

CLEAR CREEK REGIONAL FLOOD CONTROL PLAN

ENVIRONMENTAL BASELINE REPORT

CLEAR CREEK WATERSHED

for

HARRIS COUNTY FLOOD CONTROL DISTRICT

and

TEXAS WATER DEVELOPMENT BOARD

DANNENBAUM ENGINEERING CORPORATION

Consulting Engineers

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**CLEAR CREEK REGIONAL FLOOD CONTROL PLAN
ENVIRONMENTAL BASELINE REPORT**

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SUMMARY

Throughout the period of March 4 through May 31, 1991 an investigation of the existing baseline environmental conditions of the Clear Creek watershed was conducted. The watershed had an approximate area of 260 square miles and extends into Brazoria, Fort Bend, Galveston and Harris Counties (see Exhibit 1). The study focused upon Clear Creek and four major tributaries: Hickory Slough, Marys Creek, Cowart Creek, and Chigger Creek.

Data collection consisted of a literature review, aerial photograph interpretation, and field reconnaissance to verify literature and photographic data. The literature review was composed of a search of published and unpublished sources including environmental impact statements, theses, etc.

Clear Creek is an easternward flowing creek approximately 45 miles long with its headwaters located in the easternmost corner of Fort Bend County. The channel runs through Clear Lake, the flooded lower extremity of Clear Creek, and empties into Galveston Bay. The creek can be characterized as being sluggish and turbid due to lack of topography and a soft sediment bottom respectively. Channelization of approximately 2/3 of the channel as well as the increasing development of the watershed, have had significant impacts on the plant and animal communities. While sufficient habitat for many species may still be found, diversity of terrestrial species is relatively limited to those tolerant of human activity. The aquatic ecosystem of Clear Creek is very biologically productive. A variety of habitats including freshwater, brackish and estuarine are found.

No Federally or State listed endangered or threatened species were observed during the field investigation. With the exception of Texas windmill grass, *Houston machaeranthera* and occasional migratory species such as bald eagle, no endangered or threatened species are likely to occur within the watershed.

The vegetation along Clear Creek can be characterized as marsh, forest and brushland. Marsh areas composed of predominantly arrowroot are located along lower Clear Creek south of I-45. Brushland, consisting of *baccharis* is commonly found in this area as well. A fairly continuous riparian woodland belt extends from I-45 north to Station 2400 (see Exhibit 2 for stations). Dominant tree species within the belt are cedar elm south of Station 600, and sugarberry along with water oak north of Station 600. Brushland and pasture are the vegetational types from Station 2400 to the headwaters of Clear Creek.

Within the Clear Creek Watershed, specific areas of interest, including Clear Lake, a large undisturbed, undeveloped riparian forest and wetlands, are found. Clear Lake is an estuary which is a very important nursery hatchery area for the Galveston Bay system. The riparian woodland referred to is dominated by sugarberry and water oak. It is located between Stations 1100 and 1450 and is the largest undeveloped area along Clear Creek. The wetlands adjacent to Clear Creek include marshes in lower Clear Lake as well as between Highway 3 and I-45, some areas within the undeveloped riparian woodland, and a former reservoir located between Stations 1750 and 1800. These areas are subject to Section 404 of the Clean Water Act. Flood control alternatives should be evaluated in order to minimize the effects on these areas as well as wildlife habitat and aquatic ecosystems within the watershed.

Currently, on Clear Creek, the 100-year flood plain occupies 17,000 acres, which equates to approximately 11% of the total watershed area. Watershed population estimates for 1990 are

approximately 274,000 people. According to U. S. Corps of Engineers Report, the population by the year 2020 would be 530,000. Over 3,600 acres of recreational facilities exist in the watershed, of which the Armand Bayou Nature Center occupies approximately 1600 acres. The National Register of Historical Places does not contain any registered historical sites along Clear Creek; however, a reconnaissance survey level indicated the presence of Prehistoric and historic sites, and cemeteries in the area. Major flooding in the area is normally the result of high intensity rainfall cells which move very slowly or remain stationary over the area. Frequently, these cells are part of either tropical storms or full hurricanes. The widespread flooding that accompanied tropical storm "Claudette" in July 1979 emphasizes the seriousness of this situation. This storm, which caused in excess of \$227.5 million in total damages, is regarded as the worst in the history of the area. Within the Clear Creek Watershed, over 5,000 structures were flooded and the total residential and commercial damages exceeded \$90 million. According to the U. S. Corps of Engineers, Preconstruction Authorization Planning Report, dated May 1982, the average annual flood damages in the watershed are estimated at about \$6.6 million under existing conditions.

I. INTRODUCTION

As urban development continues to encroach upon flood prone areas, the need for increased protection from these floods while protecting environmentally important ecosystems has become one of the most challenging problems within the Clear Creek Watershed. Long-term, comprehensive planning is not only required to determine flood improvements needed for continued urban growth, but also to minimize negative environmental impacts. The first essential step in minimizing such impacts is developing an Environmental Baseline Assessment of the existing conditions of the watershed. It is the purpose of this study to assemble and provide such environmental data useful in evaluating flood control alternatives that minimize the loss of wildlife habitat and valuable ecosystems within this watershed.

The Clear Creek Watershed is located in the upper Texas Gulf Coast, immediately south of and in some locales slightly inclusive of the cities of Houston, Pearland, League City, Friendswood, Webster, and Pasadena. The watershed encompasses approximately 260 square miles in portions of Brazoria, Fort Bend, Galveston and Harris Counties (Lohse and Tyson 1973). From its headwaters located in the easternmost corner of Fort Bend County, Clear Creek flows generally eastward into Clear Lake where it then enters west-central Galveston Bay (see Exhibit 1). Much of the watershed is developed; however, a variety of vegetational types, from riparian forest to brushland and pasture exist as well.

The study was conducted during the period from March 4, 1991 to May 31, 1991. Data collection included a literature review, aerial photograph interpretation and field reconnaissance to verify literature and photographic data. The literature review entailed a thorough and systematic search of both published and unpublished sources such as journals, periodicals, theses, project reports,

environmental impact statements by governmental agencies, and environmental reports published by private business and consulting firms.

Recent false color infra-red aerial photographs (1989) were used to evaluate vegetational types and stream channel characteristics within the project area (see Exhibit 3). Open fields, brushland, and forest are distinguishable in the photographs. The colors in the photographs are determined by heat production; areas generating the most heat appear red. Green areas are not producing as much heat, and water is blue. Based on the photography, descriptions of the vegetational types and channel characteristics were determined. These descriptions were verified by field reconnaissance.

Field reconnaissance consisted of surveying as much of Clear Creek and its tributaries as possible by means of a small boat and outboard motor. The remainder of the study area was surveyed on-foot and from an automobile using bridge crossings and other access points. Data was recorded using video and still photographic equipment in addition to standard field notes. This information was used to verify and augment data obtained from the literature review and aerial photograph analysis.

Currently on Clear Creek, the 100-year flood plan occupies 17,000 acres, which equates to approximately 11% of the total watershed area. Watershed population estimates for 1990 are approximately 274,000 people. According to U. S. Corps of Engineers report, the population by the year 2020 would be 530,000. Major flooding in the area is normally the result of high intensity rainfall cells which move very slowly or remain stationary over the area. Frequently these cells are part of either tropical storms or full hurricanes. The widespread flooding that accompanied tropical storm "Claudette" in July 1979 emphasizes the seriousness of this situation. This storm, which caused in excess of \$227.5 million in total damages, is regarded

as the worst in the history of the area. Within the Clear Creek Watershed, over 5,000 structures were flooded and the total residential and commercial damages exceeded \$90 million. According to the U. S. Corps of Engineers, Preconstruction Authorization Planning Report, dated May 1982, the average annual flood damages in the watershed are estimated at about \$6.6 million under existing conditions.

II. PHYSICAL DESCRIPTION

1. Climate

The climate of Clear Creek Watershed is predominantly marine, greatly influenced by the Gulf of Mexico. Winds prevail from the southeast and south, except for brief northerly winds occurring from December through February (U.S. Army Corps of Engineers 1982). Long warm summers and short mild winters characterize the area, and results in a growing season of about 300 days. The mean annual temperature is 70°F with a recorded summer maximum of 108°F and winter minimum of 5°F (Fisher 1972).

The annual average relative humidity for the area is high with noon time values ranging from 72 percent at Galveston to 60 percent at Houston (U.S. Army Corps of Engineers, 1982). Mean annual precipitation for the area ranges from 45.95 inches in Houston to 41.8 inches in Galveston, and monthly rainfall is evenly distributed throughout the year. However, precipitation for the watershed can vary widely from intense thunderstorms of brief duration, to frontal-passage storms lasting several days, to hurricanes and tropical disturbances (Lohse and Tyson 1972).

2. Topography

Clear Creek Watershed is approximately 45 miles long, east-west, and varies from 2.0 miles wide, north-south, at the upper or western end, to 13.5 miles wide near its midpoint. The terrain is relatively flat over the watershed which is typical for the lower coastal plain. Elevations vary from 75 feet at the western end to less than 5 feet near Clear Lake. Local

relief, formed by the entrenchment of the valleys of Clear Creek, does not exceed 25 feet. The area has a seaward slope of about 2 feet per mile and natural drainage divides within the watershed are indistinct (Lohse and Tyson 1972).

3. Geology

The Clear Creek watershed is a geologically modern stream system (4,500 years old), carved into a Pleistocene-age deltaic plain. The deltaic plain was built during an interglacial stage of about 20,000 years duration and is made up of two basic substrates: (1) floodplain deposits of the ancestral Brazos river system that consist of relatively flat areas of clay sub-strata which comprises the Beaumont formation; and (2) distributory sands and silts, that were deposited in ancient meander belts as channel sands and gravel bars, or natural levee sand and silt (Lohse and Tyson 1972). This plain is still being modified today by compaction of the underlying deltaic soils, regional tilting and subsidence of the land surface, local faulting and by man's continuing alteration of the natural surface and subsurface environment.

4. Soils

Generally, the soils of the Clear Creek watershed are dominantly dark colored, clayey and loamy, nearly level prairie soils (SCS 1976). However, nearly level to gently sloping forested soils occur within the watershed as well. The nearly level soils, both in forested and prairie areas, present the biggest problem for land use. These soils are usually seasonably wet and often require adequate drainage outlets for specific land uses.

The major soil series occurring within Clear Creek Watershed are the Lake Charles, Bernard, and Edna soils (see Exhibit 4). These soils are often associated with Beaumont, Bacliff, Midland and Verland soils. Other soil series of significant note occurring in the watershed are the Mocreay, Leton, Kemah, Veston, Ijam, and Nahatche series soils. Although the soil types differ slightly from county to county and location to location, the general descriptions and locations on the landscape remain fairly consistent across the watershed area. Included are some general descriptions of the major soil types (Excerpts from SCS Soil Surveys Brazoria, Fort Bend, Galveston and Harris Counties).

Lake Charles Clay. These soils are somewhat poorly drained. Typically the surface layer is very dark gray clay about 22-24 inches thick. The upper part of the subsoil is dark gray clay to a depth of about 50-52 inches. Below that the soil turns to gray clay. Lake Charles soils are smooth in most places, but in undisturbed areas they may have "gilgai" relief. These soils are slightly lower than Bernard or Edna soils, but slightly higher than Bacliff and Beaumont soils. Lake Charles soils are used for cropland and pastureland as well as some urban development. Potential as cropland or pasture is high while potential for urban uses is moderate at best due to wetness and high shrink-swell potential.

