PATRICIO
LIMITS OF AQUIFER
JIM WELLS
NUECES
WEBB
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KLEBERG
AQUIFERS OF LIVE OAK COUNTY
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Figure No. 10
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The Gulf Coast Aquifer forms a belt along the Gulf Coast from Louisiana to the Rio Grande River. Live Oak County is located in and along the land side edge of the aquifer (See Figure No. 10). The Gulf Coast Aquifer is composed of four water producing formations known as the Catahoula tuff, Jasper Aquifer, Evangeline Aquifer and Chicot Aquifer. The Catahoula is the deepest formation, which contains groundwater near the outcrop in relatively restricted sand layers. The Jasper Aquifer is located above the Catahoula and is primarily contained within the Oakville Sandstone. The Jasper Aquifer is separated from the overlying Evangeline Aquifer by the Burkeville confining layer, which is contained in the Fleming and Goliad sands. The Chicot Aquifer is the upper component of the Gulf Coast Aquifer system. Not all formations are present throughout the Gulf Coast system and only the Catahoula and Jasper Aquifers are present in the planning area of this report (See Figures No. 8 and 9). Water quality is generally good in this aquifer system from the San Antonio River basin northeastward to Louisiana but the quality deteriorates from the San Antonio River basin southwestward to the Rio Grande River due to increased chloride concentration and salt-water encroachment along the coast.

The groundwater in Live Oak County has been known to be low in quality for many years. R.B. Anders and E.T. Baker, Jr., in their April, 1961 report, describe the ground water as "substandard in quality for municipal, industrial and irrigational uses". They did note, though, that "because better water is not available in most areas in the county, substandard water has been used successfully by users of all three categories". The soils and formations found in the planning area are discussed in detail in the previous section. Wells in the planning area of the Jackson Group, which outcrops along the county's north boundary, typically yield very small to small amounts of slightly to moderately saline water, with some thin strata yielding highly saline water. The Jackson Group is generally considered a poor aquifer in Live Oak County. The Frio Clay overlies the Jackson Group and it is not known to yield water to wells in Live Oak County. The largest surface area outcrop in the planning areas is the Catahoula tuff and it has been described as a poor aquifer, yielding very small to small amounts of

water that range in quality from slightly saline to very saline. The water in the Oakville sands, located above the Catahoula tuff, differs from bed to bed within the formation, ranging from soft to moderately hard, slightly saline and can contain excessive amounts of Fluoride. The Oakville sands are found in the very southern portion of the planning area and the formation varies from the outcrop to shallow as it dips away in the planning area.

Recharge of the water bearing formations occurs by the direct infiltration of a small portion of precipitation into permeable strata of the formations or absorption of the collected precipitation in the creeks, streams and rivers. However, only a small portion of the total precipitation is actually absorbed, with most of the water running off, evaporating or being transpired by plants.

Aquifer water quality is classified according to its dissolved-solids content.

**CLASSIFICATION OF AQUIFER WATER QUALITY**

| Description | Dissolved Solids Concentration |
|---|---|
| Fresh | Less than 1,000 mg/l |
| Slightly Saline | 1,000 to 3,000 mg/l |
| Moderately Saline (Brackish) | 3,000 to 10,000 mg/l |
| Very Saline | 10,000 to 35,000 mg/l |
| Brine (Sea water) | More than 35,000 mg/l |

The Live Oak Underground Water Conservation District (LOUWCD) was created in 1991 to preserve and protect groundwater resources in Live Oak County through regulation and permitting. The LOUWCD has monitoring wells throughout the county from which they periodically pull samples and have tested. The results from the monitoring wells in the UDS refinery effluent land application site are provided in Table III-2 in Section III. The results and other data are published in an annual report and used to monitor groundwater quality and use. A copy of the LOUWCD's District Management Plan is included as Appendix No. 7.

5. Stream Segments:

The Texas Surface Water Quality Standards (Title 30, Chapter 307 of the Texas Administrative Code) establish explicit water quality goals throughout the state. Streams in the planning area that have been classified by the State are the Nueces River, Frio River and Atascosa River. The Nueces River and the Frio River are the number one drinking water supply for the Coastal Bend Region. The stream designation and description of the extent of the segments is provided in the following (also see Figure No. 11):

**Segment 2104**: Nueces River Above Frio River – from the confluence of the Frio River in Live Oak County to Holland Dam in LaSalle County.

**Segment 2106**: Nueces/Lower Frio River – from a point 100 meters (110 yards) upstream of US 59 in Live Oak County to Choke Canyon Dam in Live Oak County.

**Segment 2107**: Atascosa River – from the confluence with the Frio River in Live Oak County to the confluence of the West Prong Atascosa River and the North Prong Atascosa River in Atascosa County.

Site specific uses and numerical criteria have been established for each classified stream segment. Site specific criteria apply specifically to substances attributed to waste discharges or to the activities of man but do not apply to instances in which surface water exceed criteria limits due to natural phenomena. A summary of water uses and criteria for the stream segments are presented in the following:

| USES: | SEGMENT | | |
|---|---|---|---|
| | 2104 | 2106 | 2107 |
| Recreation | CR | CR | CR |
| Aquatic Life | H | H | H |
| Domestic Water Supply | PS | PS | PS |
| ***CRITERIA:*** | | | |
| Chloride (mg/L) | 700 | 250 | 600 |
| Sulfate (mg/L) | 300 | 250 | 500 |
| Total Dissolved Solids (mg/L) | 1500 | 500 | 1500 |
| Dissolved Oxygen (mg/L) | 5.0 | 5.0 | 5.0 |
| pH Range (SU) | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 |
| Fecal Coliform #/100ml | 200 | 200 | 200 |
| Temperature (°F) | 90 | 90 | 90 |

**CR**: Contact Recreation **H**: High Aquatic Life Us **PS**: Public Water Supply

6. Flood Maps:

The Federal Emergency Management Association (FEMA) mapping agency was contacted for information on floodplain mapping in the vicinity of the planning area. At this time there is no mapping available for the unincorporated areas in Live Oak County. FEMA mapping is available for the City of Three Rivers. This mapping indicates that the flood plain is located along the banks of the Frio River.

The U. S. Army Corps of Engineers (USACE) was contacted with regards to floodplain mapping in the vicinity of the project site. The USACE has not undertaken any floodplain mapping in the vicinity of the project site.

The United States Department of the Interior, Bureau Of Reclamation prepared inundation maps in 1982 for a design flood with sudden failure of the Choke Canyon Dam. In the area of the City of Three Rivers the inundation downstream of the dam generally follows the Frio River and up to the levee on the west side and south side of the City. According to the information provided, the levee around the City is believed to be sufficient to protect the residential areas from inundation.

## D. LAND USE

Land use within the planning area is generally rural in nature, other than the City of Three Rivers. Land use is divided between crop production, cattle ranching and petroleum production. Principal crops include cotton, grain sorghum, wheat and corn. There are oil and natural gas fields in the area and a major petroleum refinery is located in the City of Three Rivers (see Page III-4). Other land uses include the Federal Prison Facility located west of the City of Three Rivers, the UDS effluent irrigation and hay production site located northeast of the City of Three Rivers and the Choke Canyon Reservoir which has a state park, water activities and is a source of surface water.

## E. PREVIOUS STUDIES

Over the years there have been various studies performed in the planning area. These studies range from comprehensive plans to environmental studies. The following is a list of studies found and a brief summary:

1. **Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas, Texas Department of Water Resources Report 236,** Baker, E. T., Jr., 1979,

   This report was developed to determine the stratigraphic and hydrogeologic units in the coastal plain of Texas. The information developed was to be used in a ground water flow model, which would serve as a ground water supply planning tool.

2. **Final Environmental Impact Statement – Nueces River Project Choke Canyon Dam & Reservoir Site**, 1975, Bureau Of Reclamation

   The Nueces River Project consists of an earthfill dam and reservoir on the Frio River in Live Oak County to provide an additional water supply for the Coastal Bend Region. The report discussed the need for the project, description of the project, description of the environment, environmental impacts, alternatives to the project and coordination of agency review.

3. **Comprehensive Plan – Three Rivers, Texas**, 1970, Lockwood, Andrews & Newnam, Inc.

The Comprehensive Plan was developed as a guide for development within the City. The objectives were to secure the City from flooding, provide more adequate streets, drainage facilities and sewer and water facilities and to improve the business district to facilitate growth. The population projects provided in the plan were optimistic with a 1988 projected population of 2680 persons. The 1990 census data showed a population of 1,889.

4. **Ground Water Geology of Live Oak County, Texas, Texas Board of Water Engineers Bulletin 6105**, 1961, Anders, R. B and Baker, E. T., Jr.,

This investigation of the geology and ground-water resources was undertaken to study the occurrence of ground water, to determine the chemical quality of the ground water, to study the geology, to determine the sources and areas of the ground water recharge and to determine the present and projected future development of ground water in Live Oak County. The report concluded that a large portion of the ground water used in 1950 was marginal or of substandard quality, although there is a large quantity of fair to excellent quality water available. Most of the water supply is from ground water except for the City of Three Rivers and some irrigation obtained from surface water. The 1957 rate of withdrawal could be increased significantly due to storage volume available and potential rate of recharge to the principal water bearing formations. Overall, it appears that most of the water contains sufficient concentrations of certain chemical components to limit its use for some industrial applications and that it be used with caution for long-term irrigation.

# III. WATER RESOURCES AND USES

## A. EXISTING WATER SYSTEMS

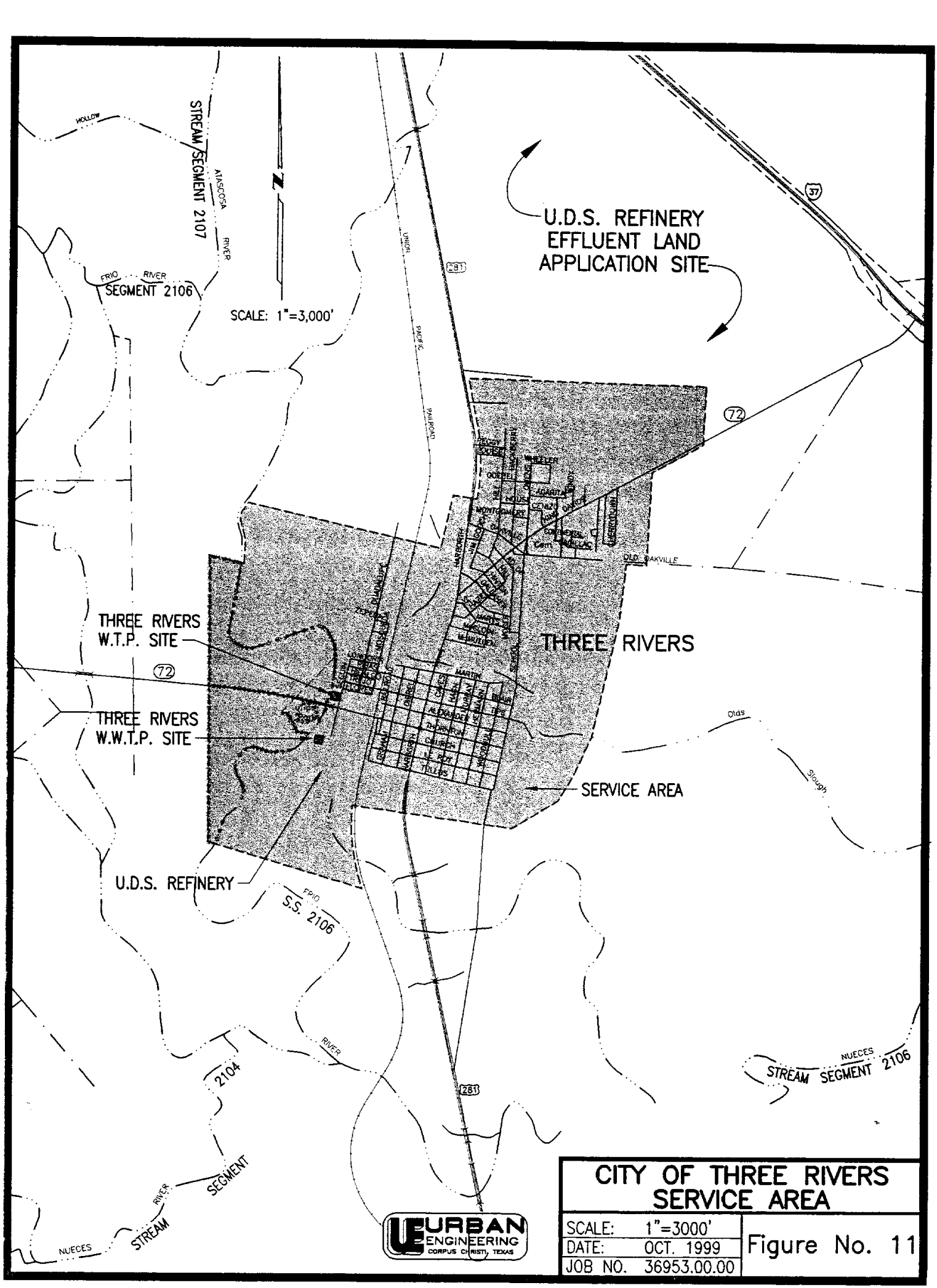
1. Domestic:

a. General:

Potable water is supplied to customers in the planning area from the City of Three Rivers, the El Oso Water Supply Corporation (W.S.C.), the Choke Canyon Water System, the McCoy Water Supply Corporation and private wells. The Certificate of Convenience and Necessities (CCNs) of each entity is shown on Figure No. 5. The City of Three Rivers provides treated potable water for customers in the City, El Oso W.S.C. provides water to people living north and east of the City of Three Rivers and for the northeasterly portion of the county, the Choke Canyon Water System provides water to those west of the City of Three Rivers and to the Federal Correctional Institution-Three Rivers, located south of Choke Canyon Reservoir and the McCoy W.S.C. provides water to customers in Whitsett and along Highways 281 and 99 (along the Live Oak – Atascosa county line).

b. City of Three Rivers Water System:

The Three Rivers Water System is made up of a water treatment plant and water distribution system, owned and operated by the City of Three Rivers. The existing water distribution and treatment system is located within the service area of the City of Three Rivers (See Figure No. 11). The source of raw water for treatment is from the Choke Canyon Reservoir. Choke Canyon Dam is located on the Frio River approximately 6 miles upstream from the City of Three Rivers. Raw water is released from the dam and travels down the Frio River where it impounded by Tipps Dam, a small dam adjacent to the water treatment plant. Raw water pumps are used to pump out of the river into the treatment plant (See Figure No. 12). A minimum of 33 cubic feet per second

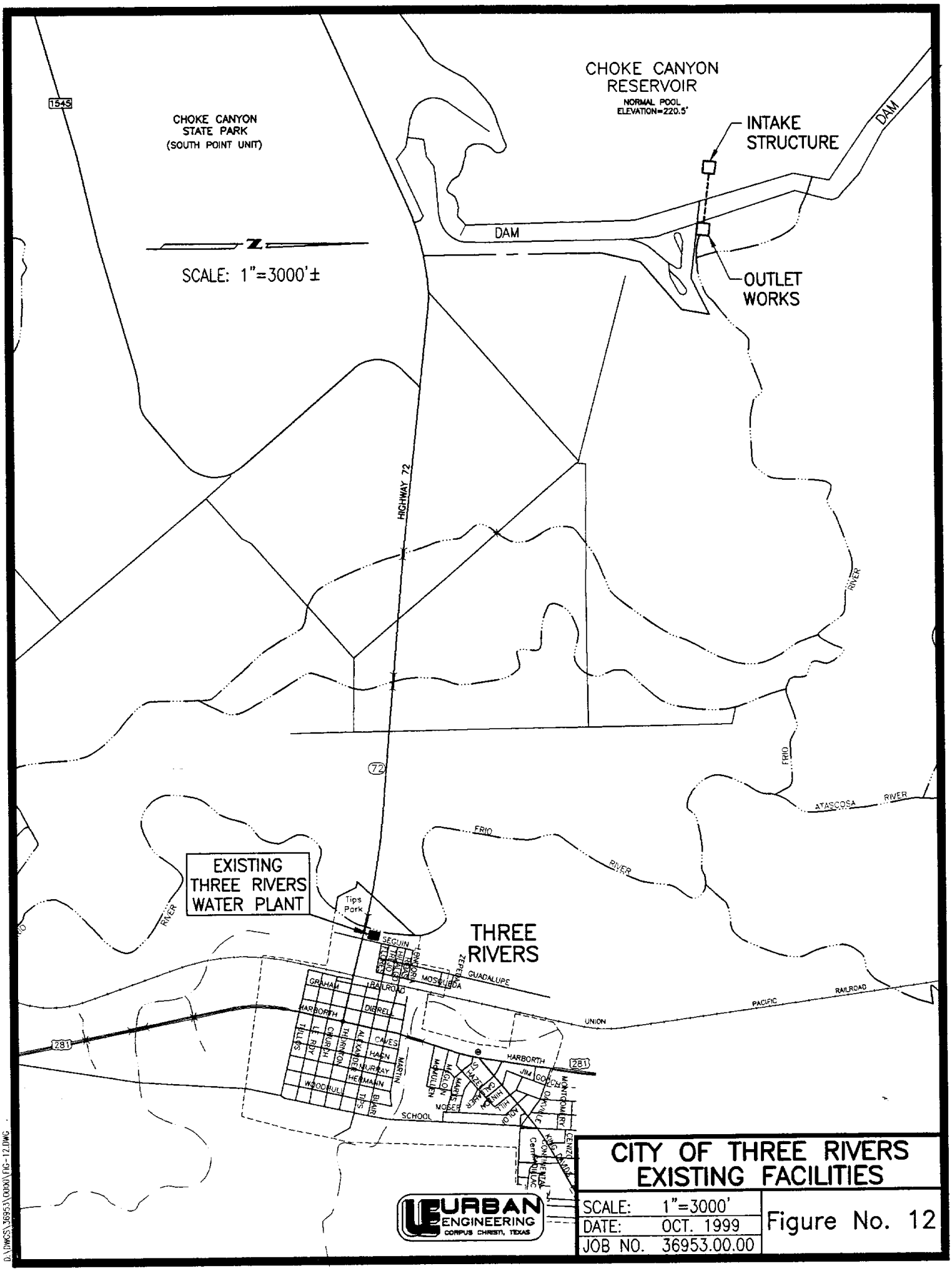



# CITY OF THREE RIVERS SERVICE AREA

| | |
|---|---|
| SCALE: | 1"=3000' |
| DATE: | OCT. 1999 |
| JOB NO. | 36953.00.00 |

Figure No. 11

URBAN ENGINEERING
CORPUS CHRISTI, TEXAS




# CITY OF THREE RIVERS EXISTING FACILITIES

| | |
|---|---|
| SCALE: | 1"=3000' |
| DATE: | OCT. 1999 |
| JOB NO. | 36953.00.00 |

Figure No. 12

URBAN ENGINEERING
CORPUS CHRISTI, TEXAS

D:\DWGS\36953\00001\FIG-12.DWG

(21.3 MGD) is constantly discharged from the dam to meet water supply and environmental needs downstream (the City of Three Rivers' portion presently amounts to 2 MGD). The water distribution system provides potable water to the citizens of the City and other customers, such as the Ultramar Diamond Shamrock refinery.

The existing water treatment plant is located on the north side of Highway 72 and adjacent to the east bank of the Frio River (See Figure No. 12). The plant is permitted by and meets the requirements of the Texas Natural Resource Conservation Commission (TNRCC). The plant has a treatment capacity of 2 MGD. The treatment plant was constructed in 1984, and upgraded in 1990 with the addition of sludge drying beds. The plant is generally in good condition and can be easily expanded to 3 MGD with the addition of another clarifier. The plant obtains raw water directly from the adjacent Frio River and pumps it to the following treatment units:

(1) 3 MGD Aerator
(2) 1 MGD Clarifiers
(1) 3 MGD Filter (575 SF)
(1) 3 MGD Transfer Basin

Water treated at the plant over the last ten years has remained at and around an average daily rate of 1,000,000 Gallons Per Day (GPD). Treated water sales to industrial customers (mainly Ultramar Diamond Shamrock Refinery) dipped to a low of 470,000 GPD in 1992, steadily rose to a maximum level of 815,000 GPD in 1997 and then dropped off to 760,000 GPD in 1998. A history of water use over the last ten years is provided in the following:

**HISTORICAL WATER USE***
**CITY OF THREE RIVERS**
**(ACRE-FT)***

| Year | Water Sales | Industrial Sales | City's Sales | Total Use |
|---|---|---|---|---|
| 1988 | 28 | 840 | 369 | 1237 |
| 1989 | 30 | 822 | 442 | 1294 |
| 1990 | 26 | 740 | 379 | 1145 |
| 1991 | 26 | 731 | 373 | 1130 |
| 1992 | 39 | 528 | 384 | 951 |
| 1993 | 45 | 652 | 388 | 1085 |
| 1994 | 47 | 652 | 437 | 1136 |
| 1995 | 22 | 780 | 410 | 1212 |
| 1996 | 22 | 821 | 402 | 1245 |
| 1997 | 13 | 913 | 242 | 1168 |

* Data from T.W.D.B. Internet site.
1 acre-foot = 325,851 Gallons.

c. El Oso Water Supply Corporation:

The El Oso Water Supply Corporation (W.S.C.) system was begun in 1973 and services customers with groundwater obtained from wells and pumping facilities located in Falls City, Karnes County, to the north east of Live Oak County. The El Oso W.S.C. service area is a large portion of the north eastern quadrant of Live Oak County but only a narrow corridor, one mile wide and parallel to IH 37, is located within the planning area (See Figure No. 5).

The water consumption within the planning area is small due to the small number of El Oso W.S.C. customers in the planning area. Considering that the groundwater provided is from a source outside the county, the water use impact of the El Oso customers in the planning area is not considered.

d. Choke Canyon Water System :

The Choke Canyon Water System services customers with groundwater obtained from wells and pumping facilities located in McMullen County, west of Live Oak County. The wells take water out of the downdip of the Carrizo-Wilcox Aquifer. The service area is located between the Choke Canyon Reservoir and the City of Three Rivers and an area to the south of Choke Canyon Reservoir (See Figure No. 5). There are approximately 185 residential and business customers. The Choke Canyon Water System also provides drinking water to the Choke Canyon State Park and the Federal Correctional Institution - Three Rivers. The state park is located along the south shore of the Choke Canyon Reservoir and can serve approximately 1000 persons per day. The Federal Correctional Institution - Three Rivers is located south of the Choke Canyon Reservoir and south of State Highway 72, just east of the Live Oak County Line. The prison population is approximately 1300 including the staff. It has a contract to purchase an average daily flowrate of 250,000 GPD with a maximum daily usage of 360,000 GPD. The total equivalent connections is estimated to be as follows:

**CHOKE CANYON W.S. EQUIVALENT CONNECTIONS**

| | |
|---|---|
| Residential and Business Customers | 185 |
| Federal Prison Equivalent Connections | 433 |
| State Park Equivalent Connections | 333 |
| Total Equivalent Connections | 951 |

The Choke Canyon Water System water supply presently consists of one operating well, dual cooling towers, a 23,000 gallon ground storage tank and two 430 GPM service pumps. Water use varies from 250,000 GPD in the winter to 360,000 GPD in the summer months. The system owner also constructed a surface water system to take and treat water from the Choke Canyon Reservoir. This system consists of a treatment plant and intake structure, but

it has not been used since 1995 due to low water levels in Choke Canyon Reservoir and the location of the intake structure

The quality of water provided by the Choke Canyon Water System does not normally meet the total dissolved solids requirements of the TNRCC. The Water System is allowed to distribute this water to its customers, though, since there is not another acceptable water supply in the area. The present owner is under enforcement action by the TNRCC due to problems with the operation and management of the system. It is likely that the TNRCC will require the present owner to bring the system into compliance or that a new owner will take over the system. The Three Rivers Water District and the NRA have offered assistance in the management and operation of this system.

2. Industrial:

The major water user in the planning area is the Ultramar Diamond Shamrock refinery located in the City of Three Rivers. The first refinery in this location was constructed in the 1930s and was known as the Three Rivers Refinery. This refinery processed local crude brought in by truck for lube oil. The refinery has been expanded over the years and Diamond Shamrock obtained the site from Sigmor in 1983. In 1996 Diamond Shamrock merged with Ultramar to become Ultramar Diamond Shamrock Corporation. This refinery operates 24 hours a day 365 days a year and continuously refines over 80,000 barrels per day of light sweet crude oil, such as that from the North Sea or the West Coast of Africa. The crude oil is delivered by ship to the Port of Corpus Christi then pumped to the refinery in Three Rivers. Until 1996 the oil was unloaded and pumped through facilities not owned by the refinery. In 1996 the crude oil began arriving by a new terminal facility constructed at the Port of Corpus Christi and 16" dia. pipeline owned by UDS. Products refined include gasolines, diesel fuel, fuel oil, propane jet fuel, process oils and fertilizers. A list of products produced is as follows:

## LIST OF PRODUCTS PRODUCED
## U.D.S. REFINERY

| | |
|---|---|
| Ammonium Thiosulfate | 150 Pale |
| Asphalt | 200 Pale |
| Aviation Gasoline | 750 Pale |
| Diesel | 2400 Pale |
| Fuel oil #4 | Kerosene |
| Fuel oil #5 | JP8 |
| Fuel oil #6 | Treated LPG |
| Heating oil #2 | Heavy cycle oil |
| Regular unleaded gasoline | Light cycle oil |
| Midgrade Unleaded gasoline | Sulfur |
| Premium unleaded gasoline | Racing fuel |
| 40 Pale | Benzene |
| 60 Pale | Toluene |
| 100 Pale | Mixed Xylenes |

The refining process includes separation, conversion and blending. Water is important to the refining process. Treated potable water is purchased from the City of Three Rivers and raw water is pumped from Ultramar Diamond Shamrock's Kittie Wells located approximately four miles to the south of the refinery. A breakdown of water usage between the City purchased and delivered from the Kittie wells is provided in Table III-1. The refinery has a contract with the City to purchase up to 1.5 MGD of potable water but has been taking only 750,000 GPD to 1,000,000 GPD. The potable water purchased from the City is used for cooling tower makeup water, process water and the fire system. The groundwater from the Kittie Wells is run through a reverse osmosis (R.O.) treatment unit to remove impurities. Reverse osmosis treatment utilizes a semipermeable membrane to remove contaminates in the water. Hydrostatic pressure forces water through the membrane and the contaminants are left behind in a brine solution. The brine solution must be disposed of. Costs for operation of the refinery's R.O. unit were not available. The R.O. treated ground water is used in for the boiler feed water.