Bernard Clay Loam. These soils are somewhat poorly drained and found on nearly level flats at elevations slightly higher than those of the Lake Charles series. Typically the surface layer is very dark gray clay loam about 6-13 inches thick. The underlying layer to a depth of 65 inches is very dark gray clay grading to light gray in the lower part. This soil is used primarily for cropland and pastureland. Potential for such uses is high. However, similar limitations exist for urbanization that exist with Lake Charles soils.

Edna Fine Sandy Loam. Edna soils occur at elevations slightly higher than the Bernard series soils and are often associated with ancient stream meanders and found on low mounds. These soils are poorly drained and very slowly permeable. The surface layer is typically dark gray fine sandy loam about 8 inches thick. Below this layer, to a depth of approximately 60 inches, is clay that is very dark gray in the upper part and light brownish gray in the lower. As with Bernard and Lake Charles soils, potential for cropland and pastureland is high, while urban use potential is moderate due to soil wetness and shrink-swell potential.

Beaumont Clay. This soil type is poorly drained and occurs in similar positions of the landscape as the Lake Charles soils but are usually slightly lower in elevation. Beaumont soils have surface layer of very firm dark gray to gray clay about 21 inches thick. The surface layer grades gradually to a layer about 38 inches thick of very firm gray clay with intersecting slickensides. The layer below that extends to about 73 inches and consists of grayish brown clay with light olive brown and strong brown mottles. Beaumont soils are on the List of Hydric Soils (SCS 1987 and 1990).

Mocarey Loam. These soils are somewhat poorly drained and slowly permeable. The surface layer is typically very dark gray loam about 12 inches thick. The subsoil, to a depth of 22 inches, is dark gray loam. The middle section, to a depth of 38 inches, is calcareous, light gray loam that has many masses of calcium carbonate. Below that, to a depth of 52 inches, is calcareous, light gray loam. These soils are suited for pastureland. Soil wetness is the limiting factor for urban uses.

Leton Loam. Leton soils are poorly drained and slowly permeable. They often are associated with Mocarey soils. Leton soils occur in old stream meanders and depressional areas. Typically, the surface layer is about 12 inches. The upper part is dark gray loam and the lower

part gray loam. The upper portion of the subsoil is gray clay loam mixed with some gray loam material to a depth of about 26 inches. The lower part, to a depth of 60 inches is light gray clay loam. Leton loam is on the list of Hydric Soils (SCS 1987 and 1990).

Bacliff Clay. This soil series is poorly drained and often occurs with Lake Charles clay. Bacliff soils are in lower areas of the landscape. The typical surface layer is dark gray clay about 9 inches thick. The lower part, to a depth of 35 inches, is gray clay. The subsoil is light gray clay to a depth of 63 inches. These soils are used mainly as cropland and pastureland. Soil wetness and shrink-swell potential are its major limitations. Bacliff soils are included on the list of Hydric Soils (SCS 1987 and 1990).

Verland. Verland soils occupy similar positions on the landscape as the Bernard soils. The surface layer is dark gray silty clay loam about 6 inches. The subsoil is gray clay to 30 inches, and light gray clay to 60 inches. Cropland as well as pasture are well suited to this soil type.

The rest of the soil series occurring in the watershed are of limited extent. However, it is important to note the other soils that are included on the list of Hydric Soils occurring within Clear Creek watershed. They are: Addicks loam, Bacliff clay, Beaumont clay, Clodine loam, Ijam soils, Harris clay, Leton loam, and Veston loam (SCS 1987 and 1990).

5. **Water Quality**

A total of 17 tributaries discharge into Clear Creek and Clear Lake. In addition, Clear Creek is tidal influenced from its confluence with Clear Lake to a point 100 meters upstream of FM 528 and non-tidal above that point (Segment 1101, TWC 1990). Besides non-point source runoff, discharges from domestic and industrial wastewater facilities have outfalls into Clear Creek.

According to the Texas Water Commission, Clear Creek Tidal has 9 permitted domestic facilities with outfalls into this segment. Clear Creek above Tidal has 23 domestic and 8 industrial permitted facilities. These point source waste loads measurably affect water quality in both of these segments.

Known water quality problems for Clear Creek Tidal include dissolved oxygen levels occasionally below 4.0 mg/L, and elevated fecal coliform bacteria. Clear Creek above tidal also has elevated fecal coliform bacteria and occasionally dissolved oxygen levels fall below 5.0 mg/L. Table 1 and 2 contain a more detailed summary of Clear Creek's water quality (Segment 1102, TWC 1990). As the tables indicate, water quality for both segments are limited. In fact neither segment meets swimmable criteria due to the fecal coliform levels. In addition, any further degradation in water quality would significantly impact the quality of aquatic habitat within the watershed.

6. Channel Characteristics

Clear Creek is an easternward flowing channel about 45 miles long which has its headwaters located in the easternmost corner of Fort Bend County. Throughout its course toward Galveston Bay, it exists as the Harris-Brazoria County Border, as well as the Harris -Galveston County Border before entering Clear Lake. Clear Lake, an estuarine lake tributary to Galveston Bay, is the flooded lower extremity of the Clear Creek channel. The channel progresses through Clear Lake and, via a narrow waterway, empties into Galveston Bay.

In the Environmental Resources Inventory and Evaluation for Clear Creek Texas, prepared by the Gulf Universities Research Consortium for the U. S. Army Corps of Engineers, the Clear Creek/Clear Lake system has been subdivided into five segments on the basis of general

ecological characteristics and related cultural uses or suitability for use. The current findings from field reconnaissance and other information gathering procedures stated previously, coincides with the subdivisions used in that report. Throughout this assessment Clear Creek is divided into stations. A map of Clear Creek with its stations has been provided in Exhibit 2.

Segment 1. Clear Lake Estuary - Station 0 originating at its restricted entrance to Galveston Bay to Station 250. The area of Clear Lake is 1,500 to 2,000 acres, with a volume of between 5,000 and 7,000 acre feet, depending upon the tide. The Clear Creek channel is 7 feet deep and 60 feet wide throughout Clear Lake which is a very biologically productive estuary due to the absence of a salt wedge. This allows fresh and saline waters to mix without the impairment of density interfaces. Due to the shallow depth of Clear Lake, combined with its bottom consisting of soft mud, turbidity resulting from wind and boats has a negative effect on the biologic productivity. However, the release of previously sediment borne material such as organic detritus and bacteria more than make up for any adverse effects (Lohse and Tyson 1973). These conditions exist up to Station 250.

Segment 2. Clear Creek Marsh - gradational from the Clear Lake estuary (Station 250) to roughly Interstate 45 approximately at Station 550. This area is generally characterized by brackish and freshwater habitat bordered by brushy/wooded banks. Throughout this segment the depth of the channel is 7 feet with an average width exceeding 300 feet. In addition to the several islands found in this segment, several sandbars were also observed. The channel meanders frequently with numerous sloughs and inlets present along both sides of the creek. The bank height is typically low, between 1-3 feet.

Segment 3. Lower Clear Creek Station 550 to Approximately 1650. This segment is characterized by a meandering creek channel which undergoes extreme differences in its channel characteristics throughout its course. It begins at Station 550 with a width of roughly 110 feet and a depth of 7 feet, and ends at approximately station 1650 which has a width of approximately 10 feet and a depth of 1 foot. There is a prominent oxbow along with numerous ponds which are adjacent to Clear Creek. Bank height varies from 5 feet to 15 feet and is irregular due to some subsegments of the channel that have been improved, resulting in elevated bank height within these areas. The creek is extensively meandering between stations 1150-1450, which is a large riparian woodland.

Segment 4. Middle Clear Creek approximately from Station 1650 to 2400. Fluvial woodland is still present along this segment which has a width ranging from 5-10 feet and bank height from 10-15 feet. Depth is typically between 1-2 feet and varies little throughout this section of the creek, and the channel is fairly straight due to previous channelization.

Segment 5. Upper Clear Creek Station 2400 to 2550. This portion of the creek has been straightened and is characterized by no wooded areas. The average depth ranges from 0-1 feet with a bank height varying between 10-15 feet where the creek has been channelized. Width of this channel is between 5 and 10 feet and its course is straight.

There are numerous tributaries flowing into Clear Creek and Clear Lake, and these consist of the following: Turkey Creek, Mud Lake, Armand Bayou, Horsepen Bayou, Big Island Slough, Spring Gully, Willow Springs Bayou, Taylor Bayou, Boggy Bayou, Taylor Lake, Cow Bayou, Hickory Slough, Marys Creek, Cowart Creek, Chigger Creek, Magnolia Creek, Jarbo Bayou, and Robinson Bayou. Of these principal tributaries, this assessment specifically addresses the channel characteristics of Hickory Slough, Marys Creek, Cowart Creek, and Chigger Creek.

Chigger Creek is a meandering creek which flows east and enters Clear Creek just west of Clear Creek Station 750. From this point to Highway 518 Chigger Creek has a width of 20 feet at its mouth to 5 feet at F.M. 518. Its depth ranges from 2-4 feet from F.M. 518 to Station 550. Chigger Creek continues to meander at a depth between 1-3 feet and width from 3-5 feet. A bypass is present intersecting Chigger Creek at roughly Stations 250 and 450. The course of the bypass is straight and possesses a width ranging between 4-8 feet and a depth of 1-3 feet. Bank height varies along Chigger Creek and ranges from 4-14 feet.

Cowart Creek flows to the east and its main channel meets Clear Creek near Clear Creek Station 900. Cowarts Creek consists of a main channel (CW-100-00-00) and two branches (CW102-00-00 and CW-103-00-00), respectively. The main channel ranges from 10-15 feet wide and 3-5 feet deep. From Stations 50 - 550 the width is between 3-10 feet with a depth of less than 3 feet. CW102-00-00 and CW103-00-00 are very similar in that the width is from 0-5 feet wide and less than 3 feet deep. Bank height varies between 3-12 feet along Cowart Creek and its branches.

Hickory Slough flows in a easterly direction and intersects Clear Creek approximately at Station 1800. It has been channelized and as a result its course is straight. Throughout its length the slough is characterized by a width ranging from 0-5 feet and a depth of less than 3 feet.

Marys Creek is composed of a main channel and a bypass. Marys Creek is east flowing and joins Clear Creek slightly west of Station 1050. Between Stations 0-450 (Marys Creek Stations), the main channel of Marys Creek ranges from 5-10 feet in width and 1-3 feet in depth. From

Station 450 - 600, its width is between 0-5 feet with a depth of less than 1 foot. The channel is meandering until roughly Station 300 whereupon the course becomes very straight. Marys Creek bypass has a straight course with a width between 0-5 feet and a depth ranging from 0-3 feet. It runs between Marys Creek Stations 100 and roughly halfway between 200 and 250.