# TABLE III-1

## ULTRAMAR DIAMOND SHAMROCK REFINERY WATER USAGE

| | CITY WATER * (Gallons) | KITTIE WELLS (Gallons) | TOTAL WATER Gal/Mo. | GPD |
|---|---|---|---|---|
| **1996** | | | | |
| January | 17,544,600 | 19,386,000 | 36,930,600 | 1,191,310 |
| February | 19,668,000 | 17,834,300 | 37,502,300 | 1,293,183 |
| March | 22,608,000 | 21,250,100 | 43,858,100 | 1,414,777 |
| April | 24,586,200 | 21,428,000 | 46,014,200 | 1,533,807 |
| May | 22,228,200 | 23,255,000 | 45,483,200 | 1,467,200 |
| June | 24,817,200 | 23,184,000 | 48,001,200 | 1,600,040 |
| July | 27,253,300 | 25,140,000 | 52,393,300 | 1,690,106 |
| August | 23,248,400 | 24,030,000 | 47,278,400 | 1,525,110 |
| September | 19,925,800 | 24,286,000 | 44,211,800 | 1,473,727 |
| October | 21,476,300 | 8,866,000 | 30,342,300 | 978,784 |
| November | 22,606,700 | 13,075,000 | 35,681,700 | 1,189,390 |
| December | 21,519,200 | 23,615,000 | 45,134,200 | 1,455,942 |
| **Annual Average** | | | | **1,401,115** |
| **1997** | | | | |
| January | 20,847,700 | 22,657,400 | 43,505,100 | 1,403,390 |
| February | 25,465,300 | 21,243,000 | 46,708,300 | 1,610,631 |
| March | 28,035,500 | 23,692,300 | 51,727,800 | 1,668,639 |
| April | 23,455,500 | 20,049,800 | 43,505,300 | 1,450,177 |
| May | 24,832,300 | 22,585,200 | 47,417,500 | 1,529,597 |
| June | 22,498,600 | 25,534,800 | 48,033,400 | 1,601,113 |
| July | 22,797,800 | 2,606,200 | 25,404,000 | 819,484 |
| August | 26,775,800 | 24,667,600 | 51,443,400 | 1,659,465 |
| September | 25,964,000 | 23,972,800 | 49,936,800 | 1,664,560 |
| October | 27,466,000 | 23,257,700 | 50,723,700 | 1,636,248 |
| November | 27,400,000 | 23,655,300 | 51,055,300 | 1,701,843 |
| December | 21,938,700 | 22,022,400 | 43,961,100 | 1,418,100 |
| **Annual Average** | | | | **1,513,604** |

* Purchased from City of Three Rivers

## TABLE III-1 CONTINUED

| | CITY WATER * (Gallons) | KITTIE WELLS (Gallons) | TOTAL WATER Gal/Mo. | GPD |
|---|---|---|---|---|
| **1998** | | | | |
| February | 17,753,400 | 21,824,900 | 39,578,300 | 1,364,769 |
| March | 19,014,100 | 23,518,500 | 42,532,600 | 1,372,019 |
| April | 19,416,000 | 22,480,700 | 41,896,700 | 1,396,557 |
| May | 25,814,500 | 23,610,800 | 49,425,300 | 1,594,365 |
| June | 26,901,300 | 24,452,900 | 51,354,200 | 1,711,807 |
| July | 26,217,400 | 24,414,300 | 50,631,700 | 1,633,281 |
| August | 25,872,100 | 23,833,800 | 49,705,900 | 1,603,416 |
| September | 25,706,800 | 23,749,400 | 49,456,200 | 1,648,540 |
| October | 24,691,000 | 23,845,200 | 48,536,200 | 1,565,684 |
| November | 21,800,600 | 23,631,800 | 45,432,400 | 1,514,413 |
| December | 26,261,100 | 21,616,600 | 47,877,700 | 1,544,442 |
| **Annual Average** | | | | **1,522,112** |
| **1999** | | | | |
| January | 26,982,800 | 23,255,400 | 50,238,200 | 1,620,587 |
| February | 24,031,700 | 19,558,200 | 43,589,900 | 1,503,100 |
| March | 23,025,800 | 23,994,100 | 47,019,900 | 1,516,771 |
| April | 25,767,900 | 22,910,500 | 48,678,400 | 1,622,613 |
| May | 25,580,500 | 23,366,100 | 48,946,600 | 1,578,923 |
| June | 22,204,000 | 23,567,700 | 45,771,700 | 1,525,723 |
| July | 25,089,100 | 24,415,600 | 49,504,700 | 1,596,926 |
| August | 27,406,200 | 23,991,500 | 51,397,700 | 1,657,990 |
| September | 26,213,900 | 22,213,900 | 48,427,800 | 1,614,260 |

* Purchased from City of Three Rivers

3. Private Systems:

There are approximately 160 private wells in the planning area providing water for domestic use, irrigation and stock watering. As discussed in Section II the quality of the water accessible in the aquifers located in the planning area is poor, mainly due to high dissolved solids. Many residents use the water for bathing and washing dishes but buy drinking and cooking water elsewhere and haul it home.

## B. EXISTING WATER SOURCES

1. Choke Canyon Reservoir:

The Choke Canyon Reservoir is owned by the United States Bureau of Reclamation (USBR) and operated by the City of Corpus Christi. The Texas Water Rights Commission designated the City of Corpus Christi and the Nueces River Authority as joint sponsors of the Choke Canyon Reservoir project and they both hold a Certificate of Adjudication (#21-3214). The City's portion is 80% and the NRA's portion is 20%. The reservoir is operated in conjunction with Lake Corpus Christi located to the south on the Nueces River. The water supply system is known as the Choke Canyon-Lake Corpus Christi System and the system can supply approximately 178,000 acre-feet of water per year. Municipal and industrial users from seven counties of the "Coastal Bend Region" depend on water from this reservoir system. These counties are Aransas, Bee, Jim Wells, Kleberg, Live Oak, Nueces and San Patricio.

The Choke Canyon Reservoir is located approximately 4 miles to the west of the City of Three Rivers and was constructed on the Frio River. The reservoir has a conservation pool storage capacity of 695,271 acre-feet and was designed provide 129,000 acre-feet as a firm annual yield when operated with Lake Corpus Christi. Water is released daily from the dam into the Frio River which delivers the water to the Nueces River and thence to Lake Corpus Christi. Water is released under two conditions, one is a minimum of 33 CFS (21.3 MGD) to meet downstream environmental needs established during the reservoir design and to meet the City of Three Rivers potable water demand and the other is for

transfers to Lake Corpus Christi for diversions from the City of Corpus Christi system.

2. Ground Water:

The Texas Water Development Board has identified nine major aquifers and twenty minor aquifers in the State of Texas. Major aquifers are characterized as supplying large quantities of water over a large area of the State and minor aquifers as supplying large quantities of water in small areas or small quantities of water over a large area. Ground water in the planning area is withdrawn from the Carrizo-Wilcox Aquifer and Gulf Coast Aquifer. These aquifers are discussed in Section II.4 and are shown in Figure No. 10 (in Section II).

Wells in the northern portion of the county draw water out of the downdip of the Carrizo-Wilcox Aquifer in the Jackson Group. The water in the downdip of this aquifer is typically soft, high temperature and slightly saline. According to test results of the Live Oak UWCD monitoring wells in this region, the total dissolved solids concentration range from 2100 mg/l to 2800 mg/l.

Ground water pumped from the Gulf Coast Aquifer can come from four water producing formations known as the Catahoula tuff, Jasper Aquifer, Evangeline Aquifer and Chicot Aquifer. The Live Oak UWCD monitoring wells located in the Catahoula tuff outcrop produce 4 to 12 GPM and were drilled to depths of 60' to 120'. These wells produce water with a dissolved solids concentration of 1800 mg/l to 3200 mg/l, except for the Bellows well. The Bellows well is adjacent to the UDS effluent land application site and testing indicates dissolved solids of less than 1000 mg/l. This could be attributed to the flushing or dilution of the salinity levels by the migration of UDS effluent through the soil. Confirmation of this would require additional testing and research beyond the scope of this study.

Wells in the southern portion of the planning area draw water from the Jasper Aquifer in the Oakville Sandstone and the Evangeline Aquifer in the Goliad Sands.

Major ground water users in the area include Choke Canyon Water Supply and Ultramar Diamond Shamrock refinery. The Choke Canyon Water Supply presently has one well operating and typical demands range from 250,000 GPD to 360,000 GPD. The well pumps water from the downdip of the Carrizo-Wilcox aquifer and this water, as discussed in the previous paragraphs, has a high temperature and is typically high in total dissolved solids. The water pumped out of the ground is cooled in cooling towers before being stored and then pumped into the distribution system. The UDS refinery has three operating wells located south of the City of Three Rivers. These wells supply approximately 750,000 GPD to the refinery (Table III-1 shows the typical supply for the last four years). This water is pumped from the Gulf Coast Aquifer and is used as boiler feed water after being processed through a reverse osmosis treatment to remove impurities.

## C. PRESENT WATER NEEDS

1. Municipal:

The City of Three Rivers treats and distributes potable water for customers in the City and for the Ultramar Diamond Shamrock refinery. The Three Rivers Water Treatment Plant is experiencing problems with pumping the raw water into the plant and producing enough potable water to meet the demand.

The peak month water usage for 1998 occurred in June and the municipal and industrial use for that month is presented in the following:

**PRESENT PEAK WATER USE**

| | |
|---|---|
| City of Three Rivers | 604,000 GPD |
| U.D.S. Refinery | 897,000 GPD |
| Total 1998 Peak Water Use | 1,501,000 GPD |

The existing Three Rivers Water Treatment Plant has a design treatment capacity of 2 MGD. During rainfall events the existing plant capacity is reduced to approximately 55% of the design capacity due to the increased turbidity in the raw water. This means the plant will only produce about 1.1 MGD of potable water during the periods of high turbidity and there is not enough water available to provide for the needs of industrial and municipal customers

The City of Three Rivers is having difficulties with treatment capacity of the water treatment plant due to high turbidity in their raw water supply from the Frio River. The Atascosa River intersects the Frio River approximately three miles upstream of the treatment plant intake. The Atascosa River is intermittent and during periods of rainfall, the waters become heavily laden with sediment from runoff. This "muddy" water mixes with the waters released into the Frio River from the Choke Canyon Reservoir and results in the water pumped from the Frio River being highly turbid (high in solids). Under normal conditions the plant experiences incoming turbidities in the range of 15 to 20 nephelometry turbidity units (NTU) and during periods of heavy rainfall the incoming turbidity ranges from 350 to 400 NTU. These high turbidities can linger in the incoming raw water for up to a week after a heavy rainstorm. Turbidity is the suspended and colloidal material found in the supply water. Not only is eliminating this material from the drinking water important from an esthetic point of view but also from a health standpoint as well. Turbidity has an indirect health concern, as the particulate matter is associated with microorganisms. The microorganisms attach themselves to the particles, which, in turn, interfere with the disinfection process. This interference requires more chlorine to disinfect the water and an increased chlorine demand. It should also be noted that chlorinated organic precursor materials have also been related to the aquatic material that is dissolved in turbid waters.

The abnormally high turbidity also greatly reduces the treatment capacity of the plant and increases the amount of chemicals required. An increased operation and maintenance cost is directly associated with the high turbidity. Additional chemical costs and the cost to clean the filters and haul the sludge to a suitable disposal site are the main contributors to the increased operation and maintenance costs.

During periods of heavy rainfall, the velocity of the Frio River causes vortex problems at the Water Treatment Plant intake structure. Under these conditions, normal operations at the plant must be modified. The City must take one of the three (3) intake pumps out of service and place a portable 6" pump inline. The temporary pump is able to pump the water from the river to supplement the reduced pumpage of the standard pumps. This situation occurs every time there is heavy rainfall in the watershed of the Atascosa River and lasts anywhere from one (1) week to a month.

Another entity with potable water problems is the Choke Canyon Water System. The Choke Canyon Water System provides groundwater from wells to approximately 185 customers on the south and east sides of Choke Canyon Reservoir, to the Choke Canyon State Park and to the Federal Correctional Institution-Three Rivers located south of Choke Canyon Reservoir. Water demand ranges from 250,000 GPD to 360,000 GPD. The system originally utilized three wells for the supply water but only one well is presently in operation. The quality of water provided from the well does not meet TNRCC dissolved solids standards and is only allowed for use since there are no other sources available at present. The water requires cooling after being pumped from the ground and the dissolved solids are typically high. The Choke Canyon Water System also has a surface water treatment plant with an intake structure in Choke Canyon Reservoir. The surface water system has been inactive since 1995 due to the low lake levels leaving the intake structure high and dry. Better quality water is needed to improve water service to these customers. In addition, the owner is presently under enforcement action by the TNRCC due to the problems with the operation and management

of the system. It is possible that the TNRCC may require that the system operation and management be taken over by an outside entity. The Three Rivers Water District and NRA have offered assistance for this system.

2. Industrial:

The Ultramar Diamond Shamrock refinery utilizes potable water purchased from the City of Three Rivers and groundwater provided by its own wells. The division of water used between the supply available is approximately 50:50 (See Table III-1). The 1998 annual average water use is as follows:

**1998 ANNUAL AVERAGE WATER USE**

| | |
|---|---|
| Potable Water From City of Three Rivers | 761,200 GPD |
| Groundwater From Kittie Wells | 765,400 GPD |
| Total Water Used | 1,526,600 GPD |

A major reason for the U.D.S. refinery to have two sources of water is to ensure reliability of access to water to maintain production capabilities. The reliability is somewhat limited, though, due to pumping capabilities, availability of the groundwater and the limit of available water from the City of Three Rivers. As discussed in the previous section, the Three Rivers Water Plant production capabilities can be curtailed due to turbidity as a result of rainfall events.

At present the U.D.S. refinery's normal operation is to utilize the two sources of water and there are no proposals to change this. If a problem were to occur with the availability of groundwater then it could be critical to them that the Three Rivers Water Treatment Plant be able to produce at maximum capabilities no matter what the weather or river conditions.

3. Private Systems:

Potable water from private wells is generally not available to persons located within the planning area due to groundwater quality. To provide a quality of water meeting TNRCC standards will require some method of

treatment or connection to a public or private water supply system. Until areas become more densely populated, construction of rural water lines to serve these persons is unlikely.

## D. PROJECTED WATER NEEDS

1. Municipal:

The City of Three Rivers is projected to have a slight growth in the future as discussed in Section II of this report. The population is projected to grow 0.4% to 0.5% per year over the next 20 years from year 2000 to year 2020 and grow by about 0.25% to 0.30% per year from year 2020 to year 2050. The projected peak monthly demand, based on existing demand and projected population growth, is presented in the following table:

**PROJECTED POTABLE WATER DEMAND**
**CITY OF THREE RIVERS**

| Year | Projected Peak Daily Demand |
|---|---|
| 2000 | 0.604 MGD |
| 2010 | 0.634 MGD |
| 2020 | 0.667 MGD |
| 2030 | 0.688 MGD |
| 2040 | 0.708 MGD |
| 2050 | 0.730 MGD |

The Choke Canyon Water Supply system has experienced problems with providing suitable water for its customers. Alternatives to address the water needs for this system include constructing pipeline transmission facilities from the City of Three Rivers water system or treating the groundwater prior to distribution. These alternatives are discussed in Section III.G. The Choke Canyon Water Supply service area has experienced growth through the years and is expected to continue to add customers. The projected growth for the Cities of Three Rivers and George West and the balance of the county is shown on Page II-3. Although the balance of the county growth is projected to be small it is possible that the Choke Canyon Water Supply service area will experience a greater growth rate due to the location along the Choke

Canyon Reservoir. A growth rate of the same magnitude as that of the City of Three Rivers is used for the following water demand projection.

**PROJECTED POTABLE WATER DEMAND**

**CHOKE CANYON WATER SUPPLY**

| Year | Prison | Domestic | Proj. Total Peak Daily Demand |
|---|---|---|---|
| 2000 | 0.300 MGD | 0.070 MGD | 0.370 MGD |
| 2010 | 0.300 MGD | 0.074 MGD | 0.374 MGD |
| 2020 | 0.300 MGD | 0.077 MGD | 0.377 MGD |
| 2030 | 0.300 MGD | 0.079 MGD | 0.379 MGD |
| 2040 | 0.300 MGD | 0.082 MGD | 0.382 MGD |
| 2050 | 0.300 MGD | 0.084 MGD | 0.384 MGD |

Other needs for the Choke Canyon Water Supply system are adequate management and operation. As discussed in previous sections it is likely that another entity will take over this system due to the TNRCC enforcement action.

2. Industrial:

Ultramar Diamond Shamrock refinery staff does not anticipate any growth for the future or additional water demand at present. The refinery presently obtains roughly 50% of its water needs from the City of Three Rivers and 50% from its Kittie Wells located south of the refinery. Although past operations at the refinery has taken only a maximum of 0.9 MGD of potable water from the City, the refinery has an existing contract with the City that allows them to take up to 1.0 MGD. Any change in conditions at the Kittie Wells could cause the refinery to increase its intake of potable water from the City of Three Rivers.

There have been discussions in the recent past concerning construction of a Cogeneration facility at the U.D.S. refinery site or in the area. Due to economics the construction of the facility is not presently being pursued. The Cogeneration facility, if ever constructed, is estimated to have a water demand of 2.0 MGD.

3. Private Use:

For planning purposes, we have assumed that 25% of the county's population, outside of the two major cities, is located in the planning area. This is based on a ratio of the planning area to the overall county area. Using the projected population increase shown in Section II and 130 Gallons Per Capita Per Day (GPCD) we have developed the following project water needs by persons outside the City of Three Rivers service area:

**PROJECTED RESIDENTIAL WATER DEMAND**
**(OUTSIDE THREE RIVERS SERVICE AREA AND NOT INCLUDING CHOKE CANYON W.S.)**

| Year | Projected Peak Daily Demand |
|---|---|
| 2000 | 0.074 MGD |
| 2010 | 0.075 MGD |
| 2021 | 0.077 MGD |
| 2030 | 0.079 MGD |
| 2040 | 0.081 MGD |
| 2050 | 0.082 MGD |

4. Combined Water Needs For Planning Area:

Water supply needs considered for the entire planning area includes that required by the City of Three Rivers, the Choke Canyon Water Supply, the U.D.S. refinery and private (rural) users. These needs were developed in the previous sections and are summarized in the following table.

**PROJECTED PLANNING AREA TOTAL WATER DEMAND**

| Year | City of Three Rivers | Choke Canyon Water Supply | Industrial* | Private | **Total** |
|---|---|---|---|---|---|
| 2000 | 0.604 MGD | 0.370 MGD | 1.50 MGD | 0.074 MGD | **2.548 MGD** |
| 2010 | 0.634 MGD | 0.374 MGD | 1.50 MGD | 0.075 MGD | **2.583 MGD** |
| 2020 | 0.667 MGD | 0.377 MGD | 1.50 MGD | 0.077 MGD | **2.621 MGD** |
| 2030 | 0.688 MGD | 0.379 MGD | 1.50 MGD | 0.079 MGD | **2.646 MGD** |
| 2040 | 0.708 MGD | 0.382 MGD | 1.50 MGD | 0.081 MGD | **2.671 MGD** |
| 2050 | 0.730 MGD | 0.384 MGD | 1.50 MGD | 0.082 MGD | **2.696 MGD** |

*Max. possible use under existing contract and assuming no expansion.

Note that the above figures include the maximum possible City water use by the UDS refinery and connection of all rural private residences in the planning area. It is unlikely that this will occur within the next ten years. The actual water demand projected to the year 2010 is provided as follows:

**PROJECTED ACTUAL 2010 WATER DEMAND**

| | |
|---|---|
| Municipal | 0.634 MGD |
| Choke Canyon W.S. | 0.374 MGD |
| Industrial | 1.000 MGD |
| Total Water Demand | 2.008 MGD |

## E. IDENTIFICATION OF GROUNDWATER RECHARGE AREA

The Ultramar Diamond Shamrock refinery disposes of treated effluent by land application on their permitted site located north of the City of Three Rivers (See Figure No. 13). The refinery began land application in 1985 and applies approximately 1.0 MGD on 617 acres. The land application site is located in the Catahoula tuff formation outcrop (See Figure No. 8).

The Catahoula tuff formation can contain groundwater near the outcrop in relatively restricted sand layers. The Catahoula tuff, though, is composed predominantly of tuffaceous clay, tuff (a fragmental rock consisting of smaller kinds of volcanic detritus) and thin beds of sand and conglomerate. Sand and gravel beds have been found many miles deep in the downdip of the formation. Coarse grained sand, large quantities of tuff and clay accompany the gravel. The tuff restricts the movement of water through many of the gravel and sand zones so that in the downdip these zones either do not yield water or yield only small quantities of highly mineralized water. The Catahoula tuff formation is known to be a poor aquifer in Live Oak County.

A study and report of the land application site was prepared by Underground Resource Management, Inc. in 1984. Two borings were drilled as a part of the study and found that a thick caliche deposit underlies the northern portion of the site. The thickness of the caliche varied from less than 15 feet to greater than 40 feet. No free water was encountered in the borings and the sediments removed

were dry to depths greater than 30 feet. Surface sediments encountered appeared to be slowly permeable and underlying sediments had low permeability.

Although the Underground Resource Management, Inc. borings did not indicate a water table during the study there are private water wells located along the southeastern boundary of the original site. Records indicate that a well was drilled in 1980 on the Bellows property and a depth to water of 25' was recorded. This well is located along the east boundary of the existing land application site (See Figure No. 13) and is now used as a monitoring well by the Live Oak Underground Water Control District. This well is into the Catahoula tuff formation and the records show a flowrate of 4 GPM was determined. The low flowrate is indicative of the low permeability of the Catahoula tuff. The U.D.S. refinery has also drilled monitoring wells around the site. The ground water level recorded for each well in June 1996 is provided in the following table.

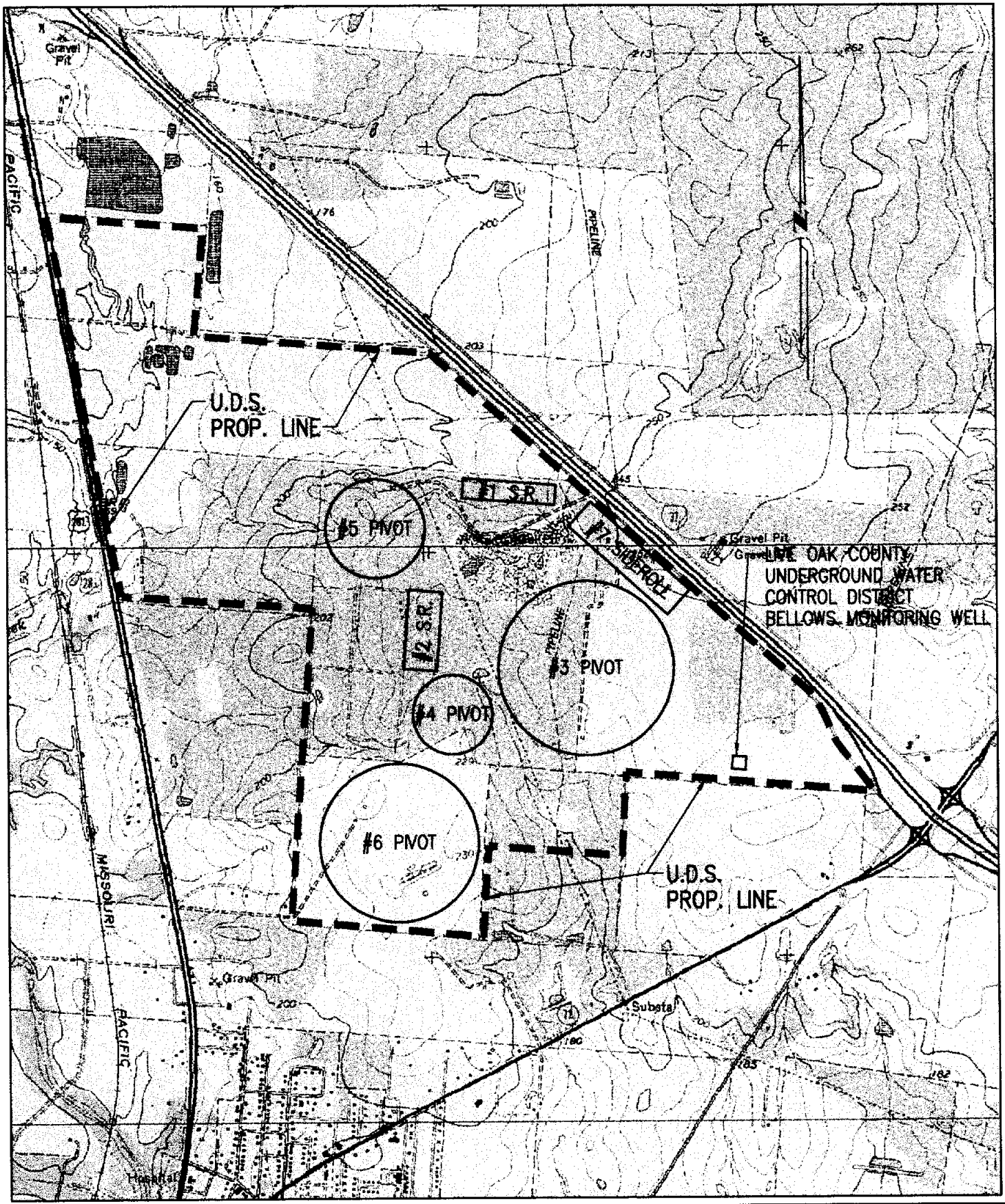
**GROUND WATER MEASUREMENTS – June, 1996**

ULTRAMAR DIAMOND SHAMROCK MONITORING WELLS

| Monitoring Well | Ground Elevation * | Water Depth** (Feet) | Ground Water Elevation* |
|---|---|---|---|
| MW-1 | 100.76 | 6.33 | 94.43 |
| MW-2 | 100.22 | 6.08 | 94.14 |
| MW-3 | 101.03 | 6.97 | 94.06 |
| MW-4 | 92.66 | 8.50 | 84.16 |
| MW-5 | 87.64 | 6.28 | 81.36 |
| MW-6 | 77.60 | 4.76 | 72.84 |
| MW-7 | 96.25 | 6.67 | 89.58 |
| MW-8 | 92.63 | 4.51 | 88.12 |
| MW-9 | 91.62 | 7.20 | 84.42 |

* Datum unknown. USGS Three Rivers Quadrangle shows elevations at or above El. 200.

** Measured June 17, 1996.




FROM: U.S.G.S. COMANCHE AND
THREE RIVERS QUADRANGLE MAPS

URBAN ENGINEERING
CORPUS CHRISTI, TEXAS

# U.D.S. REFINERY
# EFFLUENT DISPOSAL SITE

| | |
|---|---|
| SCALE: | 1"=2000' |
| DATE: | OCT. 1999 |
| JOB NO. | 36953.00.00 |

Figure No. 13

D:\DWGS\36953\0000\FIG-13.DWG

The measured water depth ranges from 4.5' to 8.5' below the ground elevation. It appears, although information on groundwater levels at the site is limited, that the water table around the land application site has risen due to the infiltration of effluent. There is no long term data available, though, to show whether the water table is rising, fluctuating or has equalized. What is known is discussed in the following:

1. The Live Oak Underground Water Control District has monitoring wells spread throughout the county. The District has begun a program of sampling these wells to monitor groundwater quality. Wells in the area of the land application site on the downdip side are shown on Figure No. 8 and testing data is provided in Table III-2. The Bellows Monitoring Well listed in the table is on the U.D.S. land application site (note that this is the original site of the Bellows well but that the well has since been relocated to the south after UDS obtained this property). The total dissolved solids results appear low for water typically found in the Catahoula tuff formation. This could be a result of the influence of the treated effluent percolating through the soil in this area.

2. There has been periodic seepage of groundwater from a caliche outcrop in a creek bed on the west side of the land application site. Water has been observed by U.D.S. refinery personnel seeping from the outcrop and soaking the bottom soil of the creek bed for a distance downstream of the outcrop until the moisture disappears into an area of sandy loam. There is also an area of sandy loam on the southeast corner of the site that has developed into a marsh or saturated condition. It is believed that a clay outcrop is trapping the groundwater and forcing it to the surface where it either evaporates or the additional hydraulic head increase the percolation rate. The slope of the ground surface in this area is approximately 4%.