III. BIOLOGICAL DESCRIPTION

1. Vegetation

1.1. Overview

The Clear Creek watershed area is located in the Gulf Prairies and Marshes Vegetational area of Texas. More specifically, it is part of the Gulf or Coastal Prairies Division of the vegetational area. Correll and Johnston (1970) describe the area as follows: The Gulf Prairies and Marshes area occupies approximately 9,500,000 acres along the coast of Texas. The Gulf or Coastal Prairies area is a nearly level, slowly drained plain less than 150 feet elevation, with level grasslands that support ranching and farming, low flat woodlands especially along the streams, swamps and fresh-water marshes. The marsh area is limited to narrow belts of low wet marsh interspersed with dunes immediately adjacent to the coast. Riparian or bottomland forest appears as narrow bands along creeks, and upland forest occurs as isolated clusters within the prairie grassland (U.S. Army Corp of Engineers, 1982).

The climax vegetation of the Gulf Prairies is largely tall grass prairie or post oak savannah. Principal climax plants are big bluestem (*Andropogon gerardi*), seacoast bluestem (*Schizachyrium scoparium* var, *littoralis*), Indian grass (*Sorghastrum nutans*), eastern gamagrass (*Tripsacum dactyloides*), gulf muhly (*Muhlenbergia capillaris*), species of *Panicum* and others (Gould 1975). However, it is doubtful that this native climax prairie still exists within the area due to fire suppression (necessary to maintain these species), conversion to range and cropland, and loss to urbanization (Lohse and Tyson, 1973).

1.2 Clear Creek Watershed

Although native tall grass prairie is essentially absent from the area, three vegetational types may be found within the watershed: marsh, forest, and brushland (Lohse & Tyson 1973). According to Lohse & Tyson (1973) the brushland areas exist due to human activity (such as fire protection) altering what probably would succeed to tall grass prairie. These brushlands are dominated by eastern baccharis (*Baccharis halimifolia*), southern bayberry (*Myrica cerifera*) and marsh elder (*Iva frutescens*).

Marsh vegetation within the watershed lacks great diversity. Salt-marsh dominated by *Spartina* spp., occurs only in the lower reaches of Clear Creek and Armand Bayou. Lohse & Tyson (1973) report that these areas cover less than 10 acres. Farther upstream, pure stands of arrowroot (*Sagittaria* sp.) can be found in shallow backwaters. Other common marsh vegetation includes Reedgrass (*Phragmites communis*) and cat-tail (*Typha* spp.). In the upper parts of the watershed, smartweed (*Polygonum* spp.) is often found to be the dominant marsh plant (Lohse and Tyson 1972).

Forest vegetation within Clear Creek covers the most area of any of the three types. Lohse and Tyson (1972) divide the forest vegetation into four basic "types". The first is cedar elm woodland. This type occurs in the lower portion of Clear Creek (below mile 12) and is dominated by cedar elm (*Ulmus crassifolia*) and winged elm (*Ulmus alata*). The second type described by Lohse and Tyson (1972) is mixed bottomland forest found in the lower middle Clear Creek area (miles 12-17). This area is dominated by sugarberry (*Celtis laevigata*) and water oak (*Quercus nigra*). Ash (*Fraxinus* spp.) and slippery elm (*Ulmus rubra*) are also common in this type. Mixed upland forest occurs in upper middle Clear Creek (miles 17-33). This type is characterized by ash and elm along the streamside. Water oak becomes less

prominent and these species intermix with willow oak (*Quercus phellos*), red oak (*Quercus falcata*), and pecan (*Carya illinoensis*) further from the stream. Above mile 33 elm and ash become less abundant and the final forest type is found. This type, streamside woodland (upper Clear Creek), is dominated by black willow (*Salix nigra*), and Chinese tallow-tree (*Sapium sebiferum*), as well as sugarberry.

1.3 Existing Conditions

Field reconnaissance revealed that the existing vegetational types within the Clear Creek watershed generally coincide with the findings of Lohse and Tyson (1972). Marsh, brushland, and forest are the principal vegetational types found along Clear Creek and its tributaries. Dominant marsh species noted were *Sagittaria* sp. and smartweed. Common brushland species included eastern baccaharis and southern bayberry. Abundant forest species observed were cedar elm, sugarberry, water oak, and green ash.

The vegetational belt varies from about 10 - 50 feet to as much as 800 - 1200 feet along the main channel. Most of the watershed has been developed, especially in the lower portion of Clear Creek and Clear Lake. However, a few relatively large undeveloped areas still exist. As stated previously, a map of Clear Creek with its stations has been provided in Exhibit 2.

Main Channel

Station 0 to 350. The areas from Galveston Bay to FM 270 are all essentially developed. Saltwater marshes are basically non-existent with the exception of a few isolated areas dominated by *Spartina* spp.

Station 350 - 450. This section of the Creek is highly urbanized as well. However, several areas of low brushland do exist. Dominant species include eastern baccharis, marsh elder, and southern bayberry. *Spartina Spartinae* occurs scattered along the waters edge. A true vegetational "belt" does not exist along this section but a small riparian area exists at about Station 400 that consists primarily of cedar elm, sugarberry, and chinese tallow tree.

Station 450 - 550. Between State Highway 3 to Interstate 45 several marsh areas exist consisting of pure stands of *Sagittaria* sp. These areas are located in low areas in and along the waters edge. Refer to Exhibit 3-A for an aerial infrared photo of this area. The largest of these marshes occurs near Interstate 45. Moving from the waters edge low brushland with eastern baccharis and marsh elder grades into cedar elm and chinese tallow tree woodland. The vegetational belt is relatively narrow (approximately 30 - 200 feet).

Station 550 - 600. With the exception of a residential development south of the channel (just west of I-45), this area is relatively undeveloped. The vegetation is similar to the previous section however, cedar elm is less prominent. Water oak and sugarberry are the dominant tree species and brushland no longer occurs. Pure stands of *Sagittaria* sp. still exist, but are not as large as some of the areas east of Interstate 45. The width of the vegetation in this section is relatively wide, more than 500 feet.

Station 600 - 850. Little development occurs in this section as with the previous section. However, the belt of riparian vegetation narrows to approximately 30 to 250 feet wide. The riparian vegetation becomes more diverse in this section. Slippery elm and green ash (*Fraxinus pennsylvanica*) are more prevalent, in addition to the water oak and sugarberry. Chinese tallow tree, yupon, Japanese honeysuckle and privet are common understory species. Further from the channel scattered loblolly pine (*Pinus taeda*), American sycamore (*Plantanus occidentalis*),

and post oak (*Quercus stellata*) can be found. Along the water, *Sagittaria* sp. is still common and around frequent oxbows "inlets" and pockets of water "Palmetto Flats", low spots with dwarf palmetto (*Sabal minor*) dominating the understory, are prevalent.

Station 850 - 900. The vegetation is primarily the same in this section; however, red mulberry (*Morus rubra*) becomes more prevalent in the understory. The width of the vegetation decreases and residential development increases between these stations. The vegetation averages about 20 to 50 feet in width.

Several large (60 to 70 feet tall) eastern red cedars (*Juniperus virginiana*) can be found on the north bank just east of the FM 528 bridge as well as two small (4 to 6 feet tall) baldcypress trees on the north bank west of the FM 528 bridge.

Station 900 - 1100. The section between these two stations has basically been developed into residential areas. The riparian vegetation through this area is only approximately 10 to 50 feet wide and in some places 20 to 30 feet separates the tree line from the channel. Dominant vegetation is basically the same as the last section. Common species include green ash, slippery elm, water oak, chinese tallow tree and red mulberry. Also of note in this section is a riparian area roughly 500 to 600 feet square with an oxbow meander running through the middle.

Station 1100 - 1450. The area just north of FM Road 2351, between approximately Station 1100 to 1450, is the largest undeveloped area along Clear Creek. Exhibit 3-B is an aerial infrared photo of this area. Within this section the creek has not been improved and the riparian vegetation is at its widest (700 to greater than 1000 feet). Vegetation diversity may be at its highest within the area. Along the creek species such as green ash, water oak, sugarberry, and willow oak occur. Moving further from the channel, the species composition changes to a

mixed upland association of loblolly pine, red oak, American sycamore, slippery elm, red mulberry, post oak, and several hickory species (*Carya* spp.), in addition to the water and willow oak. Understory species are dominated by privet and yaupon.

Station 1450 - 1650. Above 1450 the vegetation belt along the creek narrows to an average of 200 to 300 feet. However, along the south side of the channel the belt of vegetation narrows to approximately 0 to 30 feet due to residential development. The north side is less developed and the belt of trees and shrubs extend to 700 feet. The channel has been improved within this section and the distance from the channel to the riparian vegetation is as much as 40 feet. Species diversity declines within this section probably due to improved channel conditions. Black willow (*Salix nigra*) is dominant along the creek as well as sugarberry and water oak. Smartweed is the dominant plant in and along the waters edge.

Station 1650 - 1750. The riparian tree belt within this area narrows significantly and averages about 50 to 200 feet in width. However, the area is generally undeveloped and most of the areas adjacent to the creek channel are being used for agricultural purposes. Some of the fields are fallow and being invaded by species such as chinese tallow tree. Dominant species occurring within the tree belt are black willow, sugarberry and chinese tallow tree with green ash and water oak becoming less prevalent (see Exhibit 3-C).

Station 1750 - 1950. The vegetational belt along this portion of the creek is also narrow and averages approximately 150 to 200 feet. A shrub area or brushland is once again notable within this section between the creek channel and the forested areas. Brushland species include eastern baccharis, Chinese tallow tree and some sugarberry saplings. Along the waters edge black willow is also common. Beyond the brushland, the forested area is dominated by sugarberry, water oak, and green ash.

Station 1950 - 2400. A narrow belt of trees lines this part of the channel ranging from 30 to more than 200 feet in one or two areas. South of the channel is primarily developed while the area to the north is being used for agricultural purposes. Sugarberry, black willow and chinese tallow tree are still the dominant tree species.

Station 2400 - 2550. The vegetation along this section changes from forest to low woodland and brushland. The tree and shrub belt is narrow (30 - 35 feet) to non-existent. Most of the area is in agricultural use. Chinese tallow tree, eastern baccharis, and southern bayberry are the most common plants.

The vegetation along the four Clear Creek tributaries this study is addressing is considerably less extensive than along the main channel. Most of the land along these tributaries is developed and as stated earlier these channels have been improved and rectified over most of their course.

Chigger Creek

Station 0 - 50. This section is basically undeveloped. The vegetation along the creek is riparian forest about 200 feet wide. Dominant species include water oak, sugarberry, and green ash. Adjacent land is pasture.

Station 50 - 500. The rest of the Chigger Creek area is basically all developed. However a narrow band of riparian forest runs the length of the channel and ranges from 20 to 70 feet wide. In most places the tree line is 30 to 40 feet from the waters edge. Common species include water oak, willow oak, sugarberry, green ash, and chinese tallow tree.

Cowart Creek

Station 0 - 200. The riparian forest along this section varies from 100 to 200 feet wide with one area between Station 50 and 100 extending to approximately 300 feet. However, as much as 30 feet separates the tree line from the creek channel in the first part of the creek. Tree species found here are essentially the same as along Clear Creek, such as sugarberry, water oak, and green ash.

Station 200 - 300. The hardwood forest along this portion is scattered and essentially ends at Station 300. Most of the area has been developed or is being used for agricultural purposes.