# TABLE III-2
## LIVE OAK COUNTY MONITORING WELLS
## LIVE OAK COUNTY UNDERGROUND WATER CONTROL DISTRICT

| NAME | BELLOWS (1) | | BLEDSOE (2) | | | DUNN (3) | | | STAPLETON (4) | | | KOPPLIN (5) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Depth | 120' | | 147' | | | 482' | | | 116' | | | | | |
| Drill Date | 1/2/80 | | 5/22/73 | | | 9/3/87 | | | 7/6/84 | | | | | |
| Casing Diameter | 4" | | 4" | | | 4" | | | 4.5" | | | Unknown | | |
| Water Level | 25' | | 25' | | | 83' | | | 28' | | | | | |
| GPM | 4 | | 80 | | | 86 | | | 6 | | | | | |
| Formation | Catahoula | | Oakville | | | Oakville | | | Catahoula | | | Catahoula | | |
| Testing Date | 11/97 | 10/98 | 11/95 | 10/97 | 10/98 | 10/95 | 10/97 | 10/98 | 10/95 | 10/97 | 10/98 | 10/95 | 10/97 | 10/98 |
| Calcium (Ca) | 60 | 128.5 | 3 | 2 | 185 | 176 | 249 | 34.5 | 243 | 179 | 187 | 281 | 7 | 15 |
| Magnesium (Mg) | 11.5 | 78.5 | 328 | 261 | 192 | 93 | 86 | 142 | 85 | 152 | 78 | 320 | 296 | 416 |
| Sodium (Na) | 157 | 313 | 814.3 | 768.6 | 665 | 216.2 | 151.9 | 290 | 235 | 162.9 | 198 | 473.6 | 604.9 | 681 |
| Bicarbonate (HCO3) | 350 | 310 | 230 | 160 | 280 | 260 | 220 | 260 | 310 | 280 | 320 | 240 | 280 | 270 |
| Sulfate (SO4) | 50 | 147.5 | 1450 | 1450 | 575 | 75 | 68 | 72.5 | 65 | 75 | 65 | 525 | 575 | 725 |
| Chloride (Cl) | | 330 | 290 | 220 | 700 | 320 | 300 | 370 | 310 | 220 | 220 | 630 | 560 | 660 |
| Nitrogen (NO3-N) | 2.03 | 4 | 1 | 1.5 | 3.3 | 0.08 | 0.8 | 0.9 | 30.7 | 27.7 | 20 | 2.6 | 0.1 | 3.5 |
| pH | 7.3 | 7.09 | 6.96 | 6.97 | 6.93 | 7.36 | 7.34 | 6.93 | 7.16 | 7.34 | 6.91 | 6.76 | 6.78 | 6.66 |
| Iron | 1.28 | 0.3 | 0.04 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.03 | 0.03 | 0.05 | 0.41 | 0.03 |
| TDS | 750 | 820 | 1560 | 1560 | 1450 | 2600 | 810 | 790 | 960 | 830 | 650 | 1700 | 1450 | 1430 |
| TOT | 350 | 310 | 230 | 160 | 280 | 260 | 220 | 260 | 310 | 280 | 320 | 240 | 280 | 270 |
| TOTA | 71.5 | 207 | 331 | 263 | 377 | 269 | 335 | 176.5 | 328 | 331 | 265 | 601 | 303 | 431 |
| SA | | 9.47 | | 20.6 | 14.8 | | 3.61 | 9.52 | | 3.89 | 5.3 | | 15.1 | 14.2 |
| Specific Conductivity | 1160 | 1650 | 3110 | 3110 | 2890 | 1596 | 1620 | 1570 | 1920 | 1660 | 1300 | 3420 | 2900 | 2850 |

NOTES:
(1) Adjacent to and south of UDS irrigation site
(2) 5.6 miles southeast of UDS irrigation site
(3) 10.3 miles east-southeast of UDS irrigation site
(4) 4.8 miles east-NORTHEAST of UDS irrigation site
(5) 6.8 miles east of UDS irrigation site

All test results in mg/l except Specific Conductivity is umhos/cm

It does not appear that the land application of effluent by the U.D.S. refinery has an effect on aquifer recharge. The land application site is located in the Catahoula tuff, a formation of low permeability, little water yield and known to be a poor aquifer in Live Oak County. Any migration of groundwater (infiltrated effluent) is likely to be downward along the downdip of the formation (See Figure No. 9) and possibly horizontal. The downdip and land surface in this area slopes to the southeast and towards the Nueces River. If the ground water is migrating along the downdip it may be that a portion reaches the Nueces River. The Nueces River follows the outcrop base of the Oakville Sandstone in the area southeast of the City of Three Rivers (See Figure No. 8). The river is approximately 2.8 miles from the land application site and approximately 150' to 200' in elevation below the site. The Jasper Aquifer is also located in the Oakville Sandstone (See Figure No. 9) and below the Nueces River at this point. The Burkeville confining layer holds the Jasper Aquifer against the base of the Oakville Sandstone. The Oakville Sandstone outcrop is south of the U.D.S. effluent land application site, with the base of the outcrop located approximately 2.8 miles from the southern edge of the land application site. The rate of migration, if any, to the Nueces River would be expected to be very slow due to the low permeability of the Catahoula tuff formation. To determine if this is indeed occurring further study is merited. In Anders and Baker's April, 1961 groundwater study they pointed out, based on streamflow records of the Texas Board of Water Engineers, that the Nueces River does not pick up rejected recharge when flowing across the outcrops of the Jackson group, the Frio clay or the Catahoula tuff north of Three Rivers. Testing did indicate, though, that the river gained up to 2 cubic feet per second south of Three Rivers while crossing the outcrop of the Oakville Sandstone.

## F. POTENTIAL WATER SOURCES, PRESENT AND FUTURE

1. Groundwater:

The soil formations located in the planning area are known to yield a quality of ground water not suitable for drinking water, except for a small area at the south portion of the planning area. Wells in the northern portion of the county typically produce water that is slightly saline to very saline. Wells located in the Oakville sandstone and Goliad sand in the

very southeasterly portion of the planning area, such as the Kittie Wells located south of the City of Three Rivers, are tapped into the Jasper Aquifer of the Gulf Coast Aquifer System. The Kittie Wells are presently supplying 50% of the water requirements for the Ultramar Diamond Shamrock refinery.

There are wells located out of the planning area that are providing suitable quality groundwater. The El Oso Water Supply Corporation has wells in Karnes County that tap the downdip of the Carrizo-Wilcox Aquifer and they supply water for customers in the planning area west and north of the City of Three Rivers. The McCoy Water Supply Corporation has wells located in the Falls City area of Karnes County that tap the downdip of the Carrizo-Wilcox Aquifer and they supply water to approximately 60 customers in the planning area along Highways 281 and 99 and including Whitsett.

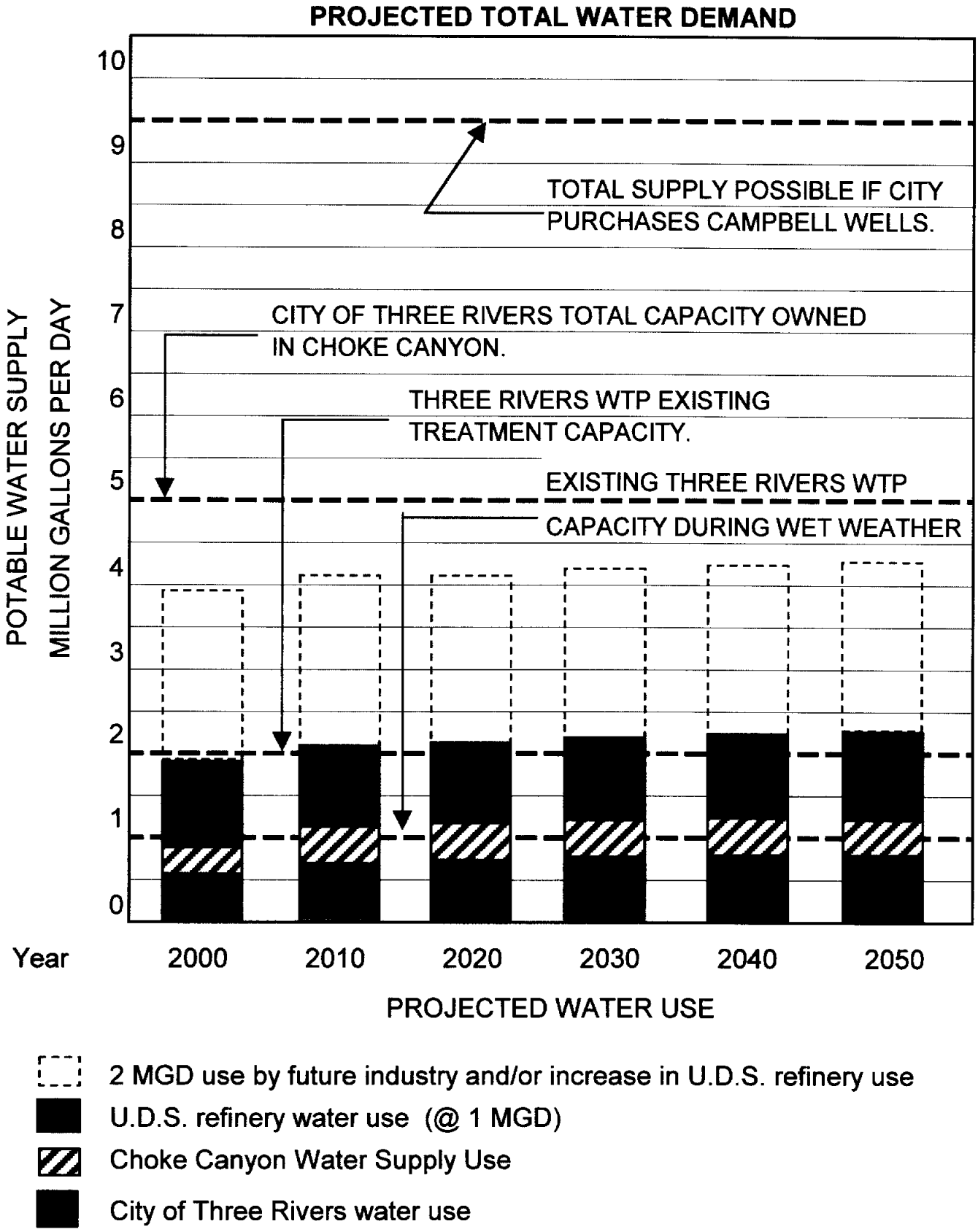
If water demand in the planning area was projected to exceed existing local groundwater or surface water supply available there are wells located north of the planning area that could be utilized. These wells, known as the Campbellton Wells, are owned by the City of Corpus Christi. The wells are located in Campbellton, Texas just north of the Atascosa and Live Oak County line. These wells are known to produce water with acceptable quality, although the water is extremely hot when pumped out the ground. Water quality test results are provided in Appendix No. 2. A cost estimate to construct facilities, including a pipeline from Campbellton to Three Rivers, is also included in Appendix No. 2. At present it does not appear that this water is necessary to supplement the existing groundwater and surface water available in the planning area.

2. Surface Water:

The only surface water located in the planning area is that impounded by the Choke Canyon Dam. The Choke Canyon Reservoir is part of the Choke Canyon- Lake Corpus Christi System and the City of Three Rivers owns 2% of the firm yield of the reservoir (determined to be 3 MGD). The City of Three Rivers has an option to be able to obtain up to a total of 5.0

MGD from the Choke Canyon Reservoir. This total available surface water capacity appears to be able to provide all potable water requirements in the planning area for the next fifty years. This is demonstrated on the chart on page III-25.

A plan presently being evaluated and which could have an affect on the operation of the Choke Canyon Reservoir is the construction of a two-way pipeline from Choke Canyon Reservoir to Lake Corpus Christi. The pipeline could reduce channel losses and evaporation losses when transferring water from Choke Canyon Reservoir to Lake Corpus Christi (presently transferred via the Frio River and Nueces River) and could be used to transfer excess water from Lake Corpus Christi to Choke Canyon Reservoir when Lake Corpus Christi is full. The project would increase the lake system annual yield but the cost is preliminarily estimated to be $126,000,000. It is not expected that the pipeline will be constructed in the near future but additional studies of the costs and benefits are being considered. The construction of the pipeline and improved yield of the Choke Canyon Reservoir could serve to ensure the water supply of the planning area beyond the year 2050.


PROJECTED TOTAL WATER DEMAND
POTABLE WATER SUPPLY
MILLION GALLONS PER DAY
10
9
8
7
6
5
4
3
2
1
0
TOTAL SUPPLY POSSIBLE IF CITY PURCHASES CAMPBELL WELLS.
CITY OF THREE RIVERS TOTAL CAPACITY OWNED IN CHOKE CANYON.
THREE RIVERS WTP EXISTING TREATMENT CAPACITY.
EXISTING THREE RIVERS WTP CAPACITY DURING WET WEATHER
Year
2000
2010
2020
2030
2040
2050
PROJECTED WATER USE
2 MGD use by future industry and/or increase in U.D.S. refinery use
U.D.S. refinery water use (@ 1 MGD)
Choke Canyon Water Supply Use
City of Three Rivers water use

## G. IDENTIFICATION AND EVALUATION OF ALTERNATIVES FOR PRESENT AND FUTURE WATER DEMANDS

There are two key issues identified in the previous sections that need to be addressed for present water demands. These issues are what water treatment improvements are needed to meet the present demands and how best to serve the Choke Canyon Water Supply system with potable water. These issues are discussed in the following:

1. Potable Water Treatment Facilities (Present Demand)

Adequate potable water supply up to 2.0 MGD capacity is necessary to provide service for the next ten years to the City of Three Rivers, the Three Rivers Water District and surrounding communities. The alternatives to meet this supply requirement are to utilize the existing Three Rivers Water Treatment Plant or to construct a new regional water treatment plant. There are advantages and disadvantages to both alternatives and these are discussed in the following paragraphs. Both alternatives were investigated to include the construction of piping and other facilities as necessary to connect the surface water treatment system to the Choke Canyon Water Supply distribution system. This cost is analyzed with the treatment plant alternatives since the cost is different for each alternative based on the location of the treatment plant and tie-in of piping.

### ALTERNATIVE NO. 1 – Utilize Existing Three Rivers WTP

The existing Three Rivers WTP is located on the west side on the City of Three Rivers and rated for 2 MGD capacity. With the construction of the proposed 16" dia. raw water transmission pipeline, the existing plant will be able to consistently provide up to 2 MGD of potable water. Funding for the 16" dia. raw water transmission pipeline is expected to be secured this summer. Design will begin immediately and construction should be completed by the spring of 2001. There are not any other improvements to the plant required in order to provide this capacity. Connection of the potable water system to the Choke

Canyon Water Supply distribution system will require construction of a new pipeline from the existing Three Rivers WTP to a new ground storage and service pump station to be located approximately halfway between the City of Three Rivers and the Federal Correctional Institution. The cost of the 16" dia. raw water transmission line is not included with the cost comparison since it is required for both alternatives and funding is nearly secured. The cost estimate for the Choke Canyon Water Supply tie-in is as follows: (See Appendix No. 6 for breakdown).

Alternative No. 1 – Existing Water Treatment
Plant & Choke Canyon Water Supply Tie-In $608,000

**ALTERNATIVE NO. 2 – New Regional WTP**

This alternative consists of construction of a new 2.0 MGD water treatment plant to be located in the area of the Choke Canyon Reservoir dam. This treatment plant would serve as a regional plant and provide potable water to the adjacent Choke Canyon Water Supply system and to the City of Three Rivers and Three Rivers Water District. The regional plant would also use the proposed 16" dia. pipeline to deliver water to the City of Three Rivers but it would be considered a treated water transmission line as opposed to a raw water pipeline as originally intended. The cost of the 16" dia. pipeline is not included in the analysis since it is common to both alternatives and funding is expected to be secured in the near future. Cost associated with this alternative include the new 2.0 MGD treatment plant, access to the plant, acquiring property, permitting and connection to the Choke Canyon Water Supply system. Connection to the Choke Canyon system is less for this alternative since the connecting pipeline is shorter and it appears in the preliminary calculations that a booster pump station and ground storage facilities will not be required. The cost estimate for this alternative is as follows: (See Appendix No. 6 for breakdown).

Alternative No. 2 – New Regional Water Treatment
Plant & Choke Canyon Water Supply Tie-In $5,307,500

**WATER TREATMENT PLANT ALTERNATIVES COST SUMMARY**

| | |
|---|---|
| Alt. No. 1 – Existing WTP & CCWS* Tie-In | $608,000 |
| Alt. No. 2 – New Regional WTP & CCWS Tie-In | $5,307,500 |

*CCWS = Choke Canyon Water Supply

2. Choke Canyon Water Supply Potable Water Service:

The existing Choke Canyon Water Supply is not able to provide adequate service or water quality to meet TRNCC standards. The options for this system are listed as follows:

**ALTERNATIVE NO. 1 - Construct 0.4 MGD Reverse Osmosis WTP**

Well water can be treated by the reverse osmosis process to improve the quality. Reverse osmosis is a typically a compact system that uses a semipermeable membrane to remove most of the undesirable constituents, such as sulfates, chlorides and total dissolved solids. Only a portion of the water supply is treated and then blended with untreated water to produce water that is within acceptable limits. Using this process results in a certain percentage of the water supply becoming unusable brine water that must be properly disposed of. The disadvantage of the reverse osmosis treatment process, though, is its high cost. A typical capital cost is $2 per gallon of capacity and operating cost can range from $3 to $6 per 1000 gallons treated. Due to cost factors, reduction in the capacity of the water supply due to the treatment process and brine disposal requirement, this alternative is not investigated any further.

**ALTERNATIVE NO. 2 - Construct Transmission Pipeline to Existing Water Treatment Plant**

It has been shown that there does exist capacity in the Three Rivers WTP to provide potable water to the Choke Canyon Water Supply system (dependent upon the construction of the proposed

16" dia. raw water line from the reservoir to the existing WTP). The existing Choke Canyon Water Supply distribution system can be connected by constructed a new pipeline from the existing Three Rivers WTP to a new ground storage and service pump station to be located approximately halfway between the City of Three Rivers and the Federal Correctional Institution. The intermediate ground storage/pump station facility is required due to the length of line required and the almost 100 feet of elevation difference between the Federal Correctional Institution and the existing Three Rivers WTP. This alternative will require construction of a transmission pump station, 8" dia. transmission pipeline, ground storage tank and service pump station. The cost estimate for this alternative is as follows: (See Appendix No. 6 for breakdown).

| | |
|---|---|
| Alternative No. 2 - Transmission Pipeline to Existing Water Treatment Plant | $608,000 |

It appears that the City of Three Rivers owns an adequate capacity in the Choke Canyon Reservoir to serve the future water supply needs of the planning area. As noted on the chart on the following page, water demand does not exceed water supply capabilities over the next fifty years. To meet these needs, though, it will be necessary for the City to make improvements to the existing raw water transmission facilities in the near future and expand the treatment capabilities in the future as the need arises. Funding for the proposed 16" dia. raw water transmission line is expected to be secured by this summer and construction completed by the spring of 2001. Expansion of the existing Three Rivers WTP to 3 MGD capacity should only require construction of a new clarifier. If growth were to far exceed projections, and future demand was to exceed the 5 MGD reservoir capacity owned by the City of Three Rivers, the City (or other entity) could purchase the Campbellton wells from the City of Corpus Christi and construct a water line to transfer this water to this area.

# IV. WASTEWATER

## A. EXISTING WASTEWATER SYSTEMS

1. Domestic:

The only domestic wastewater collection system and treatment plant within the planning area is that provided by the City of Three Rivers. The City has a gravity collection system and lift station which pumps collected wastewater to the Three Rivers Wastewater Treatment Plant (WWTP). The Three Rivers WWTP is permitted (TPDES Permit No. 10301-001) and monitored by the TNRCC. The treatment plant is located southwest of State Highway 72 and squeezed between the Ultramar Diamond Shamrock refinery and the Frio River (See Figure No. 11). The plant only treats domestic wastewater and does not receive any industrial wastewater. The treatment plant is an activated sludge process type operating in the contact stabilization aeration mode and rated for an average daily flow of 0.40 million gallons per day (MGD) with a peak flow capacity of 1.2 MGD. Treatment units include a bar screen, contact aeration basin, reaeration basin, final clarifier, chlorine contact chamber, aerobic digester and sludge drying beds. Sludge generated from the treatment process is stabilized in the aerobic digester and then dewatered in the sludge drying beds. Dried sludge is hauled from the site and disposed of at a TNRCC registered land application site. Treated effluent is chlorinated and discharged to the Frio River in the Nueces/Lower Frio River, Segment No. 2106 of the Nueces River Basin. The permitted effluent limitations are listed as follows:

**THREE RIVERS WWTP EFFLUENT LIMITATIONS**

| | |
|---|---|
| Average Daily Flow: | 0.40 MGD |
| 2-Hour Peak Flow: | 1.20 MGD |
| Biochemical Oxygen Demand (BOD5) | 20 mg/l |
| Total Suspended Solids (TSS) | 20 mg/l |
| Chlorine Residual (after 20 minutes) | 1 mg/l |
| pH | 6.0 to 9.0 |
| Minimum Dissolved Oxygen (D.O.) | 2.0 mg/l |

An average of daily flow processed by the Three Rivers WWTP from March, 1997 through May, 1999 amounts to 0.16 MGD. A summary of flow data and effluent test results for the last twelve months is provided in the following:

***SUMMARY OF EFFLUENT TESTING***
***THREE RIVERS WWTP***

| YEAR | MONTH | AVERAGE DAILY FLOW (MGD) | BOD5 (mg/l) | TSS (mg/l) | pH (Max.) |
|---|---|---|---|---|---|
| 1998 | October | 0.195 | 4.5 | 6.4 | 7.4 |
| | November | 0.211 | 7.0 | 6.5 | 7.7 |
| | December | 0.170 | 5.0 | 6.0 | 7.6 |
| 1999 | January | 0.150 | 5.0 | 5.5 | 7.8 |
| | February | 0.163 | 8.5 | 7.75 | 7.6 |
| | March | 0.133 | 11.5 | 13.75 | 7.6 |
| | April | 0.139 | 11.2 | 6.2 | 7.9 |
| | May | 0.158 | 7.0 | 8.25 | 7.9 |
| | June | 0.134 | 7.2 | 7.4 | 7.9 |
| | July | 0.154 | 11.0 | 8.25 | 7.9 |
| | August | 0.174 | 4.75 | 4.5 | 7.8 |
| | September | 0.147 | 8.4 | 6.2 | 7.5 |

Annual Average = 0.161 MGD

Segment No. 2106 is listed on the State's inventory of impaired and threatened waters and listed for elevated levels of bacteria throughout the segment. Chlorination of the effluent is utilized for disinfection purposes and to limit the build-up of bacteria in the effluent from the plant.

2. Federal Prison:

The Federal Correctional Institution-Three Rivers located in Live Oak County west of the City of Three Rivers has its own wastewater treatment facility. The facility is permitted (TPDES Permit No. 13461-01) and is monitored by the TNRCC. This facilities treats wastewater produced by the inmates and staff of the prison. Wastewater is treated utilizing the extended aeration form of the activated sludge process. The plant is rated for an average daily flow of 0.30 MGD and a peak flow capacity of 1.05 MGD. Treatment units include a bar screen,

aeration basins, clarifier, chlorine contact chamber and sludge drying beds. Treated effluent is chlorinated and then discharged to a holding pond until used for irrigation at two registered sites. The permitted effluent limitations for the prison's plant are listed as follows:

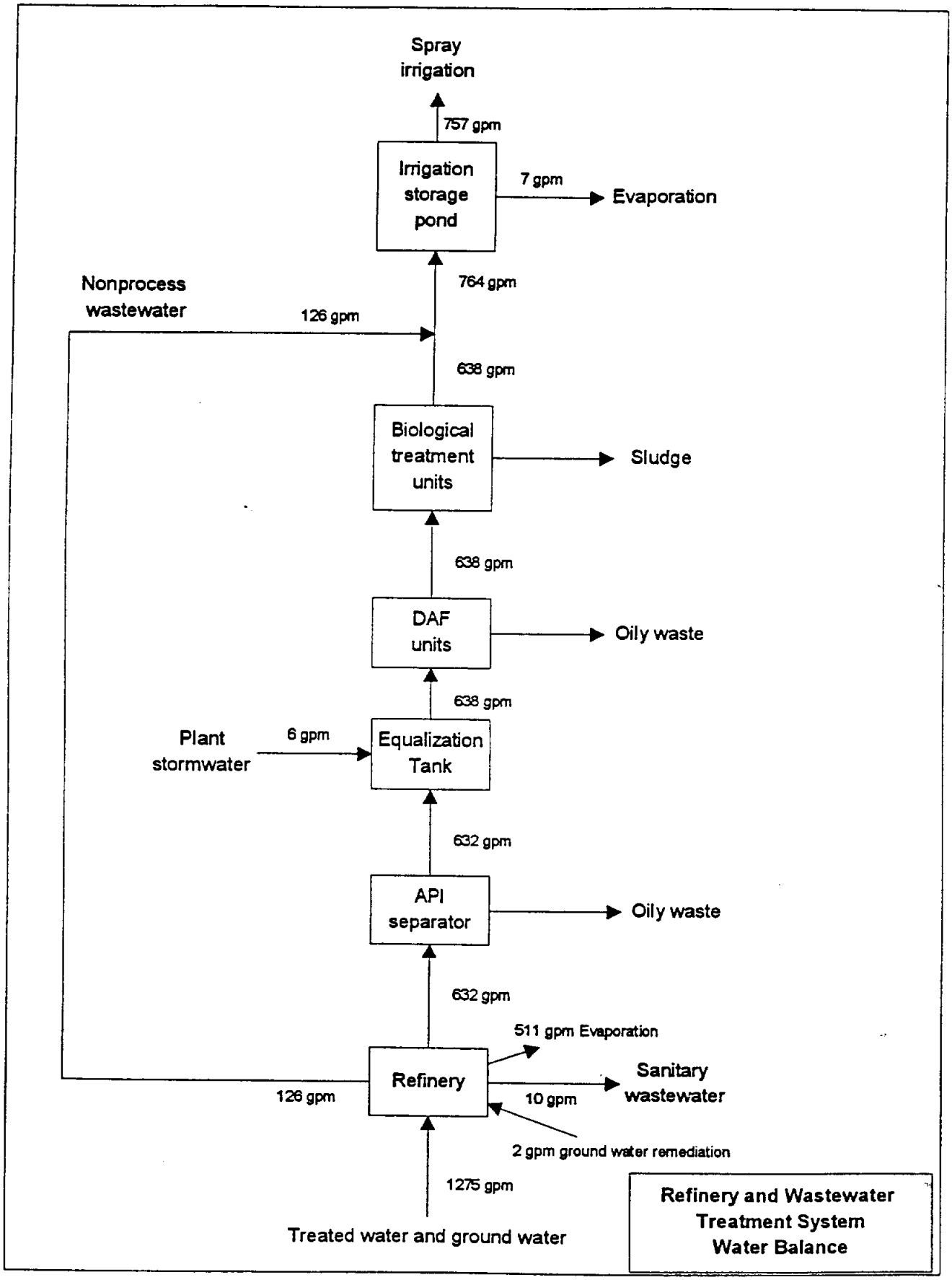
**PRISON WWTP EFFLUENT LIMITATIONS**

| | |
|---|---|
| Average Daily Flow: | 0.30 MGD |
| 2-Hour Peak Flow: | 1.05 MGD |
| Biochemical Oxygen Demand (BOD5) | 65 mg/l |
| Chlorine Residual (after 20 minutes) | 1 mg/l |
| pH | 6.0 to 9.0 |

3. Industrial:

The Ultramar Diamond Shamrock refinery, located in the City of Three Rivers, is the only industrial facility in the planning area. The refinery processes light sweet crude oil and utilizes water in the refining process. The refinery produces a waste stream from reverse osmosis treatment of the raw water used in the process, water from the oily water separator, blowdown from the cooling tower and condensate from steam sampling. Additional oily water is removed from this waste stream by a dissolved air flotation thickener. The oily water removed is returned to the refinery for processing. The water remaining enters the refinery's biological treatment unit for treatment and discharge. A schematic of the waste stream is provided on the following page. The biological treatment unit consists of aeration basins, clarifiers and digesters. Solids are separated from the water and then stabilized in the digester, dewatered and transported offsite to a TNRCC registered land application site.

Disposal of treated effluent from the refinery's biological treatment unit is permitted and monitored by the TNRCC (TPDES Permit No. 01353, a copy of the latest permit is provided in Appendix No. 4). The present permit, issued June 18, 1999, allows land application of the effluent by irrigation on the refinery's company-owned property or, in special circumstances, discharge of treated effluent through Outfall No. 001 to the Frio River in the Nueces/Lower Frio River, Segment No. 2106 of the Nueces River Basin. In the past treated effluent was only discharged to




Schematic Provided by U.D.S. Refinery

the Frio River. In 1984 the UDS refinery constructed and began land application of the treated effluent to the land disposal site located north of the City of Three Rivers (See Figure No. 13).

If all land application options are unavailable, the refinery may discharge treated effluent through Outfall No. 001 into the Frio River at a daily average flow rate not to exceed 0.8 MGD, at a maximum daily flow rate not to exceed 1.6 MGD and the discharge may not exceed a total of 20 million gallons in any calendar year. Other conditions for discharge to Outfall No. 001 include maximum parameters for effluent characteristics, such as BOD, COD, TSS, etc., and the Nueces River flow downstream must be greater than 200 cubic feet per second (CFS) during the discharge.

The normal mode of operation for disposal of treated effluent is by land application with irrigation. The treated effluent is pumped to the refinery's effluent irrigation system north of the City of Three Rivers. The irrigation system consists of a 224 acre-feet holding pond, tailwater collection ponds, irrigation points and monitoring wells, all located on 1,376 acres of land owned by UDS refinery. Irrigation is presently performed on the existing permitted 341.5 acre zones. A proposed permit amendment to be submitted in the near future will expand the irrigation zones to a total of 1020 acres. The property owned by the UDS refinery and the areas of irrigation are shown on Figure No. 13. The permit also requires that a crop of coastal bermuda and/or winter rye grasses be maintained and harvested in the irrigation site. These grasses have worked well to date utilizing the effluent of the irrigation system, with vigorous growth allowing cutting and harvesting of the site by a sub-contractor.

A portion of the existing permitted effluent limitations for irrigation are listed as follows (see page 14 of the permit in Appendix No. 4 for a complete listing of limitations):

## PERMITTED IRRIGATION EFFLUENT LIMITATIONS
## ULTRAMAR DIAMOND SHAMROCK REFINERY

| | |
|---|---|
| Land Application Rate | 2.95 acre-ft/acre/year |
| Biochemical Oxygen Demand (BOD5) | 50 mg/l |
| Chemical Oxygen Demand (COD) | 510 mg/l |
| Ammonia-Nitrogen | 100 mg/l |
| Nitrogen Application | 600 lb/acre/year* |
| pH | 6.0 to 9.0 |

*Report only, no daily maximum.

The UDS refinery is required to test the effluent and maintain records of the test results and flow rates. A summary of flow data and effluent test results for the last two years is provided on the following page.

**TABLE IV-1 SUMMARY OF EFFLUENT DATA**

**ULTRAMAR DIAMOND SHAMROCK REFINERY**

| Date Yr | Month | Average Daily Flow (GPD) | BOD5 (mg/l) | Ammonia Nitrogen (mg/l) |
|---|---|---|---|---|
| 1997 | July | 926,519 | 5.5 | 0.360 |
| | August | 1,380,058 | 9.0 | 0.874 |
| | September | 1,169,620 | 29.5 | 12.400 |
| | October | 686,921 | 33.8 | 5.700 |
| | November | 701,200 | 19.0 | 1.620 |
| | December | 804,196 | 30.4 | 7.100 |
| 1998 | January | 1,135,106 | 15.6 | 0.320 |
| | February | 838,046 | 11.4 | 3.380 |
| | March | 1,054,564 | 19.8 | 6.700 |
| | April | 1,270,471 | 14.0 | 3.700 |
| | May | 1,371,771 | 31.4 | 15.100 |
| | June | 1,341,903 | 30.4 | 10.400 |
| | July | 863,765 | 32.5 | 10.100 |
| | August | 996,805 | 25.3 | 12.800 |
| | September | 796,278 | 13.3 | 8.130 |
| | October | 993,062 | 9.7 | 0.318 |
| | November | 651,939 | 4.8 | 0.300 |
| | December | 870,885 | 5.6 | 0.230 |
| 1999 | January | 942,987 | 9.1 | 1.910 |
| | February | 1,299,339 | 9.1 | 0.870 |
| | March | 879,768 | 22.9 | 3.300 |
| | April | 886,016 | 190.5 | 28.300 |
| | May | 1,209,154 | 21.1 | 5.230 |
| | June | 1,361,503 | 25.9 | 2.100 |

The land application site has been the only method of effluent disposal for at least the last five years except during the months of December, 1998 and January, 1999. Due to a prolonged period of wet weather during these months all holding ponds were full and the site was saturated and exhibiting standing water. The permit does not allow irrigation within 24 hours following a measured rainfall of one-half inch or greater nor in any irrigation zone that contains standing water. During this period the UDS refinery followed the steps of the discharge permit and began discharge to the Frio River. The streamflow in the Nueces River, downstream of the Frio River met the flow rate requirement of greater than 200 cubic feet per second (CFS) as required by the permit and the effluent discharged was tested as required by the permit with no violations.

The existing discharge permit requires the UDS refinery to prepare a plan for investigation of the soil salinity and sodium absorption ratio for the effluent land application site. Sodium is toxic to some crops and can affect the soil's physical properties. A Soil Salinity Investigation Plan has been prepared for the refinery by James Miertschin and Associates, Inc. and was submitted to the TNRCC in September 1999. A copy of the plan is included in the appendices. The existing permit also requires monitoring of the soil on the site. As noted in the Soil Salinity Investigation Plan, the UDS refinery intends to perform monitoring which exceeds the permit requirements. Sampling to date includes quarterly soil analysis for exchangeable sodium percentage (E.S.P.). The exchangeable sodium percentage is the measure of the sodicity of the soil (E.S.P. was once the primary measure but the sodium adsorption ratio is now considered the standard). According to the Soil Survey Laboratory Information Manual, an E.S.P. greater than or equal to 15% classifies the soil as natric. The TNRCC permit requires a program of calcium amendments to reduce the E.S.P. to 10% or below should the tested value exceed 20%. A copy of the E.S.P. results since February, 1996 are provided in Table IV - 2 on the following page. The August 1999 E.S.P. test results indicated a rise in the sodicity of the soil, but none equal to or greater than 20%. This rise is possibly due to the lack of rainfall in the area. As shown in Table IV - 2, the E.S.P. values have

## *TABLE IV - 2 QUARTERLY SOIL ANALYSIS*

## *ULTRAMAR DIAMOND SHAMROCK IRRIGATION SITE*

| | EXCHANGEABLE SODIUM PERCENTAGE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SAMPLE LOCATION** | #1 Sideroll | #2 Sideroll | #7 Sideroll | #1 Pivot | #2 Pivot | #3 Pivot | #4 Pivot | #5 Pivot | #6 Pivot | #7 Pivot | #1 Monitor |
| **DATE** | | | | | | | | | | | |
| Aug., 1999 | 8.89% | 12.95% | 9.12% | | | 10.02% | 15.87% | 16.76% | 12.49% | | 5.32% |
| May, 1999 | 1.48% | 10.55% | | | | 10.55% | 3.73% | 5.99% | 2.21% | | 1.27% |
| Feb., 1999 | 7.44% | 3.55% | | | | 12.16% | 12.59% | 7.66% | 9.55% | | 1.27% |
| Dec., 1998 | | | | 0.55% | 0.02% | 0.02% | 0.02% | 0.32% | 0.25% | 0.02% | |
| Sept., 1998 | | | | 3.34% | 4.42% | 7.72% | 6.69% | 6.12% | 14.76% | 5.67% | |
| May, 1998 | 6.90% | 7.00% | | | | 10.80% | 9.30% | 8.20% | 1.80% | | |
| March, 1998 | | | | 1.20% | 4.10% | 7.90% | 7.20% | 8.10% | 16.00% | | |
| Dec., 1997 | 3.40% | 3.90% | | | | 1.10% | 7.40% | 6.80% | 4.20% | | |
| Feb., 1997 | | | | 0.74% | 5.81% | 8.71% | 13.84% | 8.88% | 13.32% | | |
| Nov., 1996 | | | | 4.17% | 4.00% | 8.05% | 6.12% | 3.99% | 4.28% | | |
| August, 1996 | | | | 2.04% | 7.82% | 11.36% | 17.23% | 7.54% | 4.22% | | |
| Feb., 1996 | | | | 1.52% | 3.85% | 7.28% | 9.37% | 13.62% | 6.79% | | |

fluctuated over the years from test to test. This could be a result of variations in the makeup of the irrigation water and the leaching of the sodium as a result of flushing from the irrigation water and/or rainfall.

Sanitary sewage produced onsite by the refinery operating personnel is collected separately from the industrial waste. The majority of this wastewater is discharged into the Three Rivers wastewater collection system for transport to and treatment at the Three Rivers WWTP. There is one building located on the refinery site that is remote from the gravity collection system and outside of the City limits. This building is served by a septic tank and drain field.

4. Private:

People living outside of the reach of the Three Rivers collection system (the only wastewater collection system in the planning area) or people not in prison (the prison has its own treatment plant) utilize onsite septic tank systems for treatment of wastewater. In general, septic tanks have been successful for the treatment of individual residents located in the county.

## B. PRESENT WASTEWATER NEEDS

1. Domestic:

The Three Rivers WWTP is presently operating at 40% capacity (0.16 MGD Existing Average Flow/0.40 MGD Plant Capacity), based on the last twelve months of operation. The plant has plenty of reserve capacity at present and no plans are proposed for expansion. The plant is generally in poor condition though, due to age and the environment. A large portion of the steel construction is showing various stages of corrosion and there have been numerous failures of equipment. Through careful operation and monitoring by plant personnel, the plant has been able to meet the permitted effluent limitations. Some renovation, though, must be done in the near future to extend the life of the plant.

2. Industrial:

The Ultramar Diamond Shamrock refinery is presently meeting permitted effluent requirements. The refinery is in the process of amending the existing permit to increase the land application acreage to 1020 acres. At the existing permitted application rate of 2.95 acre-feet/acre/year a total of 2.69 MGD could be irrigated on the proposed total acreage. This is more than adequate to handle existing and proposed effluent flow rates. At present the refinery has no plans for expansion of the existing facilities.

During the permit renewal process the NRA filed an opposition with the TNRCC. Subsequent negotiations between the UDS and the NRA led to an agreement for additional monitoring and clarification of language in the permit. This resulted in NRA withdrawing the opposition.

The refinery has had minor problems with migration of effluent off of the land application site onto adjacent private property. The migration has occurred due to two different types of problems. In one instance one of the irrigation pivots malfunctioned and stuck in one location. This caused saturation of the area until water collected and began running off onto the adjacent property along the natural grade until it was collected in a pond on the private property. As soon as the problem was discovered refinery personnel fixed the stuck pivot and removed the water from the offsite pond. Water samples were collected from the pivot and the offsite pond and a copy of the test results are included in Appendix No. 1.

Periodic seepage of groundwater from the land application site has also occurred. Water has been observed by U.D.S. refinery personnel seeping from the caliche outcrop in a creek bed on the west side of the land application site and soaking the bottom soil of the creek bed for a distance downstream of the outcrop until the moisture disappears into an area of sandy loam. There is also an area of sandy loam on the southeast corner of the site that has developed into a marsh or saturated condition. It is believed that a clay outcrop is trapping the groundwater and forcing it to the surface where it either evaporates or

the additional hydraulic head increase the percolation rate. The UDS refinery now owns the property with the marshy area on the south side of the site.

3. Private Systems:

State criteria, regulated by the TNRCC, require that individual on-site sewage disposal systems, such as septic tanks, be constructed in accordance with Chapter 285 of the Texas Administrative Code. For residential lots, Chapter 285 requires a minimum 0.5 acre lot for subdivisions served by a public water supply or 1.0 acre for subdivisions served by individual water systems (such as wells). In lieu of the minimum acreage specified, a registered professional engineer or registered sanitarian may submit a site-specific sewage disposal plan. As long as these criteria are met there should not be problems associated with onsite systems.

## C. PROJECTED WASTEWATER NEEDS

1. Municipal:

The City of Three Rivers is the only entity in the planning area with a wastewater collection and treatment system. As shown in Section II, the population of the City of Three Rivers is projected to grow 0.4% to 0.5% over the next 20 years from year 2000 to year 2020 and is projected to grow by about 0.25% to 0.3% from year 2020 to year 2050. The projected wastewater average daily flowrate, based on existing flow and projected population growth, is presented in the following table.

**PROJECTED WASTEWATER FLOW**
**CITY OF THREE RIVERS**

| Year | Projected Average Daily Flowrate |
|---|---|
| 2000 | 0.160 MGD |
| 2010 | 0.168 MGD |
| 2020 | 0.175 MGD |
| 2030 | 0.180 MGD |
| 2040 | 0.185 MGD |
| 2050 | 0.189 MGD |

As shown for the projected flowrates, the existing 0.40 MGD plant has the capacity to provide treatment through the year 2050. Due to the condition of the existing plant, though, it is expected that major renovations will be required in the next five years. In addition, there have been discussions concerning moving the plant away from its present location adjacent to the Ultramar Diamond Shamrock refinery. The treatment plant personnel have to enter the refinery site to gain access to the treatment plant. It would be advantageous to the City to relocate the plant away from the present site for safety considerations and for unlimited plant access.

2. Federal Prison:

The Federal Correctional Institution-Three Rivers is not expected to expand its present capacity. The prison has an existing treatment facility and this facility has recently undergone renovation with construction of a new holding pond. The existing facility appears adequate to handle existing and future needs of the prison.

3. Industrial:

The Ultramar Diamond Shamrock refinery presently has the facilities to treat and dispose of industrial wastewater. The refinery recently purchased additional property around the existing land application site and expanded its irrigation operation. At the existing permitted application rate of 2.95 acre-feet/acre/year a total of 2.69 MGD could be irrigated on the proposed total acreage. This is more than adequate to handle existing and proposed effluent flow rates. At present the refinery has no plans for expansion of the existing facilities.

## D. IDENTIFICATION AND EVALUATION OF ALTERNATIVES FOR PRESENT AND FUTURE WASTEWATER NEEDS

1. Municipal:

The existing Three Rivers WWTP is presently utilizing approximately 40% of its capacity and is meeting effluent limitations but it is in poor condition and located in an area only accessible through a major petrochemical refinery. A "No Action" alternative is not considered for this plant since there must be some work performed in order to ensure that it can safely and efficiently maintain its treatment capabilities. Alternatives considered to meet existing and future wastewater needs of the City of Three Rivers are listed as follows:

- Alternative No. 1 - Construct New Activated Sludge Plant In New Location And Demolish Existing Plant
- Alternative No. 2 - Construct New Lagoon/Wetlands Type Plant In New Location And Demolish Existing Plant
- Alternative No. 3 - Renovate Existing Three Rivers WWTP

These alternatives are discussed as follows.

### ALTERNATIVE NO. 1 - New Conventional Three Rivers WWTP At New Location

This alternative provides for the demolition of the existing treatment plant and construction of a new activated sludge plant at a new location. It is proposed that the new plant be located on the west side of the City to put it closer to the existing lift station. The work for this alternative involves modifications to the existing lift station due to changes in the pumping conditions, construction of a new force main to the new plant, construction of the new treatment plant and demolition of the existing plant. The complete mix mode of the activated sludge process is proposed for the new plant and new components would include a bar screen, aeration basins, clarifiers, chlorine contact chamber, aerobic digester and sludge drying beds. The cost estimate for a new conventional WWTP is as follows: (See Appendix No. 6 for breakdown)

Alternative No. 1 - New Conventional
Three Rivers WWTP At New Location: $1,380,000

**ALTERNATIVE NO. 2 - New Lagoon/Wetlands Three Rivers WWTP At New Location**

This alternative is similar to Alternative No. 1 except that a lagoon and wetlands type treatment process is proposed instead of a conventional activated sludge type process. The treatment process would also be located on the west side of the City and include a facultative lagoon, stabilization pond (aerated) and submerged flow constructed wetland. This alternative also includes modifications to the existing lift station, construction of a new force main to the new plant and provides for the demolition of the existing treatment plant. The cost estimate for this alternative is as follows: (See Appendix No. 6 for breakdown)

Alternative No. 2 - New Lagoon/Wetlands
Three Rivers WWTP At New Location: $1,494,000

**Alternative No. 3 - Renovate Existing Three Rivers WWTP**

The existing treatment plant is in poor condition. Proposed renovation would include replacement and/or repair of the existing access bridge, bar screen, aeration equipment, clarifier baffles and weirs, chlorination facility housing, chlorination equipment, flow measuring equipment and electrical. New construction would include additional sludge dewatering beds. The cost estimate for the proposed renovation is as follows: (See Appendix No. 6 for breakdown)

Alternative No. 3 - Renovate Existing
Three Rivers WWTP: $506,000

**THREE RIVERS WWTP ATERNATIVES COST SUMMARY**

| | |
|---|---|
| Alternative No. 1 - New Conventional Three Rivers WWTP At New Location: | $1,380,000 |
| Alternative No. 2 - New Lagoon/Wetlands Three Rivers WWTP At New Location: | $1,494,000 |
| Alternative No. 3 - Renovate Existing Three Rivers WWTP: | $506,000 |

2. Industrial:

The Ultramar Diamond Shamrock refinery presently has a wastewater treatment and disposal system. This system was constructed in 1984 and recent improvements have been made to the system. Although the existing system is functioning as required, possible alternatives for meeting the existing and future wastewater needs of the UDS refinery were investigated and they are listed as follows:

- Alternative No. 1 – No Action
- Alternative No. 2 – Groundwater Recharge
- Alternative No. 3 – Effluent Reuse

These alternatives are discussed in the following:

a. Alternative No. 1 – No Action:

The existing Ultramar Diamond Shamrock refinery wastewater treatment and disposal system appears to be functioning properly and adequate for existing and future needs. In 1998 the refinery purchased an additional 759 acres located around the original effluent land application site to expand their irrigation capabilities and to buffer the site from adjacent landowners. The refinery has been meeting effluent limitation requirements of the TNRCC and there are no plans to expand the refinery operations anytime soon. This "no action" alternative is the least costly for the refinery at present. They have already had large expenditures to provide the existing system being used.

b. Alternative No. 2 – Groundwater Recharge:

It appears that some localized groundwater recharge is occurring by the land application of the UDS refinery's treated effluent but this appears limited due to the type of soil formation in which the land application site is located. The land application site is located the Catahoula tuff outcrop. Even recharge by injection in this area doesn't appear realistic since the Catahoula tuff is known to be a poor aquifer due to the soils makeup. This formation generally yields small amounts of slightly saline to very saline water.

c. Alternative No. 2 – Effluent Reuse:

At this time there are not any industries or other customers known in the area that could use the treated effluent in the quality that it is presently treated to. For the refinery to reuse the treated effluent for process water would require construction of additional treatment facilities to remove impurities to obtain the required quality. This would be expensive to do and would result in a much more concentrated brine solution which would be difficult to dispose of. Disposal would likely have to be by deep well injection. Another reuse possibility briefly investigated in the past by the refinery was the pumping of the treated effluent for discharge below the saltwater dam on the Nueces River (located just west of the City of Corpus Christi). The purpose would be to obtain a credit with the TNRCC to apply to the freshwater releases from the Choke Canyon/Lake Corpus Christi reservoir system. A cursory review led to the determination that this would only work if an existing unused pipeline could be found, but would still be an expensive proposition due to pumping cost, any modifications required of the existing pipeline and construction of pumping facilities and new pipeline route for discharge below the dam.

A summary of alternatives discussed above and others considered but not discussed in detail are provided in Table IV-3 on the following page.

Each of these alternatives were eliminated due to capital and operational cost involved to implement them. The "No Action" alternative is the least costly to the refinery since the effluent land application system is already in place.

## TABLE IV-3 UDS REFINERY EFFLUENT ALTERNATIVES SUMMARY

| ALTERNATIVE | | DESCRIPTION | REASONS FOR ELIMINATION |
|---|---|---|---|
| 1 | No Action | Utilize existing land application site | |
| 2 | Groundwater Recharge | Pump effluent into ground for recharge | Existing soils |
| 3 | Effluent Reuse | Additional treatment for UDS process water | High capital/operational cost and brine byproduct |
| 4 | Effluent Reuse | Pump effluent to Corpus Christi | High capital and operational cost |
| 5 | Discharge To Frio River | Provide tertiery treatment to allow discharge | High capital and operational cost |
| 6 | Dewater Crude In Corpus Christi | Provide facilities to dewater crude oil in Corpus Christi and discharge to bay | Facilities already exist in Three Rivers |
| 7 | Utilize Wetlands Treatment Process | Use wetlands to provide additional treatment for effluent | Land application still required. Wetlands would not result in an effluent likely to receive approval by all agencies for disch. to Frio River. |

# V. CONCLUSIONS AND RECOMMENDATIONS

The previous sections discuss existing and future water and wastewater needs in the planning area. Deficiencies of the water supply for the area were identified and alternatives to eliminate these deficiencies, improve system reliability and provide additional capacity needed to meet projected water demands for the future were evaluated. The proposed improvements are designed to keep pace with growth, assure high-quality water service for the entire planning area and provide a reliable system for any future commercial and industrial development.

An evaluation was also made to determine whether the Ultramar Diamond Shamrock refinery effluent land application site was over the Oakville Sands recharge zone. It was determined that the land application site is over the Catahoula Tuff outcrop and that the lower edge of the Oakville Sandstone outcrop is approximately 3.4 miles to the south of the site.

This area of Live Oak County is unique due to the many resources found including tourism from Choke Canyon Reservoir, the federal prison, the farming and ranching community and a major refinery. Centrally located in the planning area is the Three Rivers Water District and City of Three Rivers. Both of these entities are in the position to manage the present and future water demands of this area. Wastewater is likely to continue to be managed in sub-areas.

Based on the evaluations in the preceding sections the following recommendations are made. Probable capital costs for budgeting purposes are provided for all recommended improvements. Detailed cost estimates are included in Appendix No. 6. Costs are based on year 2000 prices and the effect of inflation should be considered when planning budget costs for these recommended improvements.

## A. WATER

1. Immediate:

   a. Construct new raw water transmission pipeline from Choke Canyon Dam to Three Rivers Water Treatment Plant. Funding from the USDA is in the process of being secured and

construction of the line is expected to be completed by the spring of 2001. Estimated Project Cost $1,780,000

b. Begin negotiations to take over the Choke Canyon Water Supply and secure funding to construct a water transmission line to the existing distribution system. Possible funding sources could be revenue bonds, USDA grant/loan or TDCP grant.
Estimated Project Cost $608,000

2. Year 2010:

Construct improvements to expand the existing Three Rivers Water Plant to 3 MGD capacity.

## B. WASTEWATER

1. Immediate:

Construct improvements to the existing Three Rivers WWTP. Possible funding sources could be revenue bonds, USDA grant/loan or TDCP grant. Estimated Project Cost $506,000

2. Monitoring:

It is recommended that the monitoring of the UDS effluent land application site be continued as required by the TNRCC to prevent the irrigation activities from adversely affecting the local resources and environment.

# SELECTED REFERENCES


Anders, R. B and Baker, E. T., Jr., 1961, Ground Water Geology of Live Oak County, Texas, Texas Board of Water Engineers Bulletin 6105.

Baker, E. T., Jr., 1979, Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas, Texas Department of Water Resources Report 236.

Texas Water Development Board, 1997, Water For Texas, A Consensus-Based Update to the State Water Plan, Volume II Document No. GP-6-2.

Bureau of Reclamation Dept. of the Interior, 1975, Final Environmental Impact Statement, Nueces River Project, Choke Canyon Dam & Reservoir Site, INT FES 75-102.

United States Department of Agriculture, 1993, Soil Survey Manual, Handbook No. 18.

United States Department of Agriculture, 1995, Soil Survey Laboratory Information Manual, Soil Survey Investigation Report No. 45.

# APPENDIX NO. 1

# ULTRAMAR DIAMOND SHAMROCK REFINERY EFFLUENT TEST RESULTS

1. Brown Pond Sample – October 15, 1998

2. #6 Pivot – October 15, 1998

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

**Southern Petroleum Laboratories, Inc.**

**Certificate of Analysis Number: 98-10-661**

Approved for Release by:

Bernadette A. Fini, Senior Project Manager — 10-26-98 Date

Greg Grandits
Laboratory Director

Cynthia Schreiner
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810661-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

DATE: 10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** Brown Pond

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 15:40:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | DETECTION LIMIT | UNITS |
|---|---|---|---|
| Liquid-liquid extraction SEMIVOLATILES<br>Method 3520C ***<br>Analyzed by: KL<br>Date: 10/19/98 11:00:00 | 10/19/98 | | |
| Sulfide<br>Modified 376.2 *<br>Analyzed by: GJ<br>Date: 10/19/98 12:00:00 | ND | 0.05 | mg/L |
| Chemical Oxygen Demand<br>Method 410.1 *<br>Analyzed by: DS<br>Date: 10/16/98 16:30:00 | 300 | 60 | mg/L |
| Ammonia (as Nitrogen)<br>Method 350.2 *<br>Analyzed by: AB<br>Date: 10/19/98 09:00:00 | ND | 1 | mg/L |
| Chromium, Total<br>Method 6010B ***<br>Analyzed by: JM<br>Date: 10/23/98 10:02:00 | ND | 0.01 | mg/L |
| Acid Digestion-Aqueous, ICP<br>Method 3010A ***<br>Analyzed by: EE<br>Date: 10/19/98 10:30:00 | 10/19/98 | | |

ND - Not detected.

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
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HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810661-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

DATE: 10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** Brown Pond

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 15:40:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | DETECTION LIMIT | UNITS |
|---|---|---|---|
| Biochemical Oxygen Demand<br>Method 405.1 *<br>Analyzed by: TV<br>Date: 10/16/98 11:30:00 | 6 | 1 | mg/L |
| Chromium, Hexavalent<br>Method 3500-Cr D **<br>Analyzed by: PT<br>Date: 10/16/98 18:00:00 | ND | 0.01 | mg/L |
| Oil and Grease, Total Recoverable<br>Method 413.1 *<br>Analyzed by: DR<br>Date: 10/20/98 10:00:00 | ND | 5 | mg/L |
| Volume<br>Analyzed by: DR<br>Date: 10/20/98 10:00:00 | 950 | | mL |

ND - Not detected.