Station 300 - 550. Brushland takes over along this section. Chinese tallow tree, black willow, johnsongrass (*Sorghum halepense*) and ragweed (*Ambrosia artemissifolia*) are the common plants along the channel. Residential development and farmland characterize the adjacent areas.

Hickory Slough

Station 0 - 150. For the first few hundred yards, a concentration of sugarberry and water oak can be found. The remainder of hickory slough is characterized by brush and grasses such as eastern baccharis and johnsongrass.

Mary's Creek

Station 0 - 50. This area is relatively developed although some hardwood species occur scattered along the channel. The tree belt is narrow, only about 20 to 40 feet in width. Species found in this area are sugarberry, water oak and green ash.

Station 50 - 200. The hardwood trees within this section are scattered as well. A distance of 20 to 30 feet separates the trees from the water. This area is also highly developed.

Station 200 - 350. In this portion of Mary's creek, riparian forest species line the bank until just short of 350. The belt of trees averages 20 to 40 feet in width with two areas having a width of over 300 feet. Species composition is the same with sugarberry and water oak dominating. Above Station 250 the trees are 25 to 35 feet from the channel. The majority of the adjacent land is developed. Where development encroaches on the creek, hardwood trees decline.

Station 350 - 600. No riparian habitat can be found along this portion of the creek. The vegetation is indicative of the brushland species such as eastern baccharis, southern bayberry, chinese tallow tree, black willow, johnsongrass, and ragweed.

The existing vegetation of the Clear Creek watershed is still considerably diverse despite the amount of urban development within the area. In fact, more than 15 percent of the 4,838 species known to occur in Texas can be found within the watershed area (Correll and Johnston, 1970 and Lohse and Tyson, 1972). These species occur in three distinct habitats: forest, brushland/prairie and marsh.

The forest habitat of Clear Creek can be characterized by cedar elm woodland in lower Clear Creek, riparian forest dominated by sugarberry, water oak, and green ash, becoming a mixed pine-hardwood association in middle Clear Creek, and finally changing to low woodlands on upper Clear Creek.

Brushland/prairie habitat is a mix of coastal shrub species, such as eastern baccaharis and southern bayberry, and various herbaceous plants like *Spartina spartinae*. This habitat occurs mostly in lower Clear Creek and in the upper reaches where it displaces the riparian forest.

Marsh vegetation occurs throughout the watershed, however, the most significant areas occur in the lower Clear Creek region, and are characterized by large pure stands of *Sagittaria sp.* For an extensive list of probable vegetation of the Clear Creek watershed, refer to Lohse and Tyson (1973) and Espey Huston (1979).

1.4 Effects of Flooding

Due to the location of Clear Creek Watershed, and the precipitation which occurs periodic flooding is not uncommon. Generally, the vegetation has adapted to this type of environment and is tolerant to short periods of inundation. Wetland areas will be impacted if flooding stops. According to Mitch and Gosselink, wetlands are particularly sensitive to changes in their normal patterns of water storage and movement. In summary, flooding of the biologic communities along Clear Creek will not have negative effects and in the case of wetlands is needed.

2. Wildlife

The Clear Creek Watershed consists of a variety of habitats, such as riparian forests, along with various types of wetlands. Typically in an area composed of these habitats, a diversity of animal species would be found. Representative of the mammals expected is white-tail deer (*Odocoileus virginianus*), and rodents such as squirrels (*Sciuromorpha*) along with mice and rats (*Myomorpha*). Abundant birds would include the red winged blackbird (*Agelaius phoeniceus*), song sparrow (*Melospiza melodia*), Carolina chickadee (*Parus carolinensis*), great blue heron (*Ardea herodias*), and green heron (*Butorides virescens*). Reptiles expected to be commonly found are ground skinks (*Scinsella lateralis*), garter snakes (*Thamnophis* spp.), cottonmouth snakes (*Agkistrodon pisiuorous leveostoma*) and numerous species of water snakes. Numerous species of frogs and salamanders are dominant amphibians.

However, due to the encroachment of man upon the Clear Creek Watershed, large wildlife populations are essentially incompatible with the increasingly urbanized environment. However, many animal species can adapt to an area which has been urbanized, and many remain within the watershed under its present conditions. These include the opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), rock dove (*Columbia livia*) and starling (*Sturnus vulgaris*).

Throughout the field inspection, various species of terrestrial fauna were observed and recorded. The vast majority of the sighted animal species, as expected, were birds, and consisted of mockingbird (*Mimus polyglottes*), American kestrel (*Falco sparverius*), mourning dove (*Zenaida macroura*), double crested cormorant (*Phalacrocorax auritus*), great blue heron, green heron and brown thrasher (*Toxostoma rufum*). Of significant note, two Ospreys (*Pandron haliaetus*) were sighted. The two animal species observed, other than birds, were the

following: diamondback water snake (*Nerodia rhombifera rhombifera*) and fox squirrel (*Sciurus niger*). A detailed list of probable species inhabiting the Clear Creek watershed has been included in the appendices.

Due to the influx of saltwater into Clear Creek, a freshwater stream, the aquatic ecosystem is quite diverse. The upper reaches of Clear Creek (above Station 1100) are nontidal and inhabited by common freshwater fishes adapted to turbid, slow moving streams which have regular temperature fluctuations. Representative of the freshwater species include yellow bullhead (*Ictalurus natalis*), and spotted gar (*Lepisosteus oculatus*), which can be found downstream through the intermediate portion of the channel (Stations 1100 - 750). The intermediate portion also supports some estuarine species including alligator gar (*Lepisosteus spatula*) and bowfin (*Amia calva*).

The estuarine segment of the creek (Clear Lake to Station 750) is inhabited primarily by euryhaline species defined by Lohse and Tyson (1973) as those able to tolerate a wide range of salinity. Inhabitants characteristic of the lower portion of Clear Creek include blue crab (*Callinectes sapidus*) and striped mullet (*Mugil cephalus*).

Clear Lake is a slightly saline, shallow estuary inhabited by both marine and euryhaline species. It has been determined, after numerous investigations, that the Clear Creek and Clear Lake estuary is one of the most important nursery areas of the Galveston Bay system, for both recreational and commercial fisheries of Texas and the Gulf of Mexico (Chapman, 1963; Chin, 1961; Diener et al., 1974; Mock, 1966; Rounsefell, 1963; Turner et al. 1974).

The aquatic species observed during the field investigation of the Clear Creek-Clear Lake system consisted of striped mullet and blue crab. For a detailed list of the probable fauna refer to Lohse and Tyson (1973) and Espey Huston (1979).

The aquatic ecosystem of Clear Creek and Clear Lake is complex and biologically productive. In its existing condition, a variety of habitats can be found, supporting both freshwater and marine aquatic fauna. The terrestrial fauna inhabit a woodland belt which runs almost continuously along the creek and provides a riparian corridor that allows wildlife species to migrate between forested areas. This riparian corridor effect has been found to be of great importance in the maintenance of healthy population levels for many species. The riparian woodland also acts as a transitional zone between the marsh areas of lower Clear Creek and the bottomland forests of the middle and upper segments. The effects on both the aquatic and terrestrial ecosystems, caused by future development and channel rectification need to be thoroughly examined in order to minimize any negative impacts.

3. Armand Bayou

Although not specifically addressed in the scope of the baseline report, Armand Bayou is an important part of the Clear Lake community. Armand Bayou is one of the major freshwater streams which contributes to the Clear Lake system by providing a continuous flow of organic and inorganic material. The marshlands and waterways of the Armand Bayou watershed provide brackish as well as freshwater habitat for many plant and animal species. Along the bayou, according to Lohse and Tyson (1972), the floodplain forest contains much more willow oak and hickory and less ash than the Clear Creek floodplain. Also species diversity appears to be higher due to the greater extent of the forest. The field investigation carried out for this report resulted in findings which coincided with Lohse and Tyson (1972) as well as Armand

Bayou Report. The biological system existing in Armand Bayou area is being encroached upon by urban development. Species diversity will decline as natural habitat is replaced by urban habitat. The Armand Bayou Nature Center consists of two thousand acres of land and provides a variety of habitats from prairie to riparian forest. While this is an area of adequate size for many species the secondary effects of man's proximity will continue to have damaging effects on the biological communities that manage to survive within the Park's protected areas (Espey Huston, 1979).

4. Endangered Species

The Endangered Species Act was passed in 1973 to check the precipitous decline of native fish, wildlife, and plants in the United States. The U.S. Fish and Wildlife Service is charged with determining which species face extinction through man's alteration of their habitat, protecting them from further decline and providing for their continued survival. All Federal agencies are charged with using their authority to carry out programs for the conservation of endangered species and threatened species and must ensure that any action authorized, funded, or carried out by them does not jeopardize the continued existence of any endangered or threatened species or result in the adverse modification of critical habitat of such species. In addition, the amended Texas Parks and Wildlife Code, Chapter 60 provides for the protection of State listed endangered or threatened species.

The U.S. Fish and Wildlife Service and the Texas Parks and Wildlife Department were contacted to obtain information on the Federal and State listed threatened or endangered species that might occur within the Clear Creek watershed area.

The U.S. Fish and Wildlife Service (1987) list eleven species as threatened or endangered for the project area. Five of the eleven species are listed as historic range only, having occurred in the past but with no recent confirmed sightings. Two species, the arctic peregrine falcon (*Falco peregrinus tundrius*) and the American alligator (*Alligator mississippiensis*), are listed as threatened and the former occurring in the project area during migration only. Four species, the bald eagle (*Haliaeetus leucocephalus*), American peregrine falcon (*Falco peregrinus anatum*), prairie dawn (Texas bitterweed) (*Hymenoxis texana*), and the Houston Toad (*Bufo houstonensis*) are listed as endangered. The bald eagle is listed as wintering in the project area around large bodies of water from December to March. The American peregrine falcon is listed as occurring within the watershed area during migration. The known populations of prairie dawn occur in northern and western Harris County and northern Fort Bend County. It is found on poorly drained saline swales around the periphery of low natural mounds in open grasslands.

The Houston toad is known to have occurred within the watershed. However, no confirmed observations have been recorded since 1976, due to loss of breeding habitat to urbanization. The Texas Parks and Wildlife Department lists 16 species for Harris County, seven species as endangered and nine as threatened. The seven State-listed endangered species are the black bear (*Ursus americanus*), Attwater's prairie chicken (*Tympanuchus cupido attwateri*), bald eagle, loggerhead sea turtle (*Caretta caretta*), western smooth green snake (*Opheodrys vernalis blanchardi*), paddlefish (*Polyodon spathula*), and prairie dawn. The bald eagle and prairie dawn were discussed above. Schmidly (1983) states that no native black bears are extant in eastern Texas today. He further states that the black bear was extirpated from the western, northern and southern parts of the region during the period from 1850 to 1890 and from their last strongholds of swamps and thickets in southeastern Texas during the period from 1900 to

1940 with the possible exception of a few individuals in the Big Thicket in Hardin County and in the dense woodlands of Matagorda County where bears were sighted in 1943 and 1940, respectively.

Garrett and Barker (1987) state that the normal range of the loggerhead sea turtle is the open seas of the Atlantic Ocean. They also indicate that it has been seen nesting on Texas beaches and may also frequent large coastal bays. The U.S. Fish and Wildlife Service (1987) list the loggerhead sea turtle as threatened and includes the Texas Gulf Coast as part of its historic range. The U.S. Fish and Wildlife Service further indicates that there was one authenticated record of this species nesting on South Padre Island in 1979.