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810661-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** Brown Pond

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 15:40:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Benzene | ND | 5 | ug/L |
| Bromobenzene | ND | 5 | ug/L |
| Bromochloromethane | ND | 5 | ug/L |
| Bromodichloromethane | ND | 5 | ug/L |
| Bromoform | ND | 5 | ug/L |
| Bromomethane | ND | 10 | ug/L |
| n-Butylbenzene | ND | 5 | ug/L |
| sec-Butylbenzene | ND | 5 | ug/L |
| tert-Butylbenzene | ND | 5 | ug/L |
| Carbon tetrachloride | ND | 5 | ug/L |
| Chlorobenzene | ND | 5 | ug/L |
| Chlorodibromomethane | ND | 5 | ug/L |
| Chloroethane | ND | 10 | ug/L |
| Chloroform | ND | 5 | ug/L |
| Chloromethane | ND | 10 | ug/L |
| 2-Chlorotoluene | ND | 5 | ug/L |
| 4-Chlorotoluene | ND | 5 | ug/L |
| 1,2-Dibromo-3-chloropropane | ND | 5 | ug/L |
| 1,2-Dibromoethane | ND | 5 | ug/L |
| Dibromomethane | ND | 5 | ug/L |
| 1,2-Dichlorobenzene | ND | 5 | ug/L |
| 1,3-Dichlorobenzene | ND | 5 | ug/L |
| 1,4-Dichlorobenzene | ND | 5 | ug/L |
| Dichlorodifluoromethane | ND | 10 | ug/L |
| 1,1-Dichloroethane | ND | 5 | ug/L |
| 1,2-Dichloroethane | ND | 5 | ug/L |
| 1,1-Dichloroethene | ND | 5 | ug/L |
| cis-1,2-Dichloroethene | ND | 5 | ug/L |
| trans-1,2-Dichloroethene | ND | 5 | ug/L |
| 1,2-Dichloropropane | ND | 5 | ug/L |
| 1,3-Dichloropropane | ND | 5 | ug/L |
| 2,2-Dichloropropane | ND | 5 | ug/L |
| 1,1-Dichloropropene | ND | 5 | ug/L |
| Ethylbenzene | ND | 5 | ug/L |
| Hexachlorobutadiene | ND | 5 | ug/L |
| Isopropylbenzene | ND | 5 | ug/L |
| p-Isopropyltoluene | ND | 5 | ug/L |
| Methylene chloride | ND | 5 | ug/L |

METHOD: 8260 Water, Volatile Organics

(continued on next page)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810661-01

Diamond Shamrock

**SAMPLE ID:** Brown Pond

**ANALYTICAL DATA** (continued)

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Naphthalene | 70 | 5 | ug/L |
| n-Propylbenzene | ND | 5 | ug/L |
| Styrene | ND | 5 | ug/L |
| 1,1,1,2-Tetrachloroethane | ND | 5 | ug/L |
| 1,1,2,2-Tetrachloroethane | ND | 5 | ug/L |
| Tetrachloroethene | ND | 5 | ug/L |
| Toluene | ND | 5 | ug/L |
| 1,2,3-Trichlorobenzene | ND | 5 | ug/L |
| 1,2,4-Trichlorobenzene | ND | 5 | ug/L |
| 1,1,1-Trichloroethane | ND | 5 | ug/L |
| 1,1,2-Trichloroethane | ND | 5 | ug/L |
| Trichloroethene | ND | 5 | ug/L |
| Trichlorofluoromethane | ND | 5 | ug/L |
| 1,2,3-Trichloropropane | ND | 5 | ug/L |
| 1,2,4-Trimethylbenzene | ND | 5 | ug/L |
| Vinyl chloride | ND | 10 | ug/L |
| Xylenes (total) | ND | 5 | ug/L |
| Methyl t-butyl ether | ND | 10 | ug/L |
| 1,3,5-Trimethylbenzene | ND | 5 | ug/L |
| 1,2-Dichloroethene (total) | ND | 5 | ug/L |
| cis-1,3-Dichloropropene | ND | 5 | ug/L |
| trans-1,3-Dichloropropene | ND | 5 | ug/L |
| Acetone | ND | 100 | ug/L |
| Vinyl Acetate | ND | 10 | ug/L |
| Carbon Disulfide | ND | 5 | ug/L |
| 2-Butanone | ND | 20 | ug/L |
| 4-Methyl-2-Pentanone | ND | 10 | ug/L |
| 2-Hexanone | ND | 10 | ug/L |
| 2-Chloroethylvinylether | ND | 10 | ug/L |

| SURROGATES | AMOUNT SPIKED | % RECOVERY | LOWER LIMIT | UPPER LIMIT |
|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 50 ug/L | 98 | 80 | 120 |
| Toluene-d8 | 50 ug/L | 100 | 88 | 110 |
| 4-Bromofluorobenzene | 50 ug/L | 94 | 86 | 115 |

ANALYZED BY: GT DATE/TIME: 10/21/98 15:52:00
METHOD: 8260 Water, Volatile Organics
NOTES: * - Practical Quantitation Limit ND - Not Detected
NA - Not Analyzed

**COMMENTS:**

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810661-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** Brown Pond

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 15:40:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Acenaphthene | ND | 5 | ug/L |
| Acenaphthylene | ND | 5 | ug/L |
| Aniline | ND | 5 | ug/L |
| Anthracene | ND | 5 | ug/L |
| Benzo(a)Anthracene | ND | 5 | ug/L |
| Benzo(b)Fluoranthene | ND | 5 | ug/L |
| Benzo(k)Fluoranthene | ND | 5 | ug/L |
| Benzo(a)Pyrene | ND | 5 | ug/L |
| Benzoic Acid | ND | 25 | ug/L |
| Benzo(g,h,i)Perylene | ND | 5 | ug/L |
| Benzyl alcohol | ND | 5 | ug/L |
| 4-Bromophenylphenyl ether | ND | 5 | ug/L |
| Butylbenzylphthalate | ND | 5 | ug/L |
| di-n-Butyl phthalate | ND | 5 | ug/L |
| Carbazole | ND | 5 | ug/L |
| 4-Chloroaniline | ND | 5 | ug/L |
| bis(2-Chloroethoxy)Methane | ND | 5 | ug/L |
| bis(2-Chloroethyl)Ether | ND | 5 | ug/L |
| bis(2-Chloroisopropyl)Ether | ND | 5 | ug/L |
| 4-Chloro-3-Methylphenol | ND | 5 | ug/L |
| 2-Chloronaphthalene | ND | 5 | ug/L |
| 2-Chlorophenol | ND | 5 | ug/L |
| 4-Chlorophenylphenyl ether | ND | 5 | ug/L |
| Chrysene | ND | 5 | ug/L |
| Dibenz(a,h)Anthracene | ND | 5 | ug/L |
| Dibenzofuran | ND | 5 | ug/L |
| 1,2-Dichlorobenzene | ND | 5 | ug/L |
| 1,3-Dichlorobenzene | ND | 5 | ug/L |
| 1,4-Dichlorobenzene | ND | 5 | ug/L |
| 3,3'-Dichlorobenzidine | ND | 10 | ug/L |
| 2,4-Dichlorophenol | ND | 5 | ug/L |
| Diethylphthalate | ND | 5 | ug/L |
| 2,4-Dimethylphenol | ND | 5 | ug/L |
| Dimethyl Phthalate | ND | 5 | ug/L |
| 4,6-Dinitro-2-Methylphenol | ND | 25 | ug/L |
| 2,4-Dinitrophenol | ND | 25 | ug/L |
| 2,4-Dinitrotoluene | ND | 5 | ug/L |
| 2,6-Dinitrotoluene | ND | 5 | ug/L |

METHOD: 8270C, Semivolatile Organics - Water

(continued on next page)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

**Certificate of Analysis No. H9-9810661-01**

Diamond Shamrock

**SAMPLE ID:** Brown Pond

**ANALYTICAL DATA** (continued)

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| 1,2-Diphenylhydrazine | ND | 5 | ug/L |
| bis(2-Ethylhexyl)Phthalate | ND | 5 | ug/L |
| Fluoranthene | ND | 5 | ug/L |
| Fluorene | ND | 5 | ug/L |
| Hexachlorobenzene | ND | 5 | ug/L |
| Hexachlorobutadiene | ND | 5 | ug/L |
| Hexachloroethane | ND | 5 | ug/L |
| Hexachlorocyclopentadiene | ND | 5 | ug/L |
| Indeno(1,2,3-cd)Pyrene | ND | 5 | ug/L |
| Isophorone | ND | 5 | ug/L |
| 2-Methylnaphthalene | ND | 5 | ug/L |
| 2-Methylphenol | ND | 5 | ug/L |
| 4-Methylphenol | ND | 5 | ug/L |
| Naphthalene | ND | 5 | ug/L |
| 2-Nitroaniline | ND | 25 | ug/L |
| 3-Nitroaniline | ND | 25 | ug/L |
| 4-Nitroaniline | ND | 25 | ug/L |
| Nitrobenzene | ND | 5 | ug/L |
| 2-Nitrophenol | ND | 5 | ug/L |
| 4-Nitrophenol | ND | 25 | ug/L |
| N-Nitrosodiphenylamine | ND | 5 | ug/L |
| N-Nitroso-Di-n-Propylamine | ND | 5 | ug/L |
| Di-n-Octyl Phthalate | ND | 5 | ug/L |
| Pentachlorophenol | ND | 25 | ug/L |
| Phenanthrene | ND | 5 | ug/L |
| Phenol | ND | 5 | ug/L |
| Pyrene | ND | 5 | ug/L |
| Pyridine | ND | 5 | ug/L |
| 1,2,4-Trichlorobenzene | ND | 5 | ug/L |
| 2,4,5-Trichlorophenol | ND | 10 | ug/L |
| 2,4,6-Trichlorophenol | ND | 5 | ug/L |

METHOD: 8270C, Semivolatile Organics - Water

(continued on next page)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

**Southern Petroleum Laboratories, Inc.**

**Certificate of Analysis Number: 98-10-664**

Approved for Release by:

Bernadette A. Fini, Senior Project Manager — 10-26-98 Date

Greg Grandits
Laboratory Director

Cynthia Schreiner
Quality Assurance Officer

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810664-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

DATE: 10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** #6 Pilot

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 16:00:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | DETECTION LIMIT | UNITS |
|---|---|---|---|
| Liquid-liquid extraction SEMIVOLATILES<br>Method 3520C ***<br>Analyzed by: KL<br>Date: 10/19/98 11:00:00 | 10/19/98 | | |
| Sulfide<br>Modified 376.2 *<br>Analyzed by: GJ<br>Date: 10/19/98 12:00:00 | ND | 0.05 | mg/L |
| Chemical Oxygen Demand<br>Method 410.1 *<br>Analyzed by: DS<br>Date: 10/16/98 16:30:00 | 550 | 60 | mg/L |
| Ammonia (as Nitrogen)<br>Method 350.2 *<br>Analyzed by: AB<br>Date: 10/19/98 09:00:00 | ND | 1 | mg/L |
| Chromium, Total<br>Method 6010B ***<br>Analyzed by: JM<br>Date: 10/23/98 10:02:00 | ND | 0.01 | mg/L |
| Acid Digestion-Aqueous, ICP<br>Method 3010A ***<br>Analyzed by: EE<br>Date: 10/19/98 10:30:00 | 10/19/98 | | |

ND - Not detected.

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810664-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

DATE: 10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** #6 Pilot

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 16:00:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | DETECTION LIMIT | UNITS |
|---|---|---|---|
| Biochemical Oxygen Demand<br>Method 405.1 *<br>Analyzed by: TV<br>Date: 10/16/98 11:30:00 | 5 | 1 | mg/L |
| Chromium, Hexavalent<br>Method 3500-Cr D **<br>Analyzed by: PT<br>Date: 10/16/98 18:00:00 | ND | 0.01 | mg/L |
| Oil and Grease, Total Recoverable<br>Method 413.1 *<br>Analyzed by: AMG<br>Date: 10/21/98 08:00:00 | ND | 5 | mg/L |
| Volume<br>Analyzed by: AMG<br>Date: 10/21/98 08:00:00 | 900 | | mL |

ND - Not detected.

Notes: *Ref: Methods for Chemical Analysis of Water and Wastes, 1983, EPA
**Ref: Standard Methods for Examination of Water & Wastewater, 18th ed.
***Ref: Test Methods for Evaluating Solid Waste, EPA SW846, 3rd Ed.

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

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# Certificate of Analysis No. H9-9810664-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** #6 Pilot

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 16:00:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Benzene | ND | 5 | ug/L |
| Bromobenzene | ND | 5 | ug/L |
| Bromochloromethane | ND | 5 | ug/L |
| Bromodichloromethane | ND | 5 | ug/L |
| Bromoform | ND | 5 | ug/L |
| Bromomethane | ND | 10 | ug/L |
| n-Butylbenzene | ND | 5 | ug/L |
| sec-Butylbenzene | ND | 5 | ug/L |
| tert-Butylbenzene | ND | 5 | ug/L |
| Carbon tetrachloride | ND | 5 | ug/L |
| Chlorobenzene | ND | 5 | ug/L |
| Chlorodibromomethane | ND | 5 | ug/L |
| Chloroethane | ND | 10 | ug/L |
| Chloroform | ND | 5 | ug/L |
| Chloromethane | ND | 10 | ug/L |
| 2-Chlorotoluene | ND | 5 | ug/L |
| 4-Chlorotoluene | ND | 5 | ug/L |
| 1,2-Dibromo-3-chloropropane | ND | 5 | ug/L |
| 1,2-Dibromoethane | ND | 5 | ug/L |
| Dibromomethane | ND | 5 | ug/L |
| 1,2-Dichlorobenzene | ND | 5 | ug/L |
| 1,3-Dichlorobenzene | ND | 5 | ug/L |
| 1,4-Dichlorobenzene | ND | 5 | ug/L |
| Dichlorodifluoromethane | ND | 10 | ug/L |
| 1,1-Dichloroethane | ND | 5 | ug/L |
| 1,2-Dichloroethane | ND | 5 | ug/L |
| 1,1-Dichloroethene | ND | 5 | ug/L |
| cis-1,2-Dichloroethene | ND | 5 | ug/L |
| trans-1,2-Dichloroethene | ND | 5 | ug/L |
| 1,2-Dichloropropane | ND | 5 | ug/L |
| 1,3-Dichloropropane | ND | 5 | ug/L |
| 2,2-Dichloropropane | ND | 5 | ug/L |
| 1,1-Dichloropropene | ND | 5 | ug/L |
| Ethylbenzene | ND | 5 | ug/L |
| Hexachlorobutadiene | ND | 5 | ug/L |
| Isopropylbenzene | ND | 5 | ug/L |
| p-Isopropyltoluene | ND | 5 | ug/L |
| Methylene chloride | ND | 5 | ug/L |

METHOD: 8260 Water, Volatile Organics

(continued on next page)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810664-01

Diamond Shamrock

**SAMPLE ID:** #6 Pilot

**ANALYTICAL DATA** (continued)

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Naphthalene | 16 | 5 | ug/L |
| n-Propylbenzene | ND | 5 | ug/L |
| Styrene | ND | 5 | ug/L |
| 1,1,1,2-Tetrachloroethane | ND | 5 | ug/L |
| 1,1,2,2-Tetrachloroethane | ND | 5 | ug/L |
| Tetrachloroethene | ND | 5 | ug/L |
| Toluene | ND | 5 | ug/L |
| 1,2,3-Trichlorobenzene | ND | 5 | ug/L |
| 1,2,4-Trichlorobenzene | ND | 5 | ug/L |
| 1,1,1-Trichloroethane | ND | 5 | ug/L |
| 1,1,2-Trichloroethane | ND | 5 | ug/L |
| Trichloroethene | ND | 5 | ug/L |
| Trichlorofluoromethane | ND | 5 | ug/L |
| 1,2,3-Trichloropropane | ND | 5 | ug/L |
| 1,2,4-Trimethylbenzene | ND | 5 | ug/L |
| Vinyl chloride | ND | 10 | ug/L |
| Xylenes (total) | ND | 5 | ug/L |
| Methyl t-butyl ether | ND | 10 | ug/L |
| 1,3,5-Trimethylbenzene | ND | 5 | ug/L |
| 1,2-Dichloroethene (total) | ND | 5 | ug/L |
| cis-1,3-Dichloropropene | ND | 5 | ug/L |
| trans-1,3-Dichloropropene | ND | 5 | ug/L |
| Acetone | ND | 100 | ug/L |
| Vinyl Acetate | ND | 10 | ug/L |
| Carbon Disulfide | ND | 5 | ug/L |
| 2-Butanone | ND | 20 | ug/L |
| 4-Methyl-2-Pentanone | ND | 10 | ug/L |
| 2-Hexanone | ND | 10 | ug/L |
| 2-Chloroethylvinylether | ND | 10 | ug/L |

| SURROGATES | AMOUNT SPIKED | % RECOVERY | LOWER LIMIT | UPPER LIMIT |
|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 50 ug/L | 110 | 80 | 120 |
| Toluene-d8 | 50 ug/L | 98 | 88 | 110 |
| 4-Bromofluorobenzene | 50 ug/L | 96 | 86 | 115 |

ANALYZED BY: GT DATE/TIME: 10/21/98 16:40:00
METHOD: 8260 Water, Volatile Organics
NOTES: * - Practical Quantitation Limit ND - Not Detected
NA - Not Analyzed

**COMMENTS:**

**QUALITY ASSURANCE:** These analyses are performed in accordance with EPA guidelines for quality assurance.

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

# Certificate of Analysis No. H9-9810664-01

Diamond Shamrock
301 Leroy Street
Three Rivers, TX 78071-6000
ATTN: Kathy Carrillo

10/26/98

**PROJECT:** Irrigtion Discharge
**SITE:** Irrigtion Discharge
**SAMPLED BY:** Diamond Shamrock
**SAMPLE ID:** #6 Pilot

**PROJECT NO:**
**MATRIX:** WATER
**DATE SAMPLED:** 10/15/98 16:00:00
**DATE RECEIVED:** 10/16/98

## ANALYTICAL DATA

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| Acenaphthene | ND | 5 | ug/L |
| Acenaphthylene | ND | 5 | ug/L |
| Aniline | ND | 5 | ug/L |
| Anthracene | ND | 5 | ug/L |
| Benzo(a)Anthracene | ND | 5 | ug/L |
| Benzo(b)Fluoranthene | ND | 5 | ug/L |
| Benzo(k)Fluoranthene | ND | 5 | ug/L |
| Benzo(a)Pyrene | ND | 5 | ug/L |
| Benzoic Acid | ND | 25 | ug/L |
| Benzo(g,h,i)Perylene | ND | 5 | ug/L |
| Benzyl alcohol | ND | 5 | ug/L |
| 4-Bromophenylphenyl ether | ND | 5 | ug/L |
| Butylbenzylphthalate | ND | 5 | ug/L |
| di-n-Butyl phthalate | ND | 5 | ug/L |
| Carbazole | ND | 5 | ug/L |
| 4-Chloroaniline | ND | 5 | ug/L |
| bis(2-Chloroethoxy)Methane | ND | 5 | ug/L |
| bis(2-Chloroethyl)Ether | ND | 5 | ug/L |
| bis(2-Chloroisopropyl)Ether | ND | 5 | ug/L |
| 4-Chloro-3-Methylphenol | ND | 5 | ug/L |
| 2-Chloronaphthalene | ND | 5 | ug/L |
| 2-Chlorophenol | ND | 5 | ug/L |
| 4-Chlorophenylphenyl ether | ND | 5 | ug/L |
| Chrysene | ND | 5 | ug/L |
| Dibenz(a,h)Anthracene | ND | 5 | ug/L |
| Dibenzofuran | ND | 5 | ug/L |
| 1,2-Dichlorobenzene | ND | 5 | ug/L |
| 1,3-Dichlorobenzene | ND | 5 | ug/L |
| 1,4-Dichlorobenzene | ND | 5 | ug/L |
| 3,3'-Dichlorobenzidine | ND | 10 | ug/L |
| 2,4-Dichlorophenol | ND | 5 | ug/L |
| Diethylphthalate | ND | 5 | ug/L |
| 2,4-Dimethylphenol | ND | 5 | ug/L |
| Dimethyl Phthalate | ND | 5 | ug/L |
| 4,6-Dinitro-2-Methylphenol | ND | 25 | ug/L |
| 2,4-Dinitrophenol | ND | 25 | ug/L |
| 2,4-Dinitrotoluene | ND | 5 | ug/L |
| 2,6-Dinitrotoluene | ND | 5 | ug/L |

METHOD: 8270C, Semivolatile Organics - Water

(continued on next page)

HOUSTON LABORATORY
8880 INTERCHANGE DRIVE
HOUSTON, TEXAS 77054
PHONE (713) 660-0901

Certificate of Analysis No. H9-9810664-01

Diamond Shamrock

SAMPLE ID: #6 Pilot

ANALYTICAL DATA (continued)

| PARAMETER | RESULTS | PQL* | UNITS |
|---|---|---|---|
| 1,2-Diphenylhydrazine | ND | 5 | ug/L |
| bis(2-Ethylhexyl)Phthalate | ND | 5 | ug/L |
| Fluoranthene | ND | 5 | ug/L |
| Fluorene | ND | 5 | ug/L |
| Hexachlorobenzene | ND | 5 | ug/L |
| Hexachlorobutadiene | ND | 5 | ug/L |
| Hexachloroethane | ND | 5 | ug/L |
| Hexachlorocyclopentadiene | ND | 5 | ug/L |
| Indeno(1,2,3-cd)Pyrene | ND | 5 | ug/L |
| Isophorone | ND | 5 | ug/L |
| 2-Methylnaphthalene | ND | 5 | ug/L |
| 2-Methylphenol | ND | 5 | ug/L |
| 4-Methylphenol | ND | 5 | ug/L |
| Naphthalene | ND | 5 | ug/L |
| 2-Nitroaniline | ND | 25 | ug/L |
| 3-Nitroaniline | ND | 25 | ug/L |
| 4-Nitroaniline | ND | 25 | ug/L |
| Nitrobenzene | ND | 5 | ug/L |
| 2-Nitrophenol | ND | 5 | ug/L |
| 4-Nitrophenol | ND | 25 | ug/L |
| N-Nitrosodiphenylamine | ND | 5 | ug/L |
| N-Nitroso-Di-n-Propylamine | ND | 5 | ug/L |
| Di-n-Octyl Phthalate | ND | 5 | ug/L |
| Pentachlorophenol | ND | 25 | ug/L |
| Phenanthrene | ND | 5 | ug/L |
| Phenol | ND | 5 | ug/L |
| Pyrene | ND | 5 | ug/L |
| Pyridine | ND | 5 | ug/L |
| 1,2,4-Trichlorobenzene | ND | 5 | ug/L |
| 2,4,5-Trichlorophenol | ND | 10 | ug/L |
| 2,4,6-Trichlorophenol | ND | 5 | ug/L |

METHOD: 8270C, Semivolatile Organics - Water

(continued on next page)

# APPENDIX NO. 2

# CAMPBELLTON WELL INFORMATION

**BUDGET ESTIMATE**
**24" WELL WATER TRANSMISSION MAIN**
**FROM CAMPBELLTON TO THREE RIVERS**

| ITEM NO. | DESCRIPTION | UNIT | QUANTITY | UNIT COST | TOTAL |
|---|---|---|---|---|---|
| 1 | 12" PVC TO EXISTING WELLS | LS | 5,200 | $ 26.00 | $ 135,200.00 |
| 2 | 250,000 GAL STORAGE TANK | EA | 1 | $ 110,000.00 | $ 110,000.00 |
| 3 | PUMP BUILDING | SF | 2,000 | $ 150.00 | $ 300,000.00 |
| 4 | 3MGD PUMP | EA | 3 | $ 10,000.00 | $ 30,000.00 |
| 5 | PIG ASSEMBLY | LS | 1 | $ 15,000.00 | $ 15,000.00 |
| 6 | 24" PVC C-905 | LF | 118,600 | $ 34.00 | $ 4,032,400.00 |
| 7 | 24" D.I.P. BENDS | EA | 30 | $ 3,000.00 | $ 90,000.00 |
| 8 | 24" BUTTERFLY VALVES | EA | 4 | $ 10,000.00 | $ 40,000.00 |
| 9 | AIR RELEASE CHAMBERS | EA | 30 | $ 2,000.00 | $ 60,000.00 |
| 10 | PIG ASSEMBLY | LS | 1 | $ 15,000.00 | $ 15,000.00 |
| 11 | 36" STEEL ENCASED BORE | LF | 600 | $ 400.00 | $ 240,000.00 |
| 12 | 1,000,000 GAL STORAGE TANK | LS | 1 | $ 300,000.00 | $ 300,000.00 |
| | | | | TOTAL | $ 5,367,600.00 |

TEL. 361-884-0371 P.O. BOX 2552 78403

**JORDAN LABORATORIES, INCORPORATED**
**ANALYTICAL & ENVIRONMENTAL CHEMISTS**
**CORPUS CHRISTI, TEXAS**
**July 15, 1999**

THREE RIVERS WATER DISTRICT
City Square
Three Rivers. Texas 78071

## Report of Analysis

Identification: Campbellton City Well
6-14-99

### Constituents as Ions

| Method Number | | mg/L | Analyst | Analysis Date |
|---|---|---|---|---|
| EPA 600 215.1 | Calcium | 3.4 | Merks | 07-07-99 |
| EPA 600 242.1 | Magnesium | 0.44 | Merks | 07-07-99 |
| EPA 600 273.1 | Sodium | 275 | Merks | 07-07-99 |
| EPA 600 258.1 | Potassium | 3.3 | Merks | 07-07-99 |
| EPA 600 310.1 | Carbonate | 0 | Merks | 06-21-99 |
| EPA 600 310.1 | Bicarbonate | 594 | Merks | 06-21-99 |
| EPA 600 375.3 | Sulfate | 51 | Merks | 06-29-99 |
| SM 4500-Cl⁻ B | Chloride | 48 | Merks | 06-25-99 |
| SM 3111 D. | Silica | 30 | Allen | 07-15-99 |
| EPA 600 160.3 | Total Dissolved Solids (180 Deg.C) | 736 | Allen | 07-15-99 |
| EPA 600 310.1 | Total Alkalinity as Calcium Carbonate | 487 | Merks | 06-21-99 |
| SM 2340 B. | Total Hardness as Calcium Carbonate | 10 | Merks | 07-07-99 |
| EPA 600 236.1 | Iron | 0.01 | Allen | 07-15-99 |
| EPA 600 150.1 | pH 7.87 | | Merks | 06-21-99 |

Lab. No. M37-3500

Respectfully Submitted,

Carl F. Crownover, Pres.

form: S1-44

City of Corpus Christi

**CAMPBELLTON WELLS**
**April 1996**

| | City | 23-Apr-96 ARTESIAN mg/L | 24-Apr-96 BRUNOR mg/L | 24-Apr-96 CLYBURN mg/L | 24-Apr-96 RODRIGUES mg/L |
|---|---|---|---|---|---|
| TOTAL SOLIDS | DISSOLVED | 612 | 685 | 457 | 670 |
| PHENOL ALKALINITY | | 0 | 0 | 0 | 0 |
| TOTAL ALKALINITY | | 487 | 597 | 313 | 519 |
| CALCIUM | | 4 | 3 | 4 | 5 |
| CHLORIDES | | 98 | 64 | 50 | 66 |
| FLUORIDE | | 0.82 | 1.03 | 0.42 | 0.84 |
| HARDNESS | CaCO3 | 12 | 10 | 12 | 10 |
| ALUMINUM | | <0.02 | <0.02 | <0.02 | <0.02 |
| MAGNESIUM | | 0.5 | <0.1 | <0.1 | <0.1 |
| pH | | 8.3 | 8.45 | 8.21 | 8.14 |
| SILICA | Soluble | 29 | 27 | 28 | 29 |
| SODIUM | | 453 | 519 | 283 | 461 |
| SULFATE | | 49 | 65 | 32 | 46 |
| TURBIDITY | | 1.4 | 0.53 | 0.21 | 0.09 |

# APPENDIX NO. 3

# U.D.S. MONITORING WELLS SAMPLING MEMORANDUM

# MEMORANDUM

**Date:** 10/15/99

**To:** Urban Engineers, Mr. Larry Urban, PE

**CC:** Three Rivers Water District, Ms Rosie Forehand, President

**From:** TOM NANCE

**RE:** Sampling of Ultramar/Diamond Shamrock wastewater irrigation site, monitoring wells

---

On September 10,1999 I met with Mr. Lonnie Stewart of the Live Oak County Underground Water Conservation District to test the monitoring wells at the UDS wastewater irrigation site north of Three Rivers.

The purpose of the testing was to gather information that might assist the TRWD with its ongoing planning effort in cooperation with the Texas Water Development Board's regional water planning study, and to help the LOCUWCD try to determine the recharge zone of the Oakville sands. The District also wants to know what effect, if any, the irrigation practice has had on the local wells over the past 10 years.

We started with a meeting at the UDS administrative offices where we met with Mr. Lyn Holms, PE, environmentalist for UDS. We discussed our procedures and obtained permission and were assigned an escort/observer for the testing.

We built a hand bailer the day before testing because we were going to test for BTE's and UDS wanted no petrochemicals near their monitoring wells. A gas pump might leave residues. So we hand bailed each well three times its capacity prior to sampling.(Ouch!)

MW1, 3, 4, and 6 were bailed dry and did not recharge quick enough to sample immediately. MW 7 and 9 recharged quick enough for us to grab samples immediately after purging. The irrigation units were operating in the vicinity of the MW's 7 and 9. All of these wells are located at the lowest points of the irrigation site. We returned to the Mw 1 for sampling after 9. It had completely recharged by sight. We did not check static levels. We then went on to 3, 4, and 6 respectively. All had recharged.

We did not discard and change bailers as we moved from monitoring well to well. If we thought there was a chance of BTE's present we would have changed bailers. However, no BTE's showed present in the numerous years of self monitoring that was made available by the UDS staff and they assured us that we would find none.

We used a piece of 3" pvc new pipe, 12' long with a 1.5" bushing and a 1.5" valve on the end. We took turns (Lonnie and I, not the observer) bailing each well 22 times before we grabbed a sample.

We iced all samples and delivered them the same day to Core lab in Corpus Christi, Texas.

# GROUNDWATER SAMPLING RESULTS

## ULTRAMAR DIAMOND SHAMROCK MONITORING WELLS AT EFFLUENT

Sample Date: September 10, 1999

| Parameter | Units | RESULTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | MW-1 | MW-3 | MW-4 | MW-6 | MW-7 | MW-9 |
| Specific Conductivity | umhos/cm | 11700 | 10800 | 7350 | 12800 | 7820 | 11200 |
| pH | mg/l | 6.7 | 6.6 | 6.6 | 6.6 | 6.7 | 6.6 |
| Total Dissolved Solids (TDS) | mg/l | 7840 | 6900 | 4870 | 8340 | 5480 | 7990 |
| Chloride | mg/l | 2330 | 2310 | 1370 | 3720 | 1770 | 2430 |
| Sulfate (SO4) | mg/l | 2200 | 1700 | 1700 | 1500 | 1600 | 2500 |
| Benzene | ug/l | ND | ND | ND | ND | ND | ND |
| Ethylbenzene | ug/l | ND | ND | ND | ND | ND | ND |
| Toluene | ug/l | ND | ND | ND | ND | ND | ND |
| Xylenes (total) | ug/l | ND | ND | ND | ND | ND | ND |

Lab testing performed by Core Laboratories on September 10, 1999

ND = Non-Detectable
MW = Monitoring Well

CORE LAB

# CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348 Date: 09/24/99

CUSTOMER: Live Oak UWCD PROJECT: DIAMOND SHAMROCK ATTN: Lonnie Stewart

Customer Sample ID: MW 6
Date Sampled.....: 09/10/1999
Time Sampled.....: 13:00
Sample Matrix.....: Water

Laboratory Sample ID; 993348-6
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 12800 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.6 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 8340 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 3720 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 1500 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/14/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/14/99 | maz |

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348

Date: 09/24/99

CUSTOMER: Live Oak UWCD | PROJECT: DIAMOND SHAMROCK | ATTN: Lonnie Stewart

Customer Sample ID: MW 4
Date Sampled.....: 09/10/1999
Time Sampled.....: 12:50
Sample Matrix.....: Water

Laboratory Sample ID: 993348-5
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 7350 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.6 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 4870 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 1370 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 1700 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/14/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/14/99 | maz |

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348

Date: 09/24/99

CUSTOMER: Live Oak UWCD | PROJECT: DIAMOND SHAMROCK | ATTN: Lonnie Stewart

Customer Sample ID: MW 3
Date Sampled.....: 09/10/1999
Time Sampled.....: 12:45
Sample Matrix.....: Water

Laboratory Sample ID: 993348-4
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 10800 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.6 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 6900 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 2310 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 1700 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/14/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/14/99 | maz |

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348

Date: 09/24/99

CUSTOMER: Live Oak UWCD | PROJECT: DIAMOND SHAMROCK | ATTN: Lonnie Stewart

Customer Sample ID: MW 1
Date Sampled.....: 09/10/1999
Time Sampled.....: 12:38
Sample Matrix.....: Water

Laboratory Sample ID: 993348-3
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 11700 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.7 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 7840 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 2330 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 2200 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/14/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/14/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/14/99 | maz |

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348

Date: 09/24/99

CUSTOMER: Live Oak UWCD PROJECT: DIAMOND SHAMROCK ATTN: Lonnie Stewart

Customer Sample ID: MW 9
Date Sampled.....: 09/10/1999
Time Sampled.....: 13:08
Sample Matrix.....: Water

Laboratory Sample ID: 993348-2
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 11200 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.6 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 7990 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 2430 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 2500 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/13/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/13/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/13/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/13/99 | maz |

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 993348

Date: 09/24/99

CUSTOMER: Live Oak UWCD | PROJECT: DIAMOND SHAMROCK | ATTN: Lonnie Stewart

Customer Sample ID: MW 7
Date Sampled.....: 09/10/1999
Time Sampled.....: 12:15
Sample Matrix.....: Water

Laboratory Sample ID: 993348-1
Date Received.....: 09/10/1999
Time Received.....: 15:25

| TEST METHOD | PARAMETER/TEST DESCRIPTION | SAMPLE RESULT | REPORTING LIMIT | UNITS | DATE | TECH |
|---|---|---|---|---|---|---|
| EPA 120.1 | Specific Conductivity @ 25 degrees C | 7820 | 1 | umhos/cm | 09/10/99 | tlm |
| EPA 150.1 | pH measured at 25 deg. C | 6.7 | 0.1 | pH Units | 09/10/99 | glw |
| EPA 160.1 | Solids, Total Dissolved (TDS) | 5480 | 10 | mg/L | 09/16/99 | tlm |
| EPA 325.2 | Chloride | 1770 | 250 | mg/L | 09/14/99 | jrd |
| EPA 375.4 | Sulfate (SO4) | 1600 | 500 | mg/L | 09/23/99 | jrd |
| SW-846 8021B | Volatile Organics - Aromatics | | | | | |
| | Benzene | ND | 2 | ug/L | 09/13/99 | maz |
| | Ethylbenzene | ND | 2 | ug/L | 09/13/99 | maz |
| | Toluene | ND | 2 | ug/L | 09/13/99 | maz |
| | Xylenes (total) | ND | 2 | ug/L | 09/13/99 | maz |

# APPENDIX NO. 4

# U.D.S. PERMIT TO DISPOSE OF WASTE

**NOTE: Does not include T.N.R.C.C.'s Standard Definitions and Permit Conditions (Pages 3 to 12)**

TPDES PERMIT NO. 01353
*(For TNRCC office use only -*
*EPA I.D. No.* TX0088331)

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
P. O. Box 13087
Austin, Texas 78711-3087

This permit supercedes and replaces TNRCC Permit No. 01353, issued July 8, 1991, and NPDES Permit No. TX0088331, issued August 9, 1991.

PERMIT TO DISPOSE OF WASTES
under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

Diamond Shamrock Refining Company, L.P.

whose mailing address is

P.O. Box 696000
San Antonio, Texas 78269-6000

is authorized to treat and dispose of wastes from a petroleum refinery (SIC 2911)

located at 301 Leroy Street in the City of Three Rivers, Live Oak County, Texas

via an unnamed ditch, thence to the Nueces/Lower Frio River in Segment No. 2106 of the Nueces River Basin

only according to effluent limitations, monitoring requirements and other conditions set forth in this permit, as well as the rules of the Texas Natural Resource Conservation Commission (TNRCC), the laws of the State of Texas, and other orders of the Commission of the TNRCC (Commission). The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes property belonging to but not limited to any individual, partnership, corporation or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight on July 1, 2001.

ISSUED DATE: JUN 18 1999

For the Commission

INTERIM EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon date of issuance and lasting until plant production rate is increased (*3), the permittee is authorized to discharge treated process wastewater, utility wastewater, storm water, and treated ground water subject to the following effluent limitations:

The daily average flow of effluent shall not exceed 0.8 (*1) million gallons per day (MGD). The total volume discharged during any 24-hour period shall not exceed 1.6 (*1) million gallons.

| Effluent Characteristic | Discharge Limitations | | | Minimum Self-Monitoring Requirements | |
|---|---|---|---|---|---|
| | Daily Avg lbs/day (mg/l) | Daily Max lbs/day (mg/l) | Single Grab mg/l | Report Daily Avg. & Daily Max. Measurement Frequency | Sample Type |
| Flow (MGD) | (Report) | (Report) | N/A | 1/operating shift | Totalizing Meter |
| Biochemical Oxygen Demand (5-day) | 179 | 335 | 75 | 2/week(*2) | Composite |
| Chemical Oxygen Demand | 1750 | 3400 | 750 | 2/week(*2) | Composite |
| Total Suspended Solids | 180 | 360 | 75 | 2/week(*2) | Composite |
| Oil and Grease | 67 | 125 | 19 | 2/week(*2) | Grab |
| Ammonia as Nitrogen | 100 | 200 | 43 | 2/week(*2) | Composite |
| Phenols | 0.7 | 1.3 | 0.30 | 2/week(*2) | Grab |
| Sulfides | 0.7 | 1.2 | 0.30 | 2/week(*2) | Grab |
| Chromium, Total | 2.9 | 4.9 | 1.5 | 2/week(*2) | Composite |
| Chromium, Hexavalent | 0.09 | 0.19 | 0.04 | 2/week(*2) | Composite |
| Total Dissolved Solids | 23,400 | 30,000 | 5600 | 2/week(*2) | Composite |
| Chlorides | 10,700 | 14,000 | 2600 | 2/week(*2) | Composite |
| Selenium, Total | (Report) | (Report) | 0.05 | 2/week(*2) | Composite |
| Mercury, Total | 0.008 | 0.018 | 0.006 | 2/week(*2) | Composite |
| Zinc, Total | 3.2 | 6.7 | 1.5 | 2/week(*2) | Composite |
| Antimony, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Arsenic, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Barium, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Cadmium, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Copper, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Lead, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Silver, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |

(*1) See Other Requirements Nos. 2 and 3. The annual volume of discharge shall be monitored 1/year.
(*2) When discharge occurs.
(*3) See Other Requirements No. 5.

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day (*2), by grab sample.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

4. Effluent monitoring samples shall be taken at the following location(s): At Outfall 001, at the discharge pipe from the polishing sand filters on the west side of company property.

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning at the increase of plant production rate and lasting through date of expiration (*3), the permittee is authorized to discharge treated process wastewater, utility wastewater, storm water, and treated ground water subject to the following effluent limitations:

The daily average flow of effluent shall not exceed 0.8 (*1) million gallons per day (MGD). The total volume discharged during any 24-hour period shall not exceed 1.6 (*1) million gallons.

| Effluent Characteristic | Discharge Limitations | | | Minimum Self-Monitoring Requirements | |
|---|---|---|---|---|---|
| | Daily Avg lbs/day (mg/l) | Daily Max lbs/day (mg/l) | Single Grab mg/l | Report Daily Avg. & Daily Max. Measurement Frequency | Sample Type |
| Flow (MGD) | (Report) | (Report) | N/A | 1/operating shift | Totalizing Meter |
| Biochemical Oxygen Demand (5-day) | 211 | 395 | 75 | 2/week(*2) | Composite |
| Chemical Oxygen Demand | 2065 | 4012 | 750 | 2/week(*2) | Composite |
| Total Suspended Solids | 212 | 425 | 75 | 2/week(*2) | Composite |
| Oil and Grease | 79 | 147 | 19 | 2/week(*2) | Grab |
| Ammonia as Nitrogen | 118 | 236 | 43 | 2/week(*2) | Composite |
| Phenols | 0.8 | 1.5 | 0.30 | 2/week(*2) | Grab |
| Sulfides | 0.8 | 1.4 | 0.30 | 2/week(*2) | Grab |
| Chromium, Total | 3.4 | 5.8 | 1.5 | 2/week(*2) | Composite |
| Chromium, Hexavalent | 0.09 | 0.19 | 0.04 | 2/week(*2) | Composite |
| Total Dissolved Solids | 27,600 | 35,400 | 5600 | 2/week(*2) | Composite |
| Chlorides | 14,500 | 16,500 | 2600 | 2/week(*2) | Composite |
| Selenium, Total | (Report) | (Report) | 0.05 | 2/week(*2) | Composite |
| Mercury, Total | 0.008 | 0.018 | 0.006 | 2/week(*2) | Composite |
| Zinc, Total | 3.2 | 6.7 | 1.5 | 2/week(*2) | Composite |
| Antimony, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Arsenic, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Barium, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Cadmium, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Copper, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Lead, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |
| Silver, Total | (Report) | (Report) | N/A | 1/day (*2) | Grab |

(*1) See Other Requirements Nos. 2 and 3. The annual volume of discharge shall be monitored 1/year.
(*2) When discharge occurs.
(*3) See Other Requirements No. 5.

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day (*2), by grab sample.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

4. Effluent monitoring samples shall be taken at the following location(s): At Outfall 001, at the discharge pipe from the polishing sand filters on the west side of company property.

1. During the period beginning upon date of issuance and lasting through date of expiration, the permittee is authorized to discharge storm water runoff and plant washwater subject to the following effluent limitations:

| Effluent Characteristic | Discharge Limitations | | | Minimum Self-Monitoring Requirements | |
|---|---|---|---|---|---|
| | Daily Avg | Daily Max | Single Grab | Report Daily Avg. & Daily Max. | |
| | mg/l | mg/l | mg/l | Measurement Frequency | Sample Type |
| Chemical Oxygen Demand | N/A | 150 | 150 | 1/day * | Grab |
| Oil and Grease | N/A | 15 | 15 | 1/day * | Grab |

* When discharge occurs. A grab sample shall be collected immediately following the start of each discharge and analyzed. Monitoring shall continue 1/day for the duration of each discharge.

2. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day*, by grab sample.

3. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

4. Effluent monitoring samples shall be taken at the following location(s): At Outfall 002, the flood levee gate area at the edge of plant property.

OTHER REQUIREMENTS

1. Violations of daily maximum limitations for the following pollutants shall be reported orally to TNRCC Region 14 office within 24 hours from the time the permittee becomes aware of the violation, followed by a written report within five days:

| Pollutant |
|---|
| Total Chromium |
| Hexavalent Chromium |
| Total Mercury |
| Total Selenium |
| Total Zinc |
| Phenols |

2. The permittee is authorized to discharge treated process wastewater through Outfall 001 under the following conditions:

   a) The discharge shall not exceed 20 million gallons per calendar year.
   b) River flow must be greater than 200 cfs at gauge station 08210000 on the Nueces River during the period of discharge.

   Records of river flow at gauge station 08210000 shall be recorded for the days when discharge through Outfall 001. Records shall be maintained for a minimum period of three years and shall be made readily available for review by authorized personnel of the TNRCC or EPA Region 6 upon request.

3. The TNRCC Region 14 office and the City of Corpus Christi Water Division shall be notified at least 24 hours prior to discharge from Outfall 001. Notification shall include the time and date the discharge will commence and the estimated duration of the discharge event. If a situation arises which prevents prior notification, then the permittee shall make notification as early as possible. Additionally, the permittee shall submit a written report to the TNRCC Region 14 office, within five days following commencement of the discharge, explaining why notification was not possible. In either case, the permittee shall submit a written report of the discharge, including the dates of discharge and volumes, to the Water Quality Assessment Team (MC-150) of the TNRCC's Water Quality Division in Austin.

4. There is no mixing zone established for this discharge to an intermittent stream. Acute toxic criteria apply at the point of discharge. Chronic toxic criteria apply at the point where the discharge reaches the Nueces/Lower Frio River.

5. The permittee shall notify the TNRCC Region 14 office, the TNRCC Industrial Permits Team (MC-148) of the Water Quality Division, and the Database and Administration Team (MC-224) of the Enforcement Division at least 30 days prior to the facility's expansion of production to 110,000 barrels of throughput. Final effluent limitations for Outfall 001 shall become effective immediately following expansion.

6. Test methods utilized to determine compliance with the permit limitations and requirements shall be sensitive enough to detect the following parameters at the defined minimum analytical level (MAL).

| Parameter | MAL (mg/l) | Parameter | MAL (mg/l) |
|---|---|---|---|
| Antimony (Total) | 0.020 | Lead (Total) | 0.005 |
| Arsenic (Total) | 0.010 | Mercury (Total) | 0.0002 |
| Barium (Total) | 0.010 | Selenium (Total) | 0.010 |
| Cadmium (Total) | 0.001 | Silver (Total) | 0.002 |
| Copper (Total) | 0.010 | Zinc (Total) | 0.005 |

OTHER REQUIREMENTS

7. Within 180 days after permit issuance, the permittee shall perform an analytical test for each of the parameters listed below from samples of the dry weather discharges via Outfall 002 and submit the results to the Industrial Permits Team (MC-148), Water Quality Division of the Texas Natural Resource Conservation Commission and to the U.S. EPA Region 6 office (6WQ-PI) . A total of four test results are required. Sample frequency shall be once per week (when a dry weather discharge occurs) during normal operation. Samples obtained shall be a grab type as defined in the permit under "Definitions and Standard Permit Conditions". Testing shall be conducted according to any EPA methodology which is approved and test methods shall be sensitive enough to detect the constituent at the Minimum Analytical Level (MAL). A summary of results and a summary report of the discharges shall be submitted with original laboratory reports. The summary report shall contain the number of dry weather discharges that occurred during the period beginning on the date of the first sample event and lasting through the date of the final sampling event. An estimate of the volume of the discharge shall be provided for each dry weather discharge that occurs during this period, regardless of whether the discharge is sampled or is not sampled. If sampling can not be completed within the prescribed time frame as a result of no discharges, the permittee shall contact the Industrial Permits Team (MC-148) by letter and estimate the additional time required to complete sampling and to submit the results and summary report.

| Pollutant | MAL (mg/l) |
|---|---|
| Total Aluminum | 0.0030 |
| Total Mercury | 0.00002 |

Upon examination of the results from the above analytical tests, and upon consideration of the summary report, this permit may be reopened to incorporate additional effluent limitations or requirements based on Texas Surface Water Quality Standards.

IRRIGATION REQUIREMENTS

8. The permittee is authorized to utilize effluent from the process wastewater treatment facilities for irrigation of an approximately 618 acre company-owned tract. The tract contains a 341.5 acre zone that is utilized for irrigation with wastewater. The irrigation site is located three miles north-northeast of the city of Three Rivers.

9. The permittee shall provide adequate storage volume for treated wastewater. At a minimum, the permittee shall maintain and utilize the existing storage pond, located at the irrigation tract, that has a maximum storage capacity of 224 acre-feet. The pond shall be managed so as to maintain 2 feet of freeboard. Existing holding ponds, Ponds 5, 6, and 7, may be utilized for additional storage of treated effluent or storm water.

10. Wastewater utilized for irrigation shall be subject to the following limitations:

| Parameter | Daily Max mg/l | Annual Rate | Measurement Frequency | Sample Type |
|---|---|---|---|---|
| Flow (MGD) | Report* | N/A | 1/daily | Record |
| Hydraulic Application (acre-ft/acre/yr) | N/A | 2.95 | 1/year | Calculate |
| Nitrogen Application** (lb/acre/year) | Report | 600 | 1/quarter | Calculate |
| Chemical Oxygen Demand | 510 | N/A | 1/week | Composite |
| Biochemical Oxygen Demand (5-day) | 50 | N/A | 1/week | Composite |
| Oil and Grease | 19 | N/A | 1/week | Grab |
| Ammonia-Nitrogen | 100 | N/A | 1/week | Composite |
| Phenols | 0.3 | N/A | 1/week | Grab |

OTHER REQUIREMENTS

| Parameter | Daily Max mg/l | Annual Rate | Measurement Frequency | Sample Type |
|---|---|---|---|---|
| Sulfides | 0.3 | N/A | 1/week | Grab |
| Total Chromium | 0.7 | N/A | 1/week | Composite |
| Hexavalent Chromium | 0.06 | N/A | 1/week | Composite |
| pH (standard units) | 6.0 - 9.0*** | N/A | 1/week | Grab |

* Report irrigation rates. See other requirement No. 10.
** Defined for the purposes of this permit as consisting of ammonia-nitrogen and nitrate-nitrogen.
*** pH shall be within a range of 6.0 - 9.0 standard units.

Records of analyses shall be maintained on a monthly basis and be available at the plant site for inspection by authorized representatives of the TNRCC. Complete records shall be maintained for a minimum of at least three years. A summary of a minimum of three years of records shall be submitted as an attachment to any application for amendment or renewal of this permit.

11. The permittee shall maintain an operating log which records the daily volume of wastewater irrigated, hours that wastewater is applied, and the surface area of the irrigation site which is wetted. The log shall be maintained at the plant site and be available for inspection by authorized representatives of the TNRCC.

12. Surficial samples of irrigated soil shall be collected quarterly from the most heavily irrigated areas. The exchangeable sodium percentage (ESP) of each sample shall be analyzed. If the average of the value exceeds 20%, a program of calcium amendments shall be immediately implemented to reduce the ESP to approximately 10% or less. Results of the quarterly ESP testing shall be reported to the Database and Administration Team (MC-224) of the Enforcement Division, to the Industrial Permits Team (MC-148) of the Water Quality Division, and to the U.S. EPA Region 6 office (6WQ-PI) during September, December, March, and June of each year.

13. The permittee shall develop a written plan for investigation of elevated soil salinity and sodium adsorption ratios within the irrigation tract. The plan shall include detailed information regarding past, present and future management of soils, wastewater quality, and crops. Analytical results of historical wastewater and soil monitoring shall be incorporated in the investigation as is appropriate. The plan shall be submitted to the Ground-Water Protection Team (MC - 147) and a copy forwarded to the Industrial Permits Team (MC - 148) of the Water Quality Division and to the U.S. EPA Region 6 office (6WQ-PI) within 90 days following date of permit issuance. Approval for implementation of the plan shall be obtained from the Ground-Water Protection Team and the plan shall be initiated within 60 days of receiving the approval. This permit may be reopened to include additional requirements or limitations based upon a review of the information that is submitted.

Annual soil sampling from the root zone of the irrigated site is required. Sampling procedures shall employ accepted techniques of soil science for obtaining representative analytical results. Analyses shall be performed for oil and grease, pH, total and nitrate nitrogen, potassium, phosphorus, and conductivity. The results of the annual sampling shall be reported to the Database and Administration Team (MC-224) of the Enforcement Division and to the U.S. EPA Region 6 office (6WQ-PI) during September of each year.

14. The permittee shall maintain a crop of coastal bermuda and winter rye grasses over the irrigation site. Winter rye grass shall be over seeded during those portions of the year when coastal bermuda grass is normally dormant. A minimum of four hay cuttings per year is required at a nitrogen application rate of 600 lb/acre/year. One hay cutting per year may be eliminated for every 100 lb/acre/year reduction in actual

OTHER REQUIREMENTS

nitrogen loading, but in no case will there be less than two hay cuttings per year. All resulting hay shall be removed from the fields following cutting.

15. Irrigation practices shall be managed so as to prevent contamination of ground water and surface water. Practices shall prevent the occurrence of nuisance conditions. Wastewater shall be applied evenly so that potential for runoff of irrigation water is minimized or prevented. Tailwater control facilities shall be provided, as necessary, to insure that there is no discharge of wastewater or co-mingled process wastewater from the irrigation site.

16. No irrigation may be conducted within 24 hours following a measured rainfall of one-half inch or greater. No irrigation may be conducted on any zone that contains standing water.

## 48-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply to Outfall 001 for whole effluent toxicity testing (biomonitoring).

1. Scope, Frequency and Methodology

   a. The permittee shall test the effluent for toxicity in accordance with the provisions below. Such testing will determine if an appropriately dilute effluent sample adversely affects the survival, reproduction, or growth of the test organism(s). Toxicity is herein defined as a statistically significant difference at the 95% confidence level between the survival, reproduction, or growth of the test organism(s) in a specified effluent dilution compared to the survival, reproduction, or growth of the test organism(s) in the control (0% effluent).

   b. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA 600/4-90/027F), or the most recent update thereof:

      1) Acute static renewal 48-hour definitive toxicity test using the water flea (Daphnia pulex). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution. This test shall be conducted once per quarter.

      2) Acute static renewal 48-hour definitive toxicity test using the fathead minnow (Pimephales promelas). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution. This test shall be conducted once per six months.

      A valid test result must be submitted for each reporting period. The permittee must report, then repeat, an invalid test during the same reporting period. The repeat test shall include the control and all effluent dilutions and use the appropriate number of organisms and replicates, as specified above. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit.

   c. The permittee shall use five effluent dilution concentrations and a control in each toxicity test. These additional effluent concentrations shall be 32%, 42%, 56%, 75%, and 100% effluent. The critical dilution, defined as 100% effluent, is the effluent concentration representative of the proportion of effluent in the receiving water during critical low flow or critical mixing conditions.

   d. This permit may be amended to require a Whole Effluent Toxicity (WET) limit, a Chemical-Specific (CS) limit, a Best Management Practice (BMP), additional toxicity testing, and/or other appropriate actions to address toxicity. The permittee may be required to conduct additional biomonitoring tests and/or a Toxicity Reduction Evaluation (TRE) if biomonitoring data indicate multiple numbers of unconfirmed toxicity events.

2. Required Toxicity Testing Conditions

   a. Test Acceptance - The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fails to meet any of the following criteria:

      1) a control mean survival of 90% or greater;

      2) a Coefficient of Variation percent (CV%) of 40 or less for both the control and critical dilution. However, if significant lethality is demonstrated, a CV% greater than 40 shall not invalidate the

test. The CV% requirement does not apply when significant lethality occurs.

b. Statistical Interpretation

1) If the conditions of test acceptability are met and the survival of the test organism is equal to or greater than 90% in the critical dilution and all dilutions below that, the test shall be considered to not have demonstrated significant lethality. The permittee shall report an No Observed Effect Concentration (NOEC) of not less than the critical dilution for the reporting requirements.

2) For the water flea and fathead minnow tests, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be in accordance with the methods for determining the NOEC as described in the "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA/600/4-90/027F), or the most recent update thereof.

c. Dilution Water

1) Dilution water used in the toxicity tests shall be the receiving water collected at a point upstream of the discharge as close as possible to the discharge point, but unaffected by the discharge. Where the toxicity tests are conducted on effluent discharges to receiving waters that are classified as intermittent streams, or where the toxicity tests are conducted on effluent discharges where no receiving water is available due to zero flow conditions, the permittee shall; (a) substitute a synthetic dilution water that has a pH, hardness, and alkalinity similar to that of the closest downstream perennial water unaffected by the discharge, or (b) utilize the closest downstream perennial water unaffected by the discharge.

2) Where the receiving water proves unsatisfactory as a result of preexisting instream toxicity (i.e. fails to fulfill the test acceptance criteria of item 2.a.), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

a) a synthetic lab water control was performed (in addition to the receiving water control) which fulfilled the test acceptance requirements of item 2.a;

b) the test indicating receiving water toxicity was carried out to completion;

c) the permittee submitted all test results indicating receiving water toxicity with the reports and information required in Part 3 of this Section.

The synthetic dilution water shall have a pH, hardness, and alkalinity similar to that of the receiving water or a natural water in the drainage basin that is unaffected by the discharge, provided the magnitude of these parameters will not cause toxicity in a synthetic dilution water control that has been formulated to match the pH, hardness, and alkalinity naturally found in the receiving water. Upon approval, the permittee may substitute other appropriate dilution water with chemical and physical characteristics similar to that of the receiving water.

d. Samples and Composites

1) The permittee shall collect a minimum of two flow-weighted 24-hour composite samples from Outfall 001. The second 24-hour composite sample will be used for the renewal of the dilution concentrations for each toxicity test. A 24-hour composite sample consists of a minimum of 12 effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportionally to flow, or a sample continuously collected proportionally to flow over

a 24-hour operating day.

2) The permittee shall collect the 24-hour composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the first 24-hour composite sample. The holding time for any subsequent 24-hour composite sample shall not exceed 36 hours. Samples shall be maintained at a temperature of 4 degrees Centigrade during collection, shipping, and storage.

4) If flow from the outfall being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions, and the sample holding time, are waived during that sampling period. However, the permittee must have collected an effluent composite sample volume sufficient to complete the required toxicity tests with daily renewal of the effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Part 3.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Water Quality Assessment Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this permit in accordance with the Report Preparation Section of "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA 600/4-90/027F), or the most recent update thereof, for every valid and invalid toxicity test initiated whether carried to completion or not. All The full reports shall be retained for 3 years at the plant site and shall be available for inspection by TNRCC personnel.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 1 forms provided with this permit. All Table 1 reports must include the information specified in the Table 1 form attached to this permit.

c. Monthly biomonitoring test results are due on or before the 20th day of the month following sampling.

d. Quarterly biomonitoring test results are due on or before April 20th, July 20th, October 20th, and January 20th, for biomonitoring conducted during the previous calendar quarter.

e. Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6 month period.

f. Annual biomonitoring test results are due on or before January 20th for biomonitoring conducted during the previous 12 month period.

4. Persistent Lethality

The requirements of this Part apply only when a toxicity test demonstrates significant lethality at the critical dilution. Significant lethality is defined as a statistically significant difference, at the 95% confidence level, between the survival of the test organism in a specified effluent dilution when compared to the survival of the test organism in the control.

a. The permittee shall conduct a total of two additional tests (retests) for any species that demonstrates significant lethality at the critical dilution. The two retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two retests in lieu of routine toxicity testing. All reports shall be submitted within 20 days of test completion. Test completion is defined as the last day of the test.

b. If one or both of the two retests specified in item 4.a. demonstrates significant lethality at the critical dilution, the permittee shall initiate the TRE requirements as specified in Part 5.

c. The provisions of item 4.a. are suspended upon completion of the two retests and submittal of the TRE Action Plan and Schedule defined in Part 5 of this Section.

5. Toxicity Reduction Evaluation

a. Within 45 days of the last test day of the retest that confirms significant lethality at the critical dilution, the permittee shall submit a General Outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and/or effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the last test day of the retest that confirms significant lethality at the critical dilution, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethal effects at the critical dilution for both test species defined in item 1.c. As a minimum, the TRE Action Plan shall include the following:

1) Specific Activities - The TRE Action Plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and/or alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA/600/6-91/003), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation

procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and/or suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office (6WQ-PI) and the TNRCC Region 14 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality at the critical dilution for a period of 12 consecutive months with at least monthly testing. At the end of the 12 months, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b.