Tennant (1985) states that the western smooth green snake is known in Texas from fewer than 10 specimens, all collected on the coastal plains of Austin, Chambers, Harris and Matagorda Counties. He further states that the species' habitat is limited to the few remaining mesic prairie communities still covered with native short grasses.

According to the Texas Parks and Wildlife Department, habitat requirements for the paddlefish include a Riverine system having gravel beds for spawning as well as slow backwater areas, such as oxbows, for cruising, grazing and loafing. Dissolved oxygen (DO) requirements average 5 parts per million (ppm). However, during spawning DO requirements approach 6 - 8 ppm. The existing water quality of Clear Creek, as described earlier, create conditions not conducive to the presence of the paddlefish in the creek. In addition, conditions necessary for spawning are not present.

The Attwater's prairie chicken formerly occupied some eight million acres of coastal prairie from Kleberg County, Texas, northward to Bayou Teche, Louisiana. It's current habitat has

been reduced to several coastal counties in Texas. The total adult population in Texas has been estimated by the U.S. Fish and Wildlife Service to be less than 1200 birds. In 1987, populations were found in Aransas, Austin, Colorado, Fort Bend, Galveston, Goliad, Refugio and Victoria Counties. The last known active Attwater's prairie chicken colony in the watershed area was located within the boundaries of Ellington Field in the southeastern part of Harris County. However, these birds were moved several times, ultimately to Victoria County.

The nine State listed threatened species are the American alligator, white-faced ibis (*Plegadis chihi*), American swallow-tailed kite (*Elanoides forficatus*), wood stork (*Mycteria americana*), white-tailed hawk (*Buteo aloicaudatus*), Texas horned lizard (*Phrynosoma cornutum*), timber rattlesnake (*Crotalus horridus*), alligator snapping turtle (*Macrolemys tenorminckii*), and the reddish egret (*Egretta rufescens*).

The white-faced ibis (Texas resident species), wood stork (irregular visitor to Texas), and reddish egret (a Texas resident species) habitat is coastal swamps, marshes and ponds. The American swallow-tailed kite, an occasional migrant in Texas, is normally found along river swamps. The population of the Texas horned lizard, once seen in abundance almost throughout Texas, was drastically reduced by the late sixties. It is generally accepted that the decline in the Texas horned lizard population was a direct result of widespread use of pesticides to control ants, the lizard's main prey, and of habitat eradication and/or alteration. A strictly terrestrial species, the lizard inhabits flat, open, dry country with little plant cover. The species is still abundant in arid west Texas. The timber rattlesnake is a widely distributed species across the eastern third of Texas, although, it is generally uncommon near populated areas. The timber rattlesnake prefers extensive, dense thickets, and can also be found in open, upland pine and deciduous woods and second-growth pastures of unused farmland.

The American alligator was reclassified by the U.S. Fish and Wildlife Service from endangered to threatened in June 1985. The alligator inhabits rivers, bayous, creeks, oxbows, swamps, estuaries, lakes and marshes from the coastal plain westward to the Balcones Fault line. Alligators currently occur in more than 90% of their historic range with the greatest concentration in the middle and upper coastal counties according to the U.S. Fish and Wildlife Service. The alligator can be legally hunted in several counties along the Texas Coast. Confirmed sightings of alligators have been made within Clear Creek's watershed at the Armand Bayou Nature Center (Espey Huston, 1979).

The alligator snapping turtle is an inhabitant of deep fresh water. Even though it may occasionally enter brackish water, it is most at home in deep rivers, lakes and large streams with muddy bottoms. In Texas, the snapping turtle is found almost throughout the eastern fourth of the State, from the Oklahoma border to the Gulf Coast.

In addition, the Texas Parks and Wildlife Department states that there are two Federal Category 2 species occurring within Clear Creek Watershed. Texas windmill grass (*Chloris texensis*) and Houston machaeranthera (*Machaeranthera aurea*). Both are upper Gulf Coastal prairie remnant species. Texas windmill grass is found on sand to sandy loam soils in bare areas and grasslands.

Houston machaeranthera prefers serally barren or thinly vegetated grasslands and disturbed pastures. Both species occur within the watershed in one prairie adjacent to Underwood Street in Deer Park.

During the field work, none of the federally and/or state listed endangered or threatened species were observed. Several of the listed species do migrate through the Clear Creek Watershed. However, confirmed sightings of any federal and/or state listed endangered or threatened species have not occurred recently within the Clear Creek Watershed.

5. Wetlands

The term wetlands is variously defined. Pursuant to Section 404 of the Clean Water Act the U.S. Army Corps of Engineers (USACE) defines wetlands in 33 CFR 328.3b as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Section 404 prohibits the discharge of dredged or fill material into the waters of the United States unless previously authorized by a Department of the Army permit. The Section 404 definition of wetlands requires the presence of positive wetland indicators of three criteria (vegetation, soil and hydrology) for an area to be declared a jurisdictional wetland.

Executive Order (EO) 11990 (Federal Register, 1977) defines wetlands as those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds. EO 11990 directs Federal agencies to provide leadership and to take action to minimize the destruction, loss or degradation of

wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. This Order does not apply to the issuance by federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on non-federal property.

The U.S. Fish and Wildlife Service defines wetlands in Cowardin et al. (1979) as "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."

On January 10, 1989, the Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers and Soil Conservation Service reached an agreement on a joint wetland definition and delineation manual, the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." The procedures and criteria recommended by the Federal Manual for Identifying and Delineating Jurisdictional Wetlands were followed in the identification of wetlands for this study.

Clear Creek and Clear Lake are waters of the United States and subject to Section 404 of the Clean Water Act. Both are also navigable waters of the United States subject to the Rivers and

Harbors Act of 1899. Wetlands are also subject to Section 404; and there are four wetland areas of significant size along Clear Creek and Clear Lake. These areas are: salt marsh located in lower Clear Lake, freshwater/brackish marsh between Highway 3 and Interstate 45, riparian forest located between Stations 1100 and 1450, and a former reservoir found between stations 1750 and 1800. This reservoir was documented in the 1973 Soil Survey; however, it presently can be classified as a jurisdictional wetland. An infrared aerial photo for this area is provided in Exhibit 3-C.

In order for an area to be declared a jurisdictional wetland, it must meet the three criteria (vegetation, soil and hydrology) outlined by the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." The majority of the Clear Creek watershed typically has non-hydric soils (as mapped by the SCS) with the exception of areas around Interstate 45 where some larger areas of hydric soils are mapped. Due to periodic flooding and other causes, some areas along the creek may meet the hydrology criteria. The majority of the vegetation along Clear Creek is riparian forest, typically dominated by plant species which have been identified as wetland plants by Reed (1988). Within the riparian areas, sloughs and old oxbows are two types of areas which are present along the creek and meet the criteria to be declared jurisdictional wetlands.

The wetland assessment included in the report was prepared following the rules and regulations in effect at the time of the study, which was based on the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands", dated January 1989. The change to the 1987 Manual occurred not only after the study, but also well after the report had been completed and forwarded for review, therefore, no revisions were made. However, it is generally accepted that the 1989 Manual has a more stringent criteria than the 1987 Manual for Delineation of Wetlands, hence findings of this report would be generally on the conservative side.

On August 17, 1991 the President signed the Energy and Water Development Appropriations

Act of 1992 (the Act). The Act prohibits the Corps of Engineers (Corps) from utilizing any appropriated funds to identify or delineate any land as a "water of the United States" under the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" that was adopted on January 1989 (1989 Manual) and directs the Corps to utilize the Corps 1987 Wetlands Delineation Manual (1987 Manual) (Technical report Y-87-1) Environmental Laboratory, 1987).

IV. SOCIO-ECONOMIC EVALUATION

1. Existing Conditions

The Clear Creek Watershed falls into four counties including Fort Bend, Brazoria, Galveston and Harris County comprising approximately 260 square miles of land (see Exhibit 1). The watershed topography slopes gently from about 75 feet at the upper extremity to about 2-feet above mean sea level near the stream mouth. Clear Creek rises on the eastern edge of Fort Bend County and generally flows easterly for about 45 miles, discharging into Clear Lake, a tidal lake connected to Galveston Bay and the Gulf of Mexico. Flood control districts which function within the Clear Creek Watershed include Harris County Flood Control District, Fort Bend County Drainage District, Brazoria County Drainage District No. 4, Brazoria County Conservation and Reclamation District No. 3 and the Clear Creek Drainage District.

The rapid growth experienced in the early 1980's in the Houston metropolitan area has stimulated a large population growth in the Clear Creek Watershed area. Present development within Clear Creek is generally urban, starting at the mouth and extending to its headwaters. The communities of Kemah, Seabrook, Clear Lake Shores, Clear Lake City, League City, El Lago, Taylor Lake Village, Nassau Bay, Friendswood, Pearland and Brookside are along the mainstream of Clear Creek. Extensive residential and commercial development is taking place over the entire Clear Creek Watershed. Development is due in part to the nearby Manned Spacecraft Center (now the Lyndon B. Johnson Space Center) and space related firms and in part to the rapid growth of the Houston area.

The area along the stream is very attractive to prospective home purchasers. The fringe of timber along the stream provides desirable home sites with high aesthetic appeal. The stream affords a valuable recreational facility and easy access to adjacent bays by small boats. There

are numerous homes of good to very good quality in the flood plain of Clear Creek. The commercial development within the flood plain comprises the normal concentration of shops, stores, service establishments, and small businesses which usually accompany residential development. Also included are marine facilities for berthing and repair of pleasure craft.

As per 1989 land use, total developed areas were approximately 46,000 acres which represents 28% of the entire Watershed. Currently on Clear Creek, the 100-year flood plain occupies 17,000 acres, which equates to approximately 11% of the total watershed area. (See Exhibit 5)

2. Population Projection

The main reference used was the "Clear Creek, Texas Flood Control", Preconstruction Authorization Planning Report by U. S. Army Corps of Engineers, May 1982. County level and census tract projections were used to predict future population in the Clear Creek Watershed. (See Table 3)

The projections for each respective census tract were developed with the aid of HGAC preliminary population and land use data, dated 1979. This data was developed in conjunction with "Phase One, Technical Report, Economic Base Analysis" for the Houston-Galveston region. The projections for each census tract were used to develop a ratio between county projections and the respective census tracts for each decade to the year 2000. The respective ratios were then applied to the "most probable" county level projection to arrive at census tract projections for each decade to the year 2000. For projections from 2000 to 2020, the 1980 to 2000 trend in the respective ratios was maintained and applied to the county level projections.

As a verification of the COE population projection, the current 1990 census tract population was obtained. The watershed population was estimated based on the portion of the total population assigned to each census tract. (See Table 4) The portion of total population for a particular census tract was based on 1989 aerial photographs. As can be seen on Table 4, the 1990 census data matches closely with the population projections of the COE 1982 Flood Control Study.

3. Land Use

Land use within the watershed was taken from census tract land use data by City of Houston Planning Department, Houston-Galveston Regional Transportation Study, 1980 land use. The following categories and percentages were found for 1980, and projections by Rice Center were made for year 2000.