This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and/or effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, then this permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing the WET limit, in lieu of an alternate toxicity control measure, by identifying and confirming the toxicant and/or an appropriate control measure.

f. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 28 months from the last test day of the retest that confirmed significant lethal effects at the critical dilution. The permittee may petition the Executive Director (in writing) for an extension of the 28-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall provide information pertaining to the specific control mechanism(s) selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism(s). Copies of the Final Report on the TRE Activities shall also be submitted to the U.S. EPA Region 6 office (6WQ-PI) and the TNRCC Region 14 office.

g. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and/or to specify CS limits.

TABLE 1 (SHEET 1 OF 2)

BIOMONITORING REPORTING: DAPHNIA PULEX SURVIVAL

| | | Date | Time | Date | Time |
|---|---|---|---|---|---|
| Dates and Times Composites Collected | No. 1 FROM: | _____ | | TO: _____ | |
| | No. 2 FROM: | _____ | | TO: _____ | |

Test initiated: _____ am/pm _____ date

Dilution water used: _____ Receiving water _____ Synthetic Dilution water

PERCENT SURVIVAL

| Time | Rep | Percent effluent (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0% | 32% | 42% | 56% | 75% | 100% |
| 24h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| 48h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| Mean at test end | | | | | | | |
| CV%* | | | | | | | |

*Coefficient of Variation = Standard Deviation x 100/mean

Dunnett's Procedure or Steel's Many-One Rank Test as appropriate:

Is the mean survival at 48 hours significantly less (p = 0.05) than the control survival?

CRITICAL DILUTION (100%): _____ YES _____ NO

Enter percent effluent corresponding to the NOEC below:

NOEC survival = _____% effluent

TABLE 1 (SHEET 2 OF 2)

BIOMONITORING REPORTING: FATHEAD MINNOW SURVIVAL

| | | | Date | Time | | Date | Time |
|---|---|---|---|---|---|---|---|
| Dates and Times Composites Collected | No. 1 | FROM: | | | TO: | | |
| | No. 2 | FROM: | | | TO: | | |

Test initiated: _____ am/pm _____ date

Dilution water used: _____ Receiving water _____ Synthetic Dilution water

PERCENT SURVIVAL

| Time | Rep | Percent effluent (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0% | 32% | 42% | 56% | 75% | 100% |
| 24h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| 48h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| Mean at test end | | | | | | | |
| CV%* | | | | | | | |

*Coefficient of Variation = Standard Deviation x 100/mean

Dunnett's Procedure or Steel's Many-One Rank Test as appropriate:

Is the mean survival at 48 hours significantly less (p = 0.05) than the control survival?

CRITICAL DILUTION (100%): _____ YES _____ NO

Enter percent effluent corresponding to the NOEC below:

NOEC survival = _____ % effluent

## 24-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply individually and separately to Outfall 001 for whole effluent toxicity testing (biomonitoring). No samples or portions of samples from one outfall may be composited with samples or portions of samples from another outfall. The provisions of this Section are in addition to other biomonitoring requirements in this permit.

1. Scope, Frequency and Methodology

   a. The permittee shall test the effluent for lethality in accordance with the provisions in this Section. Such testing will determine compliance with the Surface Water Quality Standard, 30 TAC §307.6(e)(2)(B), of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

   b. The toxicity tests specified shall be conducted once per six months. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA 600/4-90/027F), or the most recent update thereof:

      1) Acute 24-hour static toxicity test using Daphnia pulex. A minimum of five (5) replicates with eight (8) organisms per replicate shall be used for this test.

      2) Acute 24-hour static toxicity test using the fathead minnow (Pimephales promelas). A minimum of five (5) replicates with eight (8) organisms per replicate shall be used for this test.

      The permittee may be required to repeat an invalid test, including the control (0% effluent). An invalid test is herein defined as any test failing to satisfy test acceptability criteria, procedures, and quality assurance requirements specified in the test methods or in this permit. An invalid test shall be repeated within the required reporting period.

   c. In addition to an appropriate control, a 100% effluent concentration shall be used in the toxicity tests. Except as discussed in item 2.b., the control and/or dilution water shall consist of a standard, synthetic, moderately hard, reconstituted water.

   d. This permit may be amended to require a Whole Effluent Toxicity (WET) limit, a Best Management Practice (BMP), chemical-specific effluent limits, additional toxicity testing, and/or other appropriate actions to address toxicity. The permittee may be required to conduct additional biomonitoring tests if biomonitoring data indicate multiple numbers of unconfirmed toxicity events.

2. Required Toxicity Testing Conditions

   a. Test Acceptance - The permittee shall repeat any toxicity test, including the control, if the control fails to meet a mean survival equal to or greater than 90%.

   b. Dilution Water - In accordance with item 1.c., the control and/or dilution water shall normally consist of a standard, synthetic, moderately hard, reconstituted water. If the permittee utilizes the results of a 48-Hour Acute test or a Chronic test to satisfy the 24-Hour Acute Biomonitoring requirements in accordance with item 1.e., the permittee may use the receiving water or dilution water that meets the requirements of item 2.a. as the control and dilution water.

   c. Samples and Composites

      1) The permittee shall collect one flow-weighted 24-hour composite sample from Outfall 001. A

24-hour composite sample consists of a minimum of twelve (12) effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow, or a sample continuously collected proportional to flow over a 24-hour operating day.

2) The permittee shall collect the 24-hour composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the 24-hour composite sample. Samples shall be maintained at a temperature of 4 degrees Centigrade during collection, shipping, and storage.

4) If the outfall ceases discharging during the collection of the effluent composite sample, the requirements for the minimum number of effluent portions are waived. However, the permittee must have collected a composite sample volume sufficient for completion of the required test. The abbreviated sample collection, duration, and methodology must be documented in the full report required in Part 3 of this Section.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Toxicity Evaluation Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this permit in accordance with the Report Preparation Section of "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fourth Edition" (EPA 600/4-90/027F), or the most recent update thereof, for every valid and invalid toxicity test initiated. All full reports shall be retained for three (3) years at the plant site and shall be available for inspection by TNRCC personnel.

b. A full report must be submitted with the first valid biomonitoring test results for each test species and with the first test results any time the permittee subsequently employs a different test laboratory. Full reports need not be submitted for subsequent testing unless specifically requested. The permittee shall routinely report the results of each biomonitoring test on the Table 2 forms provided with this permit. All Table 2 reports must include the information specified in the Table 2 form attached to this permit.

c. If semi-annual biomonitoring is required, the test results (Table 2 reports) are due on the sixth (6th) month and annual anniversary dates of permit issuance. The results of the initial toxicity tests are due six (6) months from the permit issue date.

d. If quarterly biomonitoring is required, the test results (Table 2 reports) are due on the third (3rd), sixth (6th), and ninth (9th) month and annual anniversary dates of permit issuance. The results of the initial toxicity tests are due three (3) months from the permit issue date.

4. Persistent Mortality

The requirements of this Part apply when a toxicity test demonstrates significant lethality, here defined as a mean mortality of 50% or greater to organisms exposed to the 100% effluent concentration after 24-hours

a. The permittee shall conduct two (2) additional tests (retests) for each species that demonstrates significant lethality. The two retests shall be conducted once per week for two (2) weeks. Five effluent dilution concentrations in addition to an appropriate control shall be used in the retests. These

additional effluent concentrations shall be 6%, 13%, 25%, 50% and 100% effluent. The first retest shall be conducted within 15 days of the laboratory determination of significant lethality. All test results shall be submitted within twenty (20) days of test completion of the second retest. Test completion is defined as the 24th hour.

b. If one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the Toxicity Reduction Evaluation (TRE) requirements as specified in Part 5 of this Section.

5. Toxicity Reduction Evaluation

a. Within forty-five (45) days of the retest that demonstrates significant lethality, the permittee shall submit a General Outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and/or effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within ninety (90) days of the retest that demonstrates significant lethality, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethality for both test species defined in item 1.b. As a minimum, the TRE Action Plan shall include the following:

1) Specific Activities - The TRE Action Plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and/or alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA/600/6-91/003), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation procedures, and chemical-specific analyses when the toxicity tests show significant lethality.

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within thirty (30) days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly TRE Activities Reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and/or suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to eliminate significant lethality; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office (6WQ-PI) and the TNRCC Region 14 office.

e. The permittee shall continue routine biomonitoring quarterly (as a minimum) during the TRE, using the most sensitive species unless, after initiating the TRE, the effluent ceases to induce significant lethality for twelve (12) consecutive weeks with at least weekly sampling and testing. Such evidence shall be submitted with a statement of intent to cease the TRE. The permittee may then resume testing as required by this Section.

This provision does not apply as a result of corrective actions taken. Corrective actions which eliminate or reduce effluent toxicity include source reduction or elimination, housekeeping improvements, changes in chemical usage, and modifications of influent or effluent treatment.

f. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than eighteen (18) months from the last test day of the retest that demonstrates significant lethality. The permittee may petition the Executive Director (in writing) for an extension of the 18-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE.

The report shall specify the control mechanism(s) that will, when implemented, reduce effluent toxicity as specified in item 5.g. The report will also specify a corrective action schedule for implementing the selected control mechanism(s). The permittee shall also submit copies of the Final Report on the TRE Activities to the U.S. EPA Region 6 office (6WQ-PI) and the TNRCC Region 14 office.

g. Within three (3) years of the last day of the test confirming toxicity, the permittee shall comply with

30 TAC 307.6.(e)(2)(B), which requires greater than 50% survival of the test organism in 100% effluent at the end of 24-hours. The permittee may petition the Executive Director (in writing) for an extension of the 3-year limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE.

The requirement to comply with 30 TAC 307.6.(e)(2)(B) may be exempted upon proof that toxicity is caused by an excess, imbalance, or deficiency of dissolved salts. This exemption excludes instances where individually toxic components (e.g. metals) form a salt compound. Following the exemption, the permit may be amended to include an ion-adjustment protocol, alternate species testing, or single species testing.

h. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and/or to specify a chemical-specific effluent limit(s).

TABLE 2 (SHEET 1 OF 2)

DAPHNIA PULEX SURVIVAL

GENERAL INFORMATION

| | Time (am/pm) | Date |
|---|---|---|
| Composite Sample Collected | | |
| Test Initiated | | |

PERCENT SURVIVAL

| Time | Rep | Percent effluent (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0% | 6% | 13% | 25% | 50% | 100% |
| 24h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | MEAN* | | | | | | |

1. Enter percent effluent corresponding to the LC50 below:

   24 hour LC50 (Daphnia or Ceriodaphnia) = _____% effluent
   (circle appropriate genus)

   95% confidence limits: _____

   Method of LC50 calculation:_____

*If 24-hour survivorship data from the chronic Ceriodaphnia dubia test is being used, the mean survival per dilution for all 10 replicates shall be reported on this row.

TABLE 2 (SHEET 2 OF 2)

FATHEAD MINNOW SURVIVAL
(Pimephales promelas)

GENERAL INFORMATION

| | Time (am/pm) | Date |
|---|---|---|
| Composite Sample Collected | | |
| Test Initiated | | |

PERCENT SURVIVAL

| Time | Rep | Percent effluent (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0% | 6% | 13% | 25% | 50% | 100% |
| 24h | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | MEAN | | | | | | |

1. Enter percent effluent corresponding to the LC50 below:

   24 hour LC50 (Pimephales) = _____% effluent

   95% confidence limits: _____

   Method of LC50 calculation:_____

# APPENDIX NO. 5

# SOIL SALINITY INVESTIGATION PLAN

JAMES MIERTSCHIN & ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERING
P.O. BOX 162305 • AUSTIN, TEXAS 78716-2305 • (512) 327-2708

MEMO

TO: TNRCC Ground-Water Protection Team
FROM: James Miertschin, PE, PhD
DATE: 15 September 1999
SUBJECT: Soil Salinity Investigation Plan
Diamond Shamrock Refinery Irrigation Tract
TPDES Permit No. 01353


TPDES Permit No. 01353, Other Requirements, Item 13 requires the Diamond Shamrock Refinery to develop a plan for investigation of soil salinity and sodium absorption ratios within the wastewater irrigation tract. This plan was to be submitted within 90 days of permit issuance (which was 18 June 1999).

Diamond Shamrock is currently preparing an application for permit amendment to expand the existing irrigation tract.

## 1.0 PAST AND PRESENT IRRIGATION TRACT MANAGEMENT

### 1.1 SOILS

A soils map for the existing and proposed irrigation area is shown in Figure 1. The mapping of indigenous soil units is superimposed over the irrigation area. Soils mapping was based upon unpublished soil survey data for Live Oak County provided by the USDA Natural Resources Conservation Service (NRCS, formerly Soil Conservation Service).

According to the general soils map for Live Oak County, the general soil group on the existing irrigation tract is the Runge-Papalote-Wilco group. These are typically deep, moderate to very slowly permeable, well drained upland soils that have sandy and loamy surface layers and loamy to clayey subsoils. The soils map for the irrigation tract indicates the presence of numerous individual soil types. Soils on the site appear to be fairly homogeneous with respect to composition, depth, and permeability. The soils are generally sandy clay loam. Permeabilities may be as low as 0.06 inches/hour in specific locations, but they are generally within the range of 0.2 - 2.0 inches/hour.

The individual soil types and pertinent characteristics are described in Table 1, based upon the information provided by the NRCS. The mapping units correspond to the soils map in Figure 1. Surface soil textural classification for the irrigation tract is also shown in Figure 1.

Additional soils data is available from sampling conducted in accordance with existing permit requirements. An annual soil sample from the root zone of the irrigated site is collected and tested for oil and grease, pH, total nitrogen, nitrate nitrogen, potassium, phosphorus, and conductivity. These data are displayed in Table 2. In addition, the existing permit requires that surface samples of soil shall be collected quarterly from heavily irrigated areas and analyzed for exchangeable sodium percentage (ESP). Results of the ESP tests are shown in Table 3.

The subsurface characteristics of the irrigation tract were described in an earlier report by Underground Resource Management, Inc. (URM, 1984). The tract is located on an outcrop of the Catahoula Formation, which is primarily clay and mudstone, with scattered beds and lenses of gravel and sand. The Catahoula yields very small to small quantities of fresh to slightly saline water in the project area. Two borings were performed to determine the underlying stratigraphy. The northern portion of the site is underlain by a thick caliche deposit which ranges in thickness from greater than 40 feet to less than 15 feet. Sediments obtained in the borings were dry to depths greater than 30 feet, and no free water was encountered in the drilling program. Surface sediments in the area appeared to be slowly permeable and significant seepage of waters would appear to be low. The borings did not indicate the presence of any shallow ground water at the site. The permeability of the underlying sediments was low and seepage would not be expected to be significant (URM, 1984)

## 1.2 WASTEWATER QUALITY

Historical data for wastewater quality is shown in Table 4.

The existing TPDES permit for the refinery stipulates that the effluent application rate not exceed an annual average rate of 2.95 acre-feet/acre/year. Past application rates have been at or near this permitted value.

## 1.3 COVER CROP MANAGEMENT

### Crop

The current cover crop on the existing irrigation system is coastal bermudagrass and winter ryegrass. Approximately 341.5 acres of bermuda and rye have been under cultivation on the existing 617-acre tract, the exact acreage at any one time depending upon the layout of the pivot and side roll sprinkler irrigation systems at any particular time.

The irrigation area will be expanded under a proposed permit amendment. A minimum of 403 acres is proposed for irrigation, and the actual area could be greater on the expanded irrigation tract that will have a total area of 1376 acres. Bermuda will be grown year-round, but the principal growing season is March through October. Rye

will be grown during the cool-weather months. The dual cropping approach provides evapotranspiration needs on a year-round basis.

Both bermuda and rye have been successfully cultivated on the irrigation tract using effluent from the refinery as the sole source of irrigation water. Crop growth has been vigorous to date. The main difficulty at the site has been the need to irrigate under the occasional prolonged wet-weather conditions.

## Nutrients

The nitrogen application rate for bermuda is recommended at 100 lbs N/acre per cutting, according to the Texas Agricultural Extension Service. Ryegrass will require an additional 200 lbs N/acre per year.

The nitrogen requirements for the cover crop will be provided by the nitrogen content of the refinery effluent. No other fertilization is practiced at the site.

## Watering

All irrigation will utilize treated effluent. The effluent application rate for the cover crop is projected to be 2.95 feet/year or less.

## Harvesting

When the system is operating at the maximum effluent application rate, and maximum allowable nitrogen concentration, on a specific irrigation tract, 4 cuttings of coastal bermudagrass per year are anticipated from that tract. The number of cuttings will be reduced if the average nitrogen concentration in the effluent is below the maximum allowable. The bermuda is harvested with hay cutting and baling equipment by a contract lease operator. The cover crop is occasionally burned to control fire ants.

## Salt Tolerances

Bermudagrass is relatively tolerant of high salt loadings. Published data indicates that a 100% yield potential for bermuda would require a maximum soil extract conductivity of 6.9 mmhos/cm and an irrigation water conductivity of 4.6 mmhos/cm (Schwab, G.O., et al., 1981, "Soil and Water Conservation Engineering"). Ryegrass is also relatively salt tolerant, but to a lesser extent than bermuda. The salt concentration in the root zone is controlled by leaching.

## 2.0 SCHEDULED MONITORING ACTIVITIES

Several monitoring activities that will provide information on soil salinity are planned for the irrigation tract.

### 2.1 COMPREHENSIVE SOIL SAMPLING

Comprehensive soils data for the irrigation tract will be obtained with an onsite sampling survey, in accordance with the permit renewal application requirements. A composite sample will be prepared for each irrigation zone on the irrigation tract. Each sample will actually consist of three composite samples, one from each of the three vertical zones of 0-6, 6-18, and 18-30 inches. Each composite sample will be prepared from 15 subsamples.

Each composite sample will be tested for pH, conductivity, sodium adsorption ratio, total nitrogen, nitrate-nitrogen, potassium, phosphorus, calcium, magnesium, sulphur, and sodium. Nutrient parameters will be analyzed on a plant available or extractable basis. Laboratory analyses will be provided by the Texas Agricultural Extension Service soil testing laboratory in College Station.

### 2.2 ANNUAL SOIL SAMPLING

TPDES Permit No. 01353, Other Requirements, Item 13 requires annual soil sampling from the root zone of the irrigation site. This provision could be satisfied with a single soil sample from the site, as was provided under the previous permit stipulation. To support the soil salinity investigation, Diamond Shamrock will increase the spatial coverage of the annual soil sampling activity and provide one composite sample per pivot irrigation zone. Each of these composite samples will be split into three vertical layers for testing, nominally, 0-6, 6-18, and 18-30 inches. Each sample will be tested for oil and grease, pH, total and nitrate nitrogen, potassium, phosphorus, conductivity, calcium, magnesium, sulphur, sodium, and SAR.

### 2.3 QUARTERLY SOIL SAMPLING

TPDES Permit No. 01353, Other Requirements, Item 12 requires quarterly sampling of surficial soils from the most heavily irrigated areas on the tract. To support the soil salinity investigation, Diamond Shamrock will increase the spatial coverage of the quarterly surficial soil sampling activity and provide one sample per pivot irrigation zone.

### 2.4 WASTEWATER SAMPLING

Wastewater sampling will continue in accordance with TPDES Permit No. 01353, Irrigation Requirements, Item 10. Testing will be provided for $BOD_5$, COD, oil and

grease, ammonia-nitrogen, phenols, sulfides, total chromium, hexavalent chromium, and pH. To support the soil salinity investigation, Diamond Shamrock will add measurement of conductivity to the sampling activities.

## 3.0 FUTURE IRRIGATION TRACT MANAGEMENT

### 3.1 SOILS

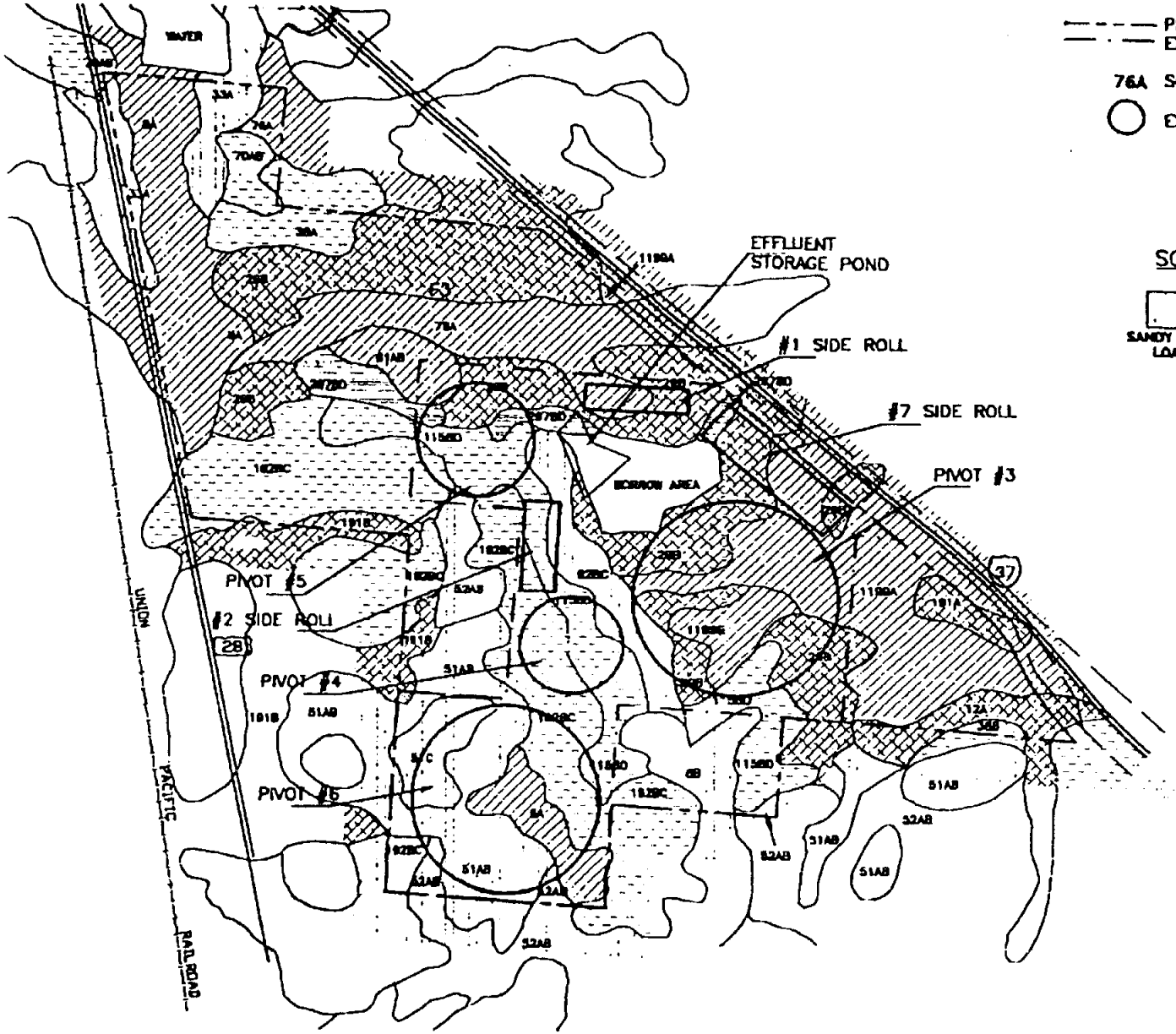
In the past irrigation practice, salinity in the root zone has been controlled by leaching and this practice is expected to continue. The sampling data described in Section 2.0 will be reviewed for indication of any special management activities that may be required. For example, a program of calcium amendment will be implemented if needed to reduce ESP, in accordance with TPDES Permit No. 01353, Other Requirements, Item 12.

### 3.2 WASTEWATER QUALITY

Wastewater quality is not expected to be substantially different from the historical wastewater quality.

### 3.3 COVER CROP MANAGEMENT

The historical cropping of bermuda and rye has been successful and will be continued.




PROPOSED IRRIGATION PROPERTY BOUNDARY

EXISTING IRRIGATION PROPERTY BOUNDARY

76A SOIL TYPE, BASED ON NRCS MAPPING

EXISTING PIVOT/SIDE ROLL

## SOIL TEXTURAL CLASS

SANDY CLAY LOAM

FINE SANDY LOAM

GRAVELLY LOAM

CLAY

CLAY LOAM

0 1,500' 3,000'

SCALE: 1"=1,500'

N

JAMES MIERTSCHIN & ASSOCIATES, INC
ENVIRONMENTAL ENGINEERING

FIGURE 1; SOILS MAP
DIAMOND SHAMROCK IRRIGATION AREA
THREE RIVERS, TEXAS

TABLE 1
SOILS PROPERTIES
DIAMOND SHAMROCK IRRIGATION TRACT

| Soil Series | Map Symbol | Depth (in) | USDA Texture | Percentage Passing Sieve No. 200 | Liquid Limit | Plasticity Index | Permeability (in/hr) | AWC (in/in) | High Water Table Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| Monteola | 6A | 0-5 | Clay | 75-90 | 51-75 | 30-50 | <0.06 | | >6.0 |
| | | 5-72 | Clay | 75-98 | 56-80 | 33-54 | <0.06 | | -- |
| Clareville | 12A | 0-11 | Clay Loam, Loam, Sandy Clay Loam | 45-70 | 32-48 | 15-27 | 0.6-2.0 | | >6.0 |
| | | 11-38 | Clay Loam, Clay, Sandy Clay | 51-80 | 46-60 | 25-37 | 0.2-0.6 | | |
| | | 38-64 | Clay Loam, Loam | 51-75 | 39-52 | 17-30 | 0.6-2.0 | | |
| Weesatche | 51AB/51C/52AB | 0-8 | Sandy Clay Loam, Loam, Fine Sandy Loam | 28-65 | 28-45 | 13-28 | 0.6-2.0 | | >6.0 |
| | | 8-38 | Sandy Clay Loam, Clay Loam | 28-75 | 36-50 | 21-30 | 0.6-2.0 | | -- |
| | | 38-80 | Sandy Clay Loam, Clay Loam, Fine Sandy Loam | 28-80 | 33-50 | 20-30 | 0.6-2.0 | | -- |
| Pavelek | 61AB | 0-7 | Clay | 70-80 | 56-66 | 33-41 | 0.06-0.2 | | >6.0 |
| | | 7-14 | Gravelly Clay, Gravelly Clay Loam | 45-55 | 51-66 | 29-41 | 0.06-0.2 | | -- |
| | | 14-20 | Cemented | -- | -- | -- | -- | | -- |
| | | 20-80 | Silty Loam, Loam | 70-80 | 20-30 | 5-12 | 0.6-2.0 | | -- |
| Pernitas | 192BC | 0-11 | Fine Sandy Loam | 30-40 | <30 | NP-7 | 2.0-6.0 | 0.11-0.16 | >6.0 |
| | 92BC | 0-11 | Sandy Clay Loam | 36-55 | 24-37 | 9-20 | 0.6-2.0 | 0.11-0.16 | >6.0 |
| | | 11-17 | Sandy Clay, Clay, Clay Loam | 53-75 | 33-57 | 16-33 | 0.6-2.0 | 0.13-0.18 | -- |
| | | 17-30 | Clay Loam, Clay | 45-70 | 30-55 | 18-32 | 0.6-2.0 | 0.13-0.19 | |
| | | 30-72 | Sandy Clay, Sandy Clay Loam | 40-67 | 35-50 | 17-27 | 0.6-2.0 | 0.10-0.15 | -- |
| Coy | 191A/191B | 0-12 | Clay Loam, Clay | 70-85 | 35-55 | 18-30 | 0.2-0.6 | | >6.0 |
| | | 12-66 | Clay, Clay Loam, Sandy Clay | 70-90 | 42-62 | 27-42 | <0.06 | | -- |
| Buchel | 8A | 0-16 | Clay | 75-95 | 55-75 | 32-48 | <0.06 | 0.12-0.20 | >60 |
| | | 16-42 | Clay | 75-95 | 55-75 | 32-48 | <0.06 | 0.12-0.20 | -- |
| | | 42-80 | Clay | 75-95 | 55-75 | 32-48 | <0.06 | 0.12-0.20 | -- |
| Raymondville-Variant | 29B | 0-14 | Clay Loam | 51-85 | 37-50 | 18-30 | -- | | -- |
| | | 14-38 | Clay, Clay Loam | 75-95 | 38-55 | 19-35 | -- | | -- |
| | | 38-60 | Clay, Clay Loam | 75-95 | 40-53 | 20-35 | -- | | -- |
| Papalote | 38A/38B | 0-14 | Fine Sandy Loam | 26-50 | <25 | NP-9 | -- | | -- |
| | | 14-36 | Sandy Clay, Clay, Clay Loam | 45-70 | 41-60 | 21-36 | -- | | -- |
| | | 36-60 | Sandy Clay Loam, Clay Loam, Sandy Loam | 40-70 | 38-48 | 18-31 | -- | | -- |
| Rosenbrock | 76A | 0-8 | Clay | 80-90 | 56-66 | 33-41 | <0.06 | 0.14-0.20 | >6.0 |
| | | 8-43 | Clay | 85-95 | 61-76 | 36-49 | <0.06 | 0.14-0.20 | -- |
| | | 43-62 | Loam, Clay Loam | 85-95 | 36-51 | 17-28 | 0.2-0.6 | 0.13-0.19 | -- |
| | | 62-80 | Loam | 70-80 | 20-30 | 5-12 | 0.6-2.0 | 0.07-0.11 | -- |
| Pharr | 115BD | 0-18 | Fine Sandy Loam | 36-50 | 21-30 | 5-13 | -- | | -- |
| | | 18-72 | Sandy Clay Loam, Clay Loam | 36-55 | 30-40 | 11-21 | -- | | -- |
| Olmos | 297BD | 0-13 | Gravelly Loam | 20-35 | 25-35 | 7-15 | 0.6-2.0 | 0.05-0.10 | >6.0 |
| | | 13-28 | Cement | -- | -- | -- | -- | -- | -- |
| Eloso | 1199A/1199B | 0-5 | Clay | 75-85 | 56-66 | 33-41 | <0.06 | 0.14-0.20 | >6.0 |
| | | 5-28 | Clay | 75-85 | 56-66 | 33-41 | <0.06 | 0.14-0.20 | -- |
| | | 28-37 | Clay Loam, Clay, | 80-95 | 51-66 | 29-41 | 0.06-0.2 | 0.08-0.18 | -- |
| | | 37-80 | Loam | 70-80 | 20-30 | 5-12 | 0.6-2.0 | 0.08-0.18 | -- |

Sources: NRCS Soil Data

**Table 2**
**Soil Analysis on Irrigation Tract**
**Diamond Shamrock**

| Date | pH | Nitrogen (ppm) | Phos (ppm) | Potassium (ppm) | Cond (uhmos/cm) | Oil & Grease (ppm) | NO3-N (ppm) |
|---|---|---|---|---|---|---|---|
| 2-Sep-93 | 7.8 | 240 | <0.5 | 3700 | 2000 | <10 | 13 |
| 10-Aug-94 | 8.1 | 3600 | 5 | 4860 | 59 | <10 | 9.4 |
| 10-Aug-94 | 8.5 | 3100 | 3.85 | 4690 | 110 | <10 | 12.3 |
| 11-Sep-95 | 7.8 | 823 | 1.18 | 2250 | 660 | 52.6 | 2.53 |
| 28-Aug-96 | 7.5 | 178 | 15.5 | 4760 | 3088 | 10.05 | 35.5 |
| 1-Sep-97 | 7.8 | 346 | 778 | 4380 | 640000 | 20 | 54.7 |
| 2-Oct-98 | 8.1 | 276.7 | 3090 | 1690 | 99 | 20 | 11.4 |
| 8-Aug-99 | 8.5 | 1930 | 138 | 3500 | 422 | 410 | 16.1 |
| 3-Sep-99 | -- | -- | -- | -- | -- | 59 | -- |

**Table 3**
**Quarterly Irrigation Soils Analysis**
**Exchangeable Sodium Percentages**
**Diamond Shamrock Three Rivers Refinery**

| Date | #6 South | #4 Center | #5 West | #3 East | #1 Side Row | #2 Side Row | #7 Side Row |
|---|---|---|---|---|---|---|---|
| 22-Jan-92 | 9.43 | 7.65 | 10.81 | | | | |
| | 9.08 | | | | | | |
| 4-May-92 | 8.25 | 8.34 | 9.75 | | | | |
| | 9.00 | | | | | | |
| 6-Jul-92 | 8.44 | 7.85 | 8.03 | 5.46 | | | |
| | 8.69 | | | | | | |
| 28-Sep-92 | 8.06 | 7.93 | 7.73 | 4.88 | 4.44 | | |
| | 9.19 | | | | | | |
| 9-Dec-92 | 8.45 | 7.75 | 7.83 | 4.39 | 4.59 | | |
| | 8.22 | | | | | | |
| 5-Jun-93 | 6.59 | 12.13 | 5.28 | 5.87 | 5.72 | | |
| | 10.42 | | | | | | |
| 14-Sep-93 | 8.35 | 11.56 | 6.32 | 5.44 | 4.39 | | |
| | 10.88 | | | | | | |
| 7-Dec-93 | 7.42 | 10.39 | 5.47 | 5.40 | 5.61 | | |
| | 11.72 | | | | | | |
| 1-Apr-93 | 7.22 | 8.16 | 7.88 | 3.37 | 5.62 | | |
| | 9.49 | | | | | | |
| 7-Mar-93 | 7.59 | 10.00 | 12.38 | 9.12 | 7.91 | | |
| | 13.16 | | | | | | |
| 29-Aug-94 | 10.19 | 12.33 | 12.15 | 9.44 | 10.21 | | |
| | 11.06 | | | | | | |
| 1-Dec-94 | 7.46 | 10.25 | 11.67 | 9.37 | 6.71 | | |
| | 13.48 | | | | | | |
| 16-Mar-95 | 28.90 | 2.40 | 2.80 | 4.30 | 0.50 | | |
| | 10.60 | | | | | | |
| 15-Jun-95 | 8.70 | 2.66 | 2.94 | 3.21 | 0.47 | 0.38 | |
| 16-Nov-95 | 0.088 | 0.049 | 0.091 | 0.055 | 0.051 | 0.046 | |
| 26-Feb-96 | 6.79 | 9.37 | 13.62 | 7.28 | 1.52 | 3.86 | |
| 5-Nov-96 | 4.28 | 6.12 | 3.99 | 8.05 | 4.17 | 4.00 | |
| 10 Feb-97 | 13.32 | 13.84 | 8.68 | 8.71 | 0.74 | 5.81 | |
| 24-Apr-97 | 1.67 | 4.21 | 2.21 | 5.22 | 0.33 | 2.95 | |
| 2-Sep-97 | 4.08 | 4.36 | 11.06 | 1.59 | 6.85 | 2.62 | |
| 3-Dec-97 | 4.2 | 7.4 | 6.8 | 1.1 | 3.4 | 3.9 | |
| 31-Mar-98 | 16 | 7.2 | 8.1 | 7.9 | 1.2 | 4.1 | |
| 29-May-98 | 1.8 | 9.3 | 8.2 | 10.8 | 6.9 | 7 | |
| 21-Sep-98 | 14.76 | 6.69 | 6.12 | 7.72 | 3.34 | 4.42 | 5.67 |
| 31-Dec-98 | 0.25 | 0.02 | 0.32 | 0.02 | 0.55 | 0.02 | 0.02 |
| 16-Feb 99 | 9.66 | 12.59 | 7.66 | 12.16 | 7.44 | 3.55 | |
| 19-May-99 | 2.21 | 3.73 | 6.99 | 10.65 | 1.48 | 10.55 | |
| 9-Aug-99 | 12.49 | 15.87 | 16.76 | 10.02 | 8.89 | 12.95 | 9.12 |

## TABLE 4
## HISTORICAL WASTEWATER DATA

| DATE MO / YR | 30 - DAY AVG FLOW (gpd) | BOD (5) (mg/l) | TSS (mg/l) | AMMON A NITROGEN (mg/l) | IRRIGATION APPLICATION RATE (acre-feet/mo.) |
|---|---|---|---|---|---|
| Jul-97 | 926,519 | 5.5 | N/A | 0.36 | 88.15 |
| Aug-97 | 1,380,058 | 9 | N/A | 0.874 | 131.29 |
| Sep-97 | 1,169,620 | 29.5 | N/A | 12.4 | 104.08 |
| Oct-97 | 686,921 | 33.8 | N/A | 5.7 | 29.51 |
| Nov-97 | 701,200 | 19 | N/A | 1.62 | 43.03 |
| Dec-97 | 804,196 | 30.4 | N/A | 7.1 | 76.50 |
| Jan-98 | 1,135,106 | 15.6 | N/A | 0.32 | 107.97 |
| Feb-98 | 838,046 | 11.4 | N/A | 3.38 | 33.43 |
| Mar-98 | 1,054,564 | 19.8 | N/A | 6.7 | 90.60 |
| Apr-98 | 1,270,471 | 14 | N/A | 3.7 | 109.15 |
| May-98 | 1,371,771 | 31.4 | N/A | 15.1 | 130.48 |
| Jun-98 | 1,341,903 | 30.4 | N/A | 10.4 | 123.53 |
| Jul-98 | 863,765 | 32.5 | N/A | 10.1 | 60.96 |
| Aug-98 | 996,805 | 26.3 | N/A | 12.8 | 58.11 |
| Sep-98 | 796,278 | 13.3 | N/A | 8.13 | 65.97 |
| Oct-98 | 993,062 | 9.7 | N/A | 0.318 | 63.99 |
| Nov-98 | 651,939 | 4.8 | N/A | 0.3 | 46.01 |
| Dec-98 | 870,886 | 5.6 | N/A | 0.23 | 72.15 |
| Jan-99 | 942,987 | 9.1 | N/A | 1.91 | 89.70 |
| Feb-99 | 1,299,339 | 9.1 | N/A | 0.87 | 111.63 |
| Mar-99 | 879,768 | 22.9 | N/A | 3.3 | 75.59 |
| Apr-99 | 886,016 | 190.5 | N/A | 28.3 | 51.65 |
| May-99 | 1,209,154 | 21.1 | N/A | 5.23 | 103.89 |
| Jun-99 | 1,361,503 | 25.9 | N/A | 2.1 | 121.16 |

# APPENDIX NO. 6

# COST ESTIMATES

# *COST ESTIMATE*

**NEW WATER TRANSMISSION FACILITIES TO SERVE CHOKE CANYON W.S.**

| | |
|---|---|
| Transmission Pump Station 1 LS | $25,600 |
| 16,500 LF of 8" PVC @ $14/LF | $231,000 |
| 10 Fittings @ $300/EA | $3,000 |
| 4 - 8" Valves @ $600/EA | $2,400 |
| 300 LF of 12" Casing Installed by Boring @ $100/LF | $30,000 |
| 1 EA Creek Crossing @ $40,000/EA | $40,000 |
| 4 Air Release Valves @ $2,000/EA | $8,000 |
| Service Pump Station 1 LS | $75,000 |
| Ground Storage Tank @ $35,000/LS | $35,000 |
| Contingencies (10%) | $45,000 |
| **TOTAL CONSTRUCTION COST** | **$495,000** |
| Engineering | $55,000 |
| Inspection | $22,000 |
| Land / Easements | $36,000 |
| **TOTAL PROJECT COST** | **$608,000** |

# *COST ESTIMATE*

**NEW REGIONAL WTP AT CHOKE CANYON RESERVOIR AND CHOKE CANYON WATER SUPPLY TIE-IN**

| | |
|---|---|
| New 2.0 MGD Water Treatment Plant | $4,000,000 |
| New Transmission Line to C.C.W.S. | |
| 8" PVC 5,000 LF @ $14/LF | $70,000 |
| Parallel 6" PVC 9,000 LF @ $10/LF | $90,000 |
| 10 Fittings @ $300/EA | $3,000 |
| 5 Valves @ $600/EA | $3,000 |
| 200 LF of 12" Casing by Boring @ $100/LF | $20,000 |
| 4 Air Release Valves @ $2,000/EA | $8,000 |
| Contingencies (10%) | $420,000 |
| TOTAL CONSTRUCTION COST | $4,614,000 |
| Engineering | $507,500 |
| Inspection | $140,000 |
| New TNRCC Permit | $10,000 |
| Land (12 Acres) | $36,000 |
| **TOTAL PROJECT COST** | **$5,307,500** |

# *COST ESTIMATE*

## NEW CONVENTIONAL THREE RIVERS WWTP AT NEW LOCATION

| | |
|---|---|
| New Conventional WWTP | $1,000,000 |
| New Force Main 1,500 LF @ $7.50 | $11,250 |
| Lift Station Modifications | $20,000 |
| Demolish Existing Plant | $25,000 |
| Contingencies (10%) | $105,750 |
| **TOTAL CONSTRUCTION COST** | **$1,162,000** |
| Engineering | $128,000 |
| Inspection | $58,000 |
| New TNRCC Discharge Permit | $10,000 |
| Land (12 Acres) | $36,000 |
| **TOTAL PROJECT COST** | **$1,394,000** |

# *COST ESTIMATE*

**NEW LAGOON/WETLANDS THREE RIVERS WWTP AT NEW LOCATION**

| | |
|---|---|
| New Lagoon/Wetlands WWTP | $1,000,000 |
| New Force Main 1,500 LF @ $7.50 | $11,250 |
| Lift Station Modifications | $20,000 |
| Demolish Existing Plant | $25,000 |
| Contingencies (10%) | $105,750 |
| **TOTAL CONSTRUCTION COST** | **$1,162,000** |
| Engineering | $128,000 |
| Inspection | $58,000 |
| New TNRCC Discharge Permit | $10,000 |
| Land (50 Acres) | $150,000 |
| **TOTAL PROJECT COST** | **$1,508,000** |

# *COST ESTIMATE*

**RENOVATE EXISTING THREE RIVERS WWTP**

| | |
|---|---|
| Renovation and Modifications | $400,000 |
| Contingencies (10%) | $40,000 |
| TOTAL CONSTRUCTION COST | $440,000 |
| Engineering | $44,000 |
| Inspection (5%) | $22,000 |
| **TOTAL PROJECT COST** | **$506,000** |

# APPENDIX NO. 7

# LIVE OAK UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

# LIVE OAK
# Underground Water Conservation District

# DISTRICT MANAGEMENT PLAN

Mr. Craig Pedersen
Executive Administrator
Texas Water Development Board
1700 N. Congress
Austin, Texas 78711-3231

Dear Mr. Pedersen,

The Live Oak Underground Water Conservation District (LOUWCD) is pleased to submit to the Texas Water Development Board (TWDB) a copy of our adopted Management Plan as mandated by Senate Bill 1 of the 75th Texas Legislature. The Live Oak Underground Water Conservation District Management Plan (LOUWCD MP) was adopted by the LOUWCD Board of Directors at their quarterly meeting on November 1, 1997, by unanimous consent. In addition, a certified copy of the LOUWCD Board of Directors resolution adopting the plan is also attached.

The LOUWCD, established in 1991, has historically had an excellent working relationship with the TWDB and it is our hope that we can count on your support as we implement the enclosed plan, it is the intent of our Board of Directors that we will begin implementation of this plan immediately to facilitate the success of our efforts.

The LOUWCD MP was developed during open meetings of the Board of Directors in accordance with all notice and hearing requirements stated in the District's procedures. Documentation that notice and hearing requirements were followed is presented in a separate attachment. The following cross-references are provided as a means of documenting the completeness of our Management Plan as applicable to the statutory requirements of Senate Bill 1 and TAC Chapter 356. During preparation of the LOUWCD Management Plan, (LOUWCD MP) all planning efforts were coordinated with the Nueces River Authority, as mandated by 36.107 (a) and TAC 356.6(a)(4). Documentation of this coordinated effort, including the resolution acknowledging this coordination, is included in this packet for your review. 36.1071(a)(1) is addressed in LOUWCD MP Section 2.0.
36.1071(a)(2) is addressed in LOUWCD MP Section 1.0.
36.1071(a)(3) Is addressed in LOUWCD Section titled SB-1 Management Goals Determined Not-Applicable 1.0
36.1071(a)(4) is addressed in LOUWCD MP Section 4.0.
36.1071(a)(5) is addressed in LOUWCD MP Section titled SB-1 Management Goals Determined Not Applicable 2.0
The requirement of 36.1071(e)(1) is met by the submission of the LOUWCD MP to the TWDB.
36.1071(e)(2) is addressed in LOUWCD Section 3.0.
36.1071(e)(3)(A) is addressed in LOUWCD MP Section titled Topography, Drainage and Groundwater Resources of Live Oak County.
36.1071(e)(3)(B) is addressed in LOUWCD MP Section titled Projected Water Supplies in Live Oak County

36.1071(e)(3)(C) is addressed in LOUWCD MP Section titled Projected Demands for Water in Live Oak County and in LOUWCD MP Section 3.0.
36.1071(e)(3)(D) is addressed in LOUWCD MP Section titled Projected Demands for Water in Live Oak County.
36.1071(e)(4) is addressed in LOUWCD MP Section titled Potential Demand and Supply Issues and Solutions.

Recently we provided your staff with a copy of our District Rules. In accordance with the requirements of 36.1071(f) we are attaching an additional copy of the District Rules in a separate enclosure. These District Rules were adopted by the LOUWCD Board of Directors at the regularly scheduled meeting on July 1, 1997, and will be used during the implementation of the LOUWCD MP.

36.1071(g) and TAC 356.6(a)(5) will not be applicable at this time, but will be addressed in five years in 2002 when the LOUWCD MP must be recertified.

The LOUWCD MP will be in force for 10 years from the date of certification. If there is any other documentation we can provide to the TWDB that will ensure the prompt certification of the Live Oak Underground Water Conservation District Management Plan, please do not hesitate to call me or my staff. I look forward to working with you and your staff throughout the implementation of the various elements of Senate Bill 1.

Sincerely,

Scott Bledsoe III

## DISTRICT MISSION

The Live Oak Underground Water Conservation District will strive to develop, promote, and implement water conservation, augmentation, and management strategies to protect water resources for the benefit of the citizens, economy, and environment of the district.

## TIME PERIOD FOR THIS PLAN

This plan becomes effective upon certification by the Texas Water Development Board and remains in effect until a revised plan is certified or September 1, 2007, which ever is earlier.

## STATEMENT OF GUIDING PRINCIPLES

The district recognizes that the groundwater resources of the region are of vital importance. The preservation of this most valuable resource can be managed in a prudent and cost effective manner through regulation and permitting. This management document is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of district activities.

### General Description

The District was created by the citizens of Live Oak County through election, November,1991. The current Board of Directors are Scott Bledsoe III - Chairman, Mark Katzfey - Vice-Chairman, Lonnie Stewart - Secretary and Treasurer, Mark Riser and Howard Crawford , Live Oak Underground Water Conservation District (LOUWCD) has the same areal extent as that of Live Oak County. The county has a vibrant economy dominated by agriculture and petroleum. The agriculture income is derived primarily from beef cattle production, wheat, corn, sorghum, and cotton, with some sheep and goat ranching.

### Location and Extent

Live Oak County, consisting of 1,072 square miles, is located in South Texas. The county is bounded on the east by Bee, San Patricio, and Karnes counties, on the north by Atascosa county, on the west by McMullen County, and on the south by Jim Wells County. George West, which is centrally located in the county, is the county seat. Three Rivers, the only other municipality in the county, is located in the northern portion of the county.

**Topography , Drainage and Groundwater Resources of Live Oak County**

Live Oak County is on the Gulf Coastal Plain in southern Texas. Most the 1,072 square miles of the county are devoted to farming and ranching which provide the principal income for the 9,000 inhabitants. The production of oil is also an important industry.

The principal water-bearing formations underlying the county are the Carrizo sand, Oakville sandstone, Lagarto clay, and Goliad sand, and range in age from Eocene to Pliocene. The formation dip toward the coast at rates ranging from less than 20 to about 140 feet to the mile.

About 2,150,000 gallons per day of ground water was withdrawn in 1957 from approximately 1,000 wells in the county. Some irrigation, municipal, and stock supplies were obtained from surface-water sources. In Live Oak County the water-bearing sands above a depth of 2,000 feet contain approximately 20 million acre-feet of fresh and slightly saline water. Even though it may be impractical to recover much of the stored water, the rate of withdrawal could be increased several times more than the 1957 rate without appreciably depleting the water available from storage for many decades. A large but unestimated amount of fresh to slightly saline water occurs in the Carrizo sand in the northern and northwestern parts of the county at depths as much as 6,000 feet. Most of the water in the Carrizo sand in Live Oak County is more than 4,000 feet below land surface and therefore is too deeply buried to be economically developed for most uses.

Most of the ground water in Live Oak County is substandard in quality for municipal, industrial, and irrigational uses. However, because better water is not available in most areas in the county, substandard water has been used successfully by users of all three categories. Generally the Goliad sand contains water of better quality than that in any formation except the Carrizo sand. In favorable areas properly constructed wells in the Carrizo, Oakville, Lagarto, and Goliad may yield 1,000 gallons per minute or more. Yields from wells tapping the other water-bearing formations generally are small and the water commonly is suitable only for stock.

Most of Live Oak County is rolling to moderately hilly, although some areas are nearly flat. The altitude ranges from about 460 feet in the southwestern part of the county to about 90 feet near Lake Corpus Christi. The county is drained by the Nueces River and its tributaries, the Frio and Atascosa Rivers, with the exception of a small, elongated area near the Bee County line which is drained by tributaries of the Aransas River.

The water-bearing formations in Live Oak County are continually recharged by the infiltration of a small part of the precipitation, which falls on the more permeable strata. However, most of the precipitation that falls in the county runs off in steams,

evaporates, or is transpired by plants. The remaining water, probably less than five percent, may reach the zone of saturation where it moves slowly toward an area of discharge such as a well, natural outlet, or, under artesian pressure, it may seep or percolate slowly upward into overlying beds.

**Surface Water Resources of Live Oak County**

There are two surface impoundments used to supply water other than for livestock consumption, Choke Canyon and Lake Corpus Christi. The average annual supply from these impoundments is 241,000 acre-feet, however, the calculated firm yield is 252,000 acre-feet. For planning calculations the impoundments will be assumed to supply 162,500 acre-feet per year by the year 2050. These figures came form the City of Corpus Christi. The owners and operation is the Nueces River Auuthority and the City of Corpus Christi within all reaches of the Nueces River in Live Oak County. The City of Corpus Christi is the major user of surface water in Live Oak County with the City of Three Rivers and the petrochemical plant, Diamond Shamrock.

**Projected Water Supplies of Live Oak County**

The annual rate of production for the Gulf Coast aquifer is 5,242 acre-feet. The estimated recharge rate for the Gulf Coast aquifer is small.

**Groundwater Use in Live Oak County**

During the past five years, annual groundwater usage in the County has varied from a high of 8960 acre-feet to a low of 7,479 acre-feet. Annual usage for the past five years is as follows:

| | | |
|---|---|---|
| 1995 | 7691 | acre-feet |
| 94 | 7479 | acre-feet |
| 93 | 7769 | acre-feet |
| 92 | 8960 | acre-feet |
| 91 | 8689 | acre-feet |

**Projected Demands for Water in Live Oak County**

This management planning document is based upon the estimates provided by the Texas Water Development Board and will be used until alternatives are generated. The TWDB has projected that the total water demands for Live Oak County will be 9783 acre-feet by the year 2050. This estimate is based on projections of the following breakdown and population statistics. George West will have a demand of 584 acre-feet per year and a population of 3499 by the year 2050. Three Rivers will have a demand of 448 acre-feet per year and a population of 2341 by the year 2050. The projected agricultural demands are 2145 acre-feet per year, projected mining demands

are 2915 acre-feet per year, projected domestic and stock demands are 1324 acre-feet per year, and projected manufacturing demands are 1345 acre-feet per year by the year 2050. Total projected demands in 2050 will be 9,783 acre-feet per year. With the exception of Three Rivers and Diamond Shamrock (used both surface and groundwater), all others use is from groundwater.

## Potential Demand and Supply Issues

The supply and demand totals for 2050 are as follows:

| | |
|---|---|
| Groundwater from | |
| Carrizo Wilcox aquifer | 2,399 acre-feet/year |
| Gulf Coast aquifer | 5,242 acre-feet/year |
| Surface water | 162,500 acre-feet/year |
| Total projected Supply | 170,141 acre-feet/year |
| Total projected Demand | 9,783 acre-feet/year |
| Balance (plus) | 160,358 acre-feet/year |

The total demand of groundwater is estimated to be 7,641 acre-feet per year by the year 2050 which is the same as projected supply. Projected supply will meet projected demand until the year 2050. A majority of the surface water is contracted already.

# LIVE OAK UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

## MISSION STATEMENT

The mission of the Live Oak Underground Water Conservation District is to protect and assure a sufficient quantity of quality water for our constituents use.
We value:

*Collection and maintenance of data on water quantity and quality
*Efficient use of groundwater
*Conjunctive water management issues
*Development and enforcement of water district rules concerning conservation of ground water.

## GOALS , OBJECTIVES , AND ACTION STEPS

Goal 1.0.Collection and maintenance of data on water quantity and quality

1.1.Measurement of water quantity and quality

a. Take measurements of depth to water level below the land surface on strategic wells on an annual basis.
b. Take water samples for chemical analysis on strategic wells on a monthly and annual basis.
c. Publish water quality and quantity data, and update reports annually.

1.2. Measurement of pollution sources and wells

a. Identify wells that are polluted and take appropriate action.
b. Identify sources of pollution and take appropriate action.
c. Provide information to the public about wells that are polluted and the sources of pollution.

Goal 2.0 Efficient use of groundwater

2.1. School education

a. Provide speakers to address water topics.
b. Distribute water resource education packets for use in the classroom
c. Sponsor teachers to attend workshops and seminars on the conservation of water and natural resources.

2.2. Farm education

a. Provide speakers to address water topics at farm meetings.
b. Distribute water resource education packets to farm leaders and farmers.
c. Sponsor farm leaders to attend workshops and seminars on the conservation of water and natural resources.

2.3. Home education

a. Provide speakers to address water topics.
b. Distribute water resource education packets to community people.
c. Encourage community leaders to attend workshops and seminars on the conservation of water and natural resources.

Goal 3.0. Developement and enforcement of water district rules

3.1. Develop rules concerning the protection of water quality, well permitting, and prohibiting waste of water.

a. Develop rules
b. Develop enforcement and implementation guidelines.

3.2 Adopt a permitting system by January 1, 2000, permit cost basis determined by administrative costs, not to exceed $25.00.

3.3 Implement procedure to have all non-exempt wells operating under production permit by January 1, 2001.

3.4 Implement and enforce a system of rules for the drilling, completing and equipping of water wells by December 1, 1999.

3.5 District Manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives (during last quarterly Board of Directors meeting each fiscal year beginning December 31, 2000).

Goal 4.0 Conjunctive water management issues

4.1 Coordinate emergency response/drought contingency planning with surface-water entities.

4.2 Evaluate existing historical data and data derived from new monitoring programs to enhance understanding of aquifer/surface-water relationships.

4.3 Evaluate the impact of surface-water usage on groundwater resources within the District as needed. Provide comments regarding surface-water rights requests for 100 percent of those requests effecting the groundwater resources of the district. Coordinate with surface-water entities on conjunctive use issues in regards to regional planning efforts by January 1, 2000 and every five years after.

## SB-1 MANAGEMENT GOALS DETERMINED NOT -APPLICABLE

Goal
1.0 Control and prevention of subsidence.

The rigid geologic framework of the region precludes significant subsidence from occurring.

Goal
2.0 Cooperative resolution of natural resource management issues.

The district has no documented occurrences of endangered or threatened species dependent upon groundwater resources.

# RESOLUTION

Whereas, the Live Oak Underground Water Conservation District has held the appropriate public hearings, and;

Whereas, the District has presented the management plan to the county officials and the Nueces River Authority.

Whereas, the District has followed the rules set forth by SB 1 and the TWDB.

Now, Therefore be it Resolved, that the Live Oak Undergroung Water Conservation District voted to pass the District management plan.

In favor: 5 Against 0

Passed and Approved this 11 day of June, 1998.

Scott Bledsoe III, President

Attest by: Lonnie Stewart

Lonnie Stewart, Secretary