<u>LAND USE</u>	<u>1980</u>	<u>2000</u>
Single Family	10.8	17.8
Multi-Family	0.8	1.4
Commercial	2.1	3.0
Industrial	3.1	3.4
Open Space	0.9	0.8
Undeveloped	79.2	70.4
Other	<u>3.1</u>	<u>3.2</u>
	<u>100.0</u>	<u>100.0</u>

Agricultural activities are scattered throughout the Watershed, but most of the agricultural lands are located on small farms, ranches and wooded lots in the middle and upper areas of the Clear Creek Watershed. The long growing season of the region makes it favorable for production of vegetables, livestock, feed grains, food crops, timber, nuts, and fruits. There is also some oil and gas production in the area. Urban and built-up areas include cities, villages,

industrial sites, railroad yards, cemeteries, airports, golf courses, institutional and public administrative sites and similar types of land areas. Some of the various land uses are illustrated on Exhibit 6.

4. Recreation Facilities

Data from the various County, and City Parks Departments was collected to arrive at an Inventory of Recreational Facilities. There are approximately 19 parks (larger than 10 acres) with 3,600 acres of public parks in the Clear Creek Watershed. (See Table 5). The majority of the parks are located in Harris County. No parks greater than 10 acres are known in Fort Bend County. The parks include a long list of facilities, such as pavilions, picnic areas, playgrounds, tennis courts, community centers, trails, swimming pools, softball fields, basketball courts, boat launches, soccer fields, fishing, arenas, exhibit halls concession buildings, and a nature center. Several of the parks are located along Clear Creek forming the "Clear Creek Parks Chain." (See Exhibit 6). One of the largest recreational areas is the Armand Bayou Nature Center, comprised of 1,639 acres. This area is in its natural state and serves as a sanctuary for various environmentally sensitive species. School and neighborhood parks (1-10 acres) are not included in Table 5 park list.

5. Archeological Resources

The National Register of Historical Places does not contain any registered historic sites along Clear Creek. A cultural resources survey of portions of the project area was conducted in 1973 by the Texas Archeological Survey. Areas of greatest potential impact were intensively surveyed; remaining portions of the U. S. Corp of Engineers project area were surveyed at a

reconnaissance level. As a result of this survey, 76 prehistoric sites, 2 historic sites, and 4 cemeteries were identified. Of this number, 51 prehistoric sites and 1 historic site may be adversely affected by proposed U. S. Corp of Engineers stream modifications. A few of the known sites, many have potential for National Register and State Archeological Landmark listing. The Texas Archeological Research Laboratory provided a description of known historical and archeological sites, which are attached in this report in the List of References Section.

6. Prime Farmland

Most of the soils in the project area can be classified as prime farmland soils. Accelerated urban development and scattered developments in Harris and Galveston Counties have caused most of the prime farmland soils to be taken out of production. Undeveloped blocks and patches of lands throughout the developed and developing areas have become vacant land because it is no longer useable for efficient agricultural production.

Installation of drainage channels enhances the soils for full urban development as well as improving undeveloped agricultural soils (mainly in the Brazoria County portion) for efficient productive use. Continued expansion of scattered new developments into agricultural areas is unnecessarily taking out large areas of prime farmland soils from efficient use for agricultural production.

7. History of Flooding

Major flooding in the Houston-Galveston area is normally the result of high intensity rainfall cells which move very slowly or remain stationary over the area. Frequently those cells are part of either tropical storms or full hurricanes. In a given year, approximately a 70 percent chance exists that the Texas coastal area will be affected by a tropical storm and a 40 percent chance exists that this storm will be a full hurricane. Meteorological conditions along the

Texas Gulf Coast are notoriously hard to predict, but the period since 1960 has been characterized by heavy rainfalls. During the three-year period of 1976-1979, one 50-year, two 100-year and one greater than 100-year frequency rainfalls occurred in the Houston-Galveston area.

Meteorological, topographic, hydrologic and urban development factors have all contributed to the problem. The terrain is characteristically very flat and the soils impervious and most of the natural drainage basins in the area have suffered from flooding. The rapid growth and development of the Houston-Galveston area has caused the problem to become even more prominent as more and more people have moved into flood-prone sectors.

In an effort to minimize drainage and flooding problems, drainage districts have been formed and numerous structural solutions have been implemented over the past 50 years. However, the growth of the Houston-Galveston area has been so rapid that the solutions have not been able to keep pace with the increased needs.

The following presentation of flooding effects covers a geographic area that includes, but is much larger than, the Clear Creek Watershed. Although the following information could not be adequately disaggregated to apply specifically to the study area, it was deemed to be of sufficient value to be included in this profile if to serve no other purpose than to provide the reader with an insightful perspective and a historic overview of recent flooding events.

8. Costs of Flood Damages

8.1 Methodology for Cost Estimates

The costs of flood damages can be determined in several ways, some of which are based on formal agency reports, others which are not. The Rice Center, in a 1980 study of four recent Houston-Galveston area floods, classified quantifiable costs into four basic categories: organized emergency disaster assistance, organized aid for recovery, informal disaster assistance and informal aid for recovery. The following discussion is based on this study.

Organized emergency disaster assistance consists of aid provided by groups and government agencies that are organized to respond to natural disasters during and just after flooding occurs. Such groups include not only the Red Cross and other charity or church organizations, but government agencies such as municipal Fire and Police Departments, the State Police, and the National Guard. Costs incurred by such groups and agencies include both direct costs of aid provided and administrative and overhead costs.

Organized aid for recovery is usually made available when people begin returning to their homes and is provided typically by government agencies such as the Federal Insurance Administration, Farmer's Home Administration, Small Business Administration, and FEMA. Usually, the Federal Emergency Management Agency assumes the role of coordinating this aid. Finally, private insurance companies provide organized aid in the form of compensation to their clients. Such firms commonly are the major source of compensation for vehicular damage.

Informal disaster assistance refers to that aid provided during and just after flooding that is not attributable to organized groups or government agencies. Most of such aid is furnished by individuals, such as neighbors and friends, and also includes self-help. Examples might include

homeowners offering shelter to stranded motorists, or persons in non-flooded areas taking in relatives from flooded areas.

Informal aid for recovery refers to post-flood costs borne by affected persons for non-compensated property repair and by businesses and farms for losses not covered by insurance. For example, some individuals use their own resources for recovery, while some businesses allow flood victims paid time-off for repairs and for applying for assistance. This category also includes costs to flood victims for the portion of flood damage not compensated for by insurance, loans or grants.

Costs associated with organized aid for recovery such as insurance claims and grants and loans are subject to formal reporting and are easily quantifiable. Also the direct aid provided by the Red Cross and other groups as part of organized emergency disaster assistance is generally reported and quantifiable. However, the administrative overhead associated with organized emergency disaster assistance, as well as the costs associated with informal disaster assistance and informal aid of recovery (lost business revenues and salaries, uninsured structure and vehicle damage and other direct costs paid by the flood victims), are not formally reported and must be estimated.

8.2 Recent Floods Affecting the Clear Creek Watershed

Since 1976, four major storms which resulted in significant flooding have affected the Houston-Galveston area. The dates of these storms were June 15, 1976; April 17-19, 1979; July 24-26, 1979; and September 17-19, 1979. These storms were analyzed in some detail in the previously mentioned study by the Rice Center. The purpose of this study was to determine the total costs associated with the four floods. Total costs meant those costs that were reported

by organized groups and agencies as well as those that were incurred but not formally reported. In this way it was possible to provide an awareness of the true magnitude of damages that resulted from these floods.

Of the four floods analyzed by the Rice Center, only two resulted in flooding in the Clear Creek Watershed: July 24-26, 1979 (Tropical Storm Claudette) and September 17-19, 1979. The Rice Center analyses did not identify damages that occurred in other watersheds that were flooded. However, the Corps of Engineers, Galveston District compiled a detailed report on Tropical Storm Claudette that evaluated damages by individual watershed and by areas within the watersheds, thus making it possible to examine more closely the impact of the flooding associated with that storm on the Clear Creek Watershed and flood plain.

Tropical Storm Claudette, July 24-26, 1979

Tropical Storm Claudette came ashore near the Texas-Louisiana border on the afternoon of July 24, 1979. It moved northward past Beaumont and was expected to continue northward. Instead the movement of the center of the storm slowed and made a counter-clockwise loop just north of Houston. Fueled by moisture-laden winds off the Gulf, the storm remained in the Houston-Galveston area for about 30 hours, pelting residents with torrential rains. As the heavy rains continued, area streams began flooding, making many streets and highways impassable. Residents of flooded areas were evacuated by Civil Defense and other authorities. On July 26, Governor Clements requested a Presidential disaster declaration. Rescue and emergency operations continued through the 26th and 27th of July. On July 28, President Carter declared that Brazoria, Chambers, Galveston, Harris, Orange and Jefferson counties constituted a major disaster area under Public Law 93-288. This declaration activated assistance programs by various government agencies. Also, all state and local agencies and

organizations cooperated in the rehabilitation and clean up required in the aftermath of the flood.

Cost and Damage Estimates Resulting from Tropical Storm Claudette.

Table 6 estimates total flood-related costs incurred in Brazoria, Galveston and Harris counties as a result of Tropical Storm Claudette. Total damages are classified into the four cost categories described previously: organized emergency disaster assistance, organized aid for recovery, informal disaster assistance, and informal aid for recovery.

The Corps of Engineers, Galveston District also made estimates of costs resulting from Tropical Storm Claudette, including estimates by watershed. These estimates are included in Table 7. Estimates for residential and commercial structures were based on visual surveys of damages in the flooded area by Corps of Engineers staff. Damage data for automobiles, agriculture and roads and highways were obtained from other sources and utilized other estimating techniques.

The cost estimates by the Corps of Engineers, shown in Table 7, are lower than those of the Rice Center primarily because the Corps of Engineers estimated only damages, while the Rice Center estimated service and administrative costs incurred by agencies such as the Red Cross, the National Guard and local Police and Fire Departments while providing organized disaster assistance. Also, the Rice Center estimates included \$13.9 million in lost business revenues, a cost which the Corps of Engineers did not estimate.

Clear Creek Damages Resulting from Tropical Storm Claudette

The Corps of Engineers made separate damage estimates for each of the four watersheds

affected by Tropical Storm Claudette--Clear Creek, Dickinson Bayou, Mustang Bayou and Chocolate Bayou. Within the Clear Creek Watershed, damage estimates were made for each of the identifiable residential or incorporated areas (shown in Table 8) and by each of the major tributaries (shown in Table 9) of Clear Creek.

All of the major tributaries, with the exceptions of Armand Bayou, Taylors Bayou and Big Island Slough, are within the Clear Creek 100-year flood plain. By deducting the damages caused by these tributaries, it is possible to estimate the residential and commercial structural damages within the Clear Creek 100-year flood plain: 4,146 structures with \$80,074.00 of damages.

Storm of September 17-19, 1979

The heavy rains and flooding of September 17-19, 1979 were due to a non-tropical low pressure system. The Houston-Galveston area received heavy rains for three days - the showers of September 17 saturated the ground, the rains of September 18 filled the streams, bayous and drainage ditches, and the storms of September 19 caused flooding on September 19-20.

For the second time within a two-month period, the Clear Creek Watershed was subjected to severe flooding, although damages associated with the September flood were less than one-fourth those associated with Tropical Storm Claudette. Detailed statistics estimating damages resulting from the September flooding are presented in Table 10 and were compiled by the Rice Center.

The above data is the most comprehensive available concerning the September flood. Additional data has not been published regarding this event, so it is not possible to estimate the

observation of maps of the flooded areas indicate that the Clear Creek Watershed was not flooded as extensively as it was during Tropical Storm Claudette.

Effects of the 1979 Floods on Life, Health, and Safety

Tropical Storm Claudette was responsible for three deaths (one each in Harris, Galveston and Jefferson counties), while the flood of September 17-19, 1979 caused four deaths (two each in Galveston and Harris counties). The Houston Red Cross reported that Tropical Storm Claudette resulted in 1,090 injuries and illnesses (11 requiring hospitalization) and that the September flood was responsible for 113 injuries (3 requiring hospitalization). Of the 1,090 injuries and illnesses resulting from Tropical Storm Claudette, 418 occurred in Brazoria County, 332 in Harris County, and 261 in Galveston County. For the September flood, Red Cross data indicated that 53 persons suffering flood-related injuries and illnesses were from Harris County, 24 were from Galveston County and 21 were from Brazoria County. Most of these injuries and illnesses probably affected residents of the Clear Creek Watershed, although no documentation, as such, could be compiled.

Finally, according to the U. S. Corps of Engineers, Preconstruction Authorization Planning Report, dated May, 1982, the average annual flood damages in the watershed are estimated at about \$6.6 million for the year 1980 and \$7.4 million for the year 2010 if no action is taken to ameliorate flooding.

V. SUMMARY

Clear Creek is approximately 45 miles long, originating in Ford Bend County and flowing generally eastward through Clear Lake into Galveston Bay. Its watershed covers 260 square miles in portions of Brazoria, Fort Bend, Galveston, and Harris Counties. According to Lohse and Tyson (1972) the vegetation types within the watershed can be generally classified as forest, brushland, and marsh. Of the three types, forest vegetation covers the largest area. Brushland areas mainly exist due to human activity (such as fire protection). Marsh areas are limited to the lower portions of Clear Creek, and essentially do not exist above I-45. Much of the watershed has been developed which has limited the diversity and size of all three vegetational types.

The data gathered during the field investigation along Clear Creek resulted in findings which generally coincide with the vegetational types described by Lohse and Tyson. The marsh areas were dominated by *Sagittaris sp.* and smartweed. The dominant brushland species include eastern baccharis and southern bayberry. The forests were composed of cedar elm, sugarberry, water oak, and green ash. An essentially continuous belt of riparian forest is present along Clear Creek from approximately I-45 to Station 2400. Brushland is present past Station 2400 and also interspersed with the marsh areas east of I-45. The marshes as stated previously are generally limited to the lower portions of Clear Creek and Clear Lake.

Clear Creek plays a major role in maintaining the productivity of Clear Lake. It has been well documented that Clear Lake, an estuary of significant importance, is a key nursery of the Galveston Bay System. The creek is typically sluggish and sediment filled; continuously providing Clear Lake with organic material.

Despite the development along Clear Creek, sufficient habitat for many species can still be found. The woodland belt along its banks provides a riparian corridor that allows wildlife species to migrate between forested areas, the longest of which is the major riparian forest between Stations 1100 and 1450. The riparian corridor is important in maintaining healthy population levels for many species.

Various wetlands are found along the creek and include marshes and old oxbows. Wetland areas adjacent to the creek are a source of detritus as well as improve water quality. Jurisdiction of these areas falls under the authority of the U. S. Army Corps of Engineers, and are subject to Section 404 of the Clean Water Act.

In its existing condition, Clear Creek is a biologically productive system. Man's influence is encroaching and as a result, plant and animal species diversity is being limited. However, biologically reproductive aquatic and terrestrial habitats presently exist today.

Currently on Clear Creek, the 100-year flood plain occupies 17,000 acres, which equates to approximately 11% of the total watershed area. Watershed population estimates for 1990 are approximately 274,000 people. According to U. S. Corps of Engineers report, the population by the year 2020 would be 530,000. Over 3,600 acres of recreational facilities exist in the watershed, of which the Armand Bayou Nature Center occupies approximately 1,600 acres. The National Register of Historical Places does not contain any registered historical sites along Clear Creek; however, a reconnaissance survey level indicated the presence of prehistoric and historic sites, and cemeteries in the area. Major flooding in the area is normally the result of high intensity rainfall cells which move very slowly or remain stationary over the area. Frequently these cells are part of either tropical storms or full hurricanes. The widespread flooding that accompanied tropical storm "Claudette" in July 1979 emphasizes the seriousness

of this situation. This storm, which caused in excess of \$227.5 million in total damages, is regarded as the worst in the history of the area. Within the Clear Creek Watershed, over 5,000 structures were flooded and the total residential and commercial damages exceeded \$90 million. According to the U. S. Corps of Engineers, Preconstruction Authorization Planning Report, dated May 1982, the average annual flood damages in the watershed are estimated at about \$6.6 million under existing conditions.

TABLES

TABLE 1

WATER QUALITY INFORMATION FOR CLEAR CREEK TIDAL
 (Segment 1101) From October 1, 1985
 Through September 30, 1989
 (Texas Water Commission)

PARAMETERS	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
Dissolved Oxygen (Mg/l)	4.0	30	1	12.0	6.8	4	3.3
Temperature (F)	95.0	30	55.4	90.8	72.5	0	0
PH	6/5-9.0	24	7.2	8.7	7.9	0	0
Chloride (Mg/l)	N/A	29	108	12200	2344	0	0
Sulfate (Mg/l)	N/A	27	31	1320	276	0	0
Total Dissolved Solids (Mg/l)	N/A	24	405	15425	4318	0	0
Fecal Coliforms (#/100 MI)	200	26	10	13000	244	13	887

Total Dissolved Solids Were Estimated by Multiplying Specific Conductance By .50

Description of Segment 1101: From the confluence with Clear Lake in Galveston/Harris County to a point 100 meters (110 yards) upstream of F.M. 528 in Galveston/Harris County.

TABLE 2

WATER QUALITY INFORMATION FOR CLEAR CREEK TIDAL
 (Segment 1102) From October 1, 1985
 Through September 30, 1989
 (Texas Water Commission)

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
Dissolved Oxygen (Mg/l)	5.0	27	4.5	17.0	8.4	3	4.8
Temperature (F)	95.0	27	54.3	87.8	72.1	0	0
PH	6.5-9.0	24	7.1	8.6	7.9	0	0
Chloride (Mg/l)	200	27	31	224	137	2	218
Sulfate (Mg/l)	100	25	21	120	43	1	120
Total Dissolved Solids (Mg/l)	600	25	191	630	492	2	626
Fecal Coliforms (#/100 ML)	200	25	10	15000	231	15	619

Total Dissolved Solids Were Estimated by Multiplying Specific Conductance By .50

Description of Segment 1101: From the confluence with Clear Lake in Galveston/Harris County to a point 100 meters (110 yards) upstream of P.M. 528 in Galveston/Harris County.

TABLE 3
CLEAR CREEK WATERSHED
POPULATION PROJECTION

YEAR	POPULATION
1980	166,680
1990	261,310
2000	380,830
2010	466,050
2020	527,360
2030	527,360
2040	527,360

Source: "Clear Creek, Texas Flood Control", Preconstruction Authorization Planning Report, by U. S. Army Corps of Engineers, May, 1982.

TABLE 4

**CLEAR CREEK WATERSHED
1990 POPULATION ESTIMATES**

CENSUS TRACT	1990 CENSUS TRACT ACTUAL	SHARE IN WATERSHED	1990 WATERSHED ESTIMATES
Harris County			
336	4,332	0.000	---
337	256	1.000	256
338	2,238	0.000	---
340	6,569	0.013	88
341	521	1.000	521
342	1,005	0.044	44
344	2,110	0.042	88
345.01	5,864	1.000	5,864
345.02	4,179	1.000	4,179
358.01	3,201	0.430	1,376
358.02	4,572	1.000	4,572
359.12	3,169	1.000	3,169
359.21	6,998	0.650	4,549
359.22	3,060	1.000	3,060
359.32	3,843	1.000	3,843
360.01	6,440	0.050	325
360.02	8,931	0.440	3,929
360.03	6,345	1.000	6,345
360.04	6,020	0.800	4,816
363	6,930	0.660	4,573
366.02	3,406	0.520	1,771
366.11	4,195	1.000	4,195
366.21	7,754	1.000	7,754
366.31	0	1.000	---
366.41	1,530	1.000	1,530
367	927	0.078	72
368.01	6,471	1.000	6,471

TABLE 4 (CONTINUED)

CLEAR CREEK WATERSHED
1990 POPULATION ESTIMATES

CENSUS TRACT	1990 CENSUS TRACT ACTUAL	SHARE IN WATERSHED	1990 WATERSHED ESTIMATES
Harris County			
368.02	3,118	0.500	1,559
369	4,531	1.000	4,531
370.10	4,451	1.000	4,451
370.20	12,672	1.000	12,672
371.02	10,147	1.000	10,147
371.11	17,513	1.000	17,513
371.21	11,457	1.000	11,457
372	8,528	1.000	8,528
373.02	10,984	1.000	10,984
373.03	5,931	1.000	5,931
373.04	2,126	1.000	2,126
373.11	8,305	1.000	8,305
373.21	7,888	1.000	7,888
374	6,929	1.000	6,929
375	8,028	1.000	8,028
TOTAL			194,439
Galveston County			
1201.01	3,470	1.000	3,470
1201.02	3,438	1.000	3,438
1202	8,166	0.978	7,984
1203	13,196	0.952	12,560
1204	3,424	0.928	3,177
1205	4,138	1.000	4,138
1206.10	1,675	1.000	1,675
1206.20	1,718	1.000	1,718
1207	9,221	0.814	7,507
1208	5,582	0.000	---
TOTAL			45,667

TABLE 4 (CONTINUED)

**CLEAR CREEK WATERSHED
1990 POPULATION ESTIMATES**

CENSUS TRACT	1990 CENSUS TRACT ACTUAL	SHARE IN WATERSHED	1990 WATERSHED ESTIMATE
Brazoria County			
601.10	6,643	1.000	6,643
601.20	6,593	1.000	6,593
602.11	3,886	0.560	2,176
602.12	4,838	1.000	4,838
602.21	4,370	0.450	1,966
602.22	6,140	1.000	6,140
602.32	3,891	1.000	3,891
603.10	4,610	0.085	392
TOTAL			32,639
Fort Bend County			
701.15	7,526	0.200	1,505
701.25	2,600	0.000	---
TOTAL			1,505
TOTAL WATERSHED			274,250

TABLE 5

**CLEAR CREEK WATERSHED
PARK AND FACILITIES INVENTORY**

NO.	PARK NAME*	ADDRESS	ACRES	FACILITIES
1.	ALMEDA ROAD	ALMEDA ROAD AT CLEAR CREEK	43	UNDEVELOPED
2.	TOM BASS REGIONAL	FELLOWS ROAD AT CLEAR CREEK	555	PAVILION, PICNIC TABLES, PLAYGROUNDS, TENNIS COURTS, BASKETBALL COURTS, FISHING
3.	CHRISTIA ADAIR	15107 CULLEN ROAD	43	PAVILION, PICNIC TABLES, PLAYGROUNDS, TRAILS, TENNIS COURTS, COMMUNITY CENTER
4.	EL FRANCO LEE	9500 HALL ROAD	324	PAVILION, PICNIC TABLES, PLAYGROUNDS, TRAILS
5.	BARRY ROSE	BARRY ROSE STREET	30	DATA NOT AVAILABLE
6.	INDEPENDENCE	3919 LIBERTY DRIVE	50	PLAYGROUND, SWIMMING POOL, TENNIS COURTS, SOFTBALL FIELD, PAVILION, PICNIC TABLES, BASKETBALL COURTS
7.	DIXIE FARM	2900 DIXIE FARM RD.	40	UNDEVELOPED
8.	CHOATE ROAD	CHOATE ROAD AT CLEAR CREEK	41	UNDEVELOPED
9.	FRANKIE CARTER RANDOLPH	5150 F.M. 2351	93	PAVILION, PICNIC TABLES, PLAYGROUNDS, TRAILS, TENNIS COURTS, SOCCER FIELDS, BASKETBALL COURTS, SOFTBALL FIELDS
10.	MEMORIAL PARK - FRIENDSWOOD	F.M. 2351 AT CLEAR CREEK	18	DATA NOT AVAILABLE
11.	OXNARD	16702 OXNARD LANE	14	PICNIC TABLES, PLAYGROUNDS
12.	CHALLENGER SEVEN MEMORIAL	2301 W. NASA BLVD.	292	PICNIC TABLES, TRAILS, COMMUNITY CENTER, BOAT LAUNCH
13.	WALTER HALL	S.H. 3 AT CLEAR CREEK	86	PAVILION, ARENA, PICNIC TABLES, BOAT LAUNCH, SOCCER FIELDS, BASEBALL FIELDS, PLAYGROUNDS, TENNIS COURTS
14.	CLEAR LAKE PARK	5001 NASA ROAD	16	PAVILION, PICNIC TABLES, PLAYGROUNDS, BASKETBALL COURTS, FISHING, BOAT LAUNCH
15.	CLEAR LAKE EXTENSION	5001 NASA ROAD	43	PAVILION, PICNIC TABLES, PLAYGROUNDS, TRAILS, TENNIS COURTS, SOCCER FIELDS, SOFTBALL FIELDS, FISHING
16.	ARMAND BAYOU	8600 BAY AREA BLVD.	1639	TRAILS, NATURE CENTER
17.	BAY AREA	7702 BAY AREA BLVD.	64	PAVILION, PICNIC TABLES, PLAYGROUNDS, TENNIS COURTS, SOCCER FIELDS, SOFTBALL FIELDS, FISHING, BOAT LAUNCH
18.	PASADENA RODEO GROUNDS	7600 RED BLUFF ROAD	106	PICNIC TABLES, ARENA, EXHIBIT HALL, CONCESSION BUILDING
19.	SOUTH BURKE	BURKE AT CRENSHAW	110	DATA NOT AVAILABLE
	TOTAL		3,607	

* PARKS LARGER THAN 10-ACRES ONLY.

TABLE 6

TROPICAL STORM CLAUDETTE COSTS OF FLOODING

ORGANIZED EMERGENCY DISASTER ASSISTANCE	\$ 1,927,379
ORGANIZED AID FOR RECOVERY	246,830,222
Home Damages 206,557,850	
Other Damages 40,272,372	
TOTAL ORGANIZED COSTS	\$248,757,601
INFORMAL DISASTER ASSISTANCE	2,636,268
INFORMAL AID FOR RECOVERY	<u>36,454,927</u>
TOTAL INFORMAL COSTS	<u>\$ 39,091,194</u>
TOTAL COSTS	<u>\$ 287,848,795</u>

Source: An Analysis of Houston Area Floods, Rice Center, June, 1980.

TABLE 7

TROPICAL STORM CLAUDETTE COSTS OF FLOOD DAMAGES

RESIDENTIAL AND COMMERCIAL DAMAGES	\$186,884,000
VEHICULAR DAMAGE	22,200,000
AGRICULTURAL DAMAGES	15,000,000
ROAD DAMAGES	<u>3,500,000</u>
TOTAL DAMAGES	<u>\$227,584,000</u>

Source: Report on Tropical Storm Claudette, U. S. Army Engineering District,

Galveston C.O.E., September, 1980.

TABLE 8**RESIDENTIAL AND COMMERCIAL DAMAGES FROM CLAUDETTE
CLEAR CREEK WATERSHED**

AREA	DAMAGES	NUMBER OF STRUCTURES
FRIENDSWOOD	\$38,906,000	1,620
SCARSDALE-SAGEMONT	22,208,000	1,443
LEAGUE CITY	6,138,000	196
NASSAU BAY	5,872,000	148
PASADENA	5,557,000	765
TAYLOR LAKE VILLAGE	3,386,000	124
SEABROOK	3,075,000	174
CLEAR LAKE SHORES	1,926,000	363
PEARLAND	1,341,000	76
LA PORTE	1,180,000	142
KEMAH	421,000	72
WEBSTER	187,000	54
TOTAL	\$90,197,000	5,177

TABLE 9**DAMAGE ESTIMATES BY MAJOR TRIBUTARIES
OF CLEAR CREEK**

STREAM	DAMAGES	NUMBER OF STRUCTURES
MAIN STREAM	\$34,899,000	1,587
TURKEY CREEK	22,208,000	1,443
MARYS CREEK	11,540,000	495
COWART CREEK	8,255,000	347
ARMAND BAYOU	5,557,000	765
TAYLOR BAYOU	3,386,000	124
CHIGGER CREEK	3,172,000	274
BIG ISLAND SLOUGH	1,180,000	142
TOTAL	\$90,197,000	5,177

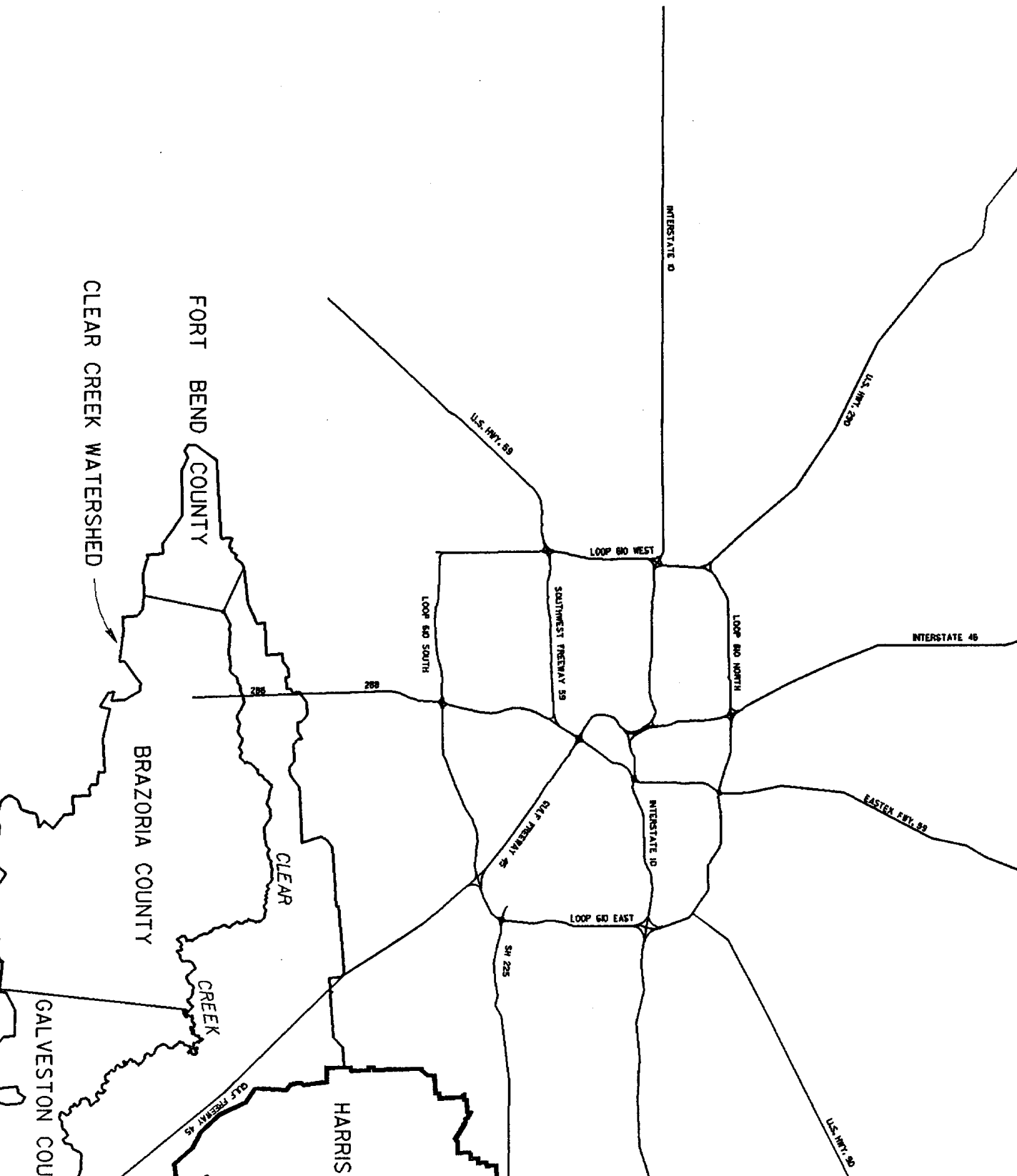
Source: Report on Tropical Storm Claudette, U. S. Army Engineer
District, Galveston C.O.E., September, 1980

TABLE 10
SEPTEMBER, 1979 STORM COSTS OF FLOODING

ORGANIZED EMERGENCY DISASTER ASSISTANCE	\$ 530,936
ORGANIZED AID FOR RECOVERY	<u>60,663,242</u>
Home Damages	\$47,600,721
Other Damages	13,062,521
TOTAL ORGANIZED COSTS	\$61,194,178
INFORMAL DISASTER ASSISTANCE	290,535
INFORMAL AID FOR RECOVERY	9,248,841
TOTAL INFORMAL COSTS	<u>\$ 9,539,376</u>
TOTAL COSTS	<u>\$ 70,733,554</u>

Source: An Analyses of Houston Area Flood, Rice Center, June, 1980

EXHIBITS



CLEAR CREEK WATERSHED

FORT BEND COUNTY

BRAZORIA COUNTY

GALVESTON COU

HARRIS

INTERSTATE 10

INTERSTATE 46

EASTEX FWY. 99

U.S. HWY. 290

U.S. HWY. 29

LOOP 60 WEST

SOUTHWEST FREEWAY 59

LOOP 60 NORTH

INTERSTATE 10

LOOP 60 EAST

GULF FREEWAY 45

LOOP 60 SOUTH

SH 225

U.S. HWY. 29

CLEAR CREEK

288

288

288

288

GULF FREEWAY 45

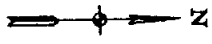
EXHIBIT 3
AERIAL INFRARED PHOTOGRAPHS

LOCATION A
STATION 400 TO 620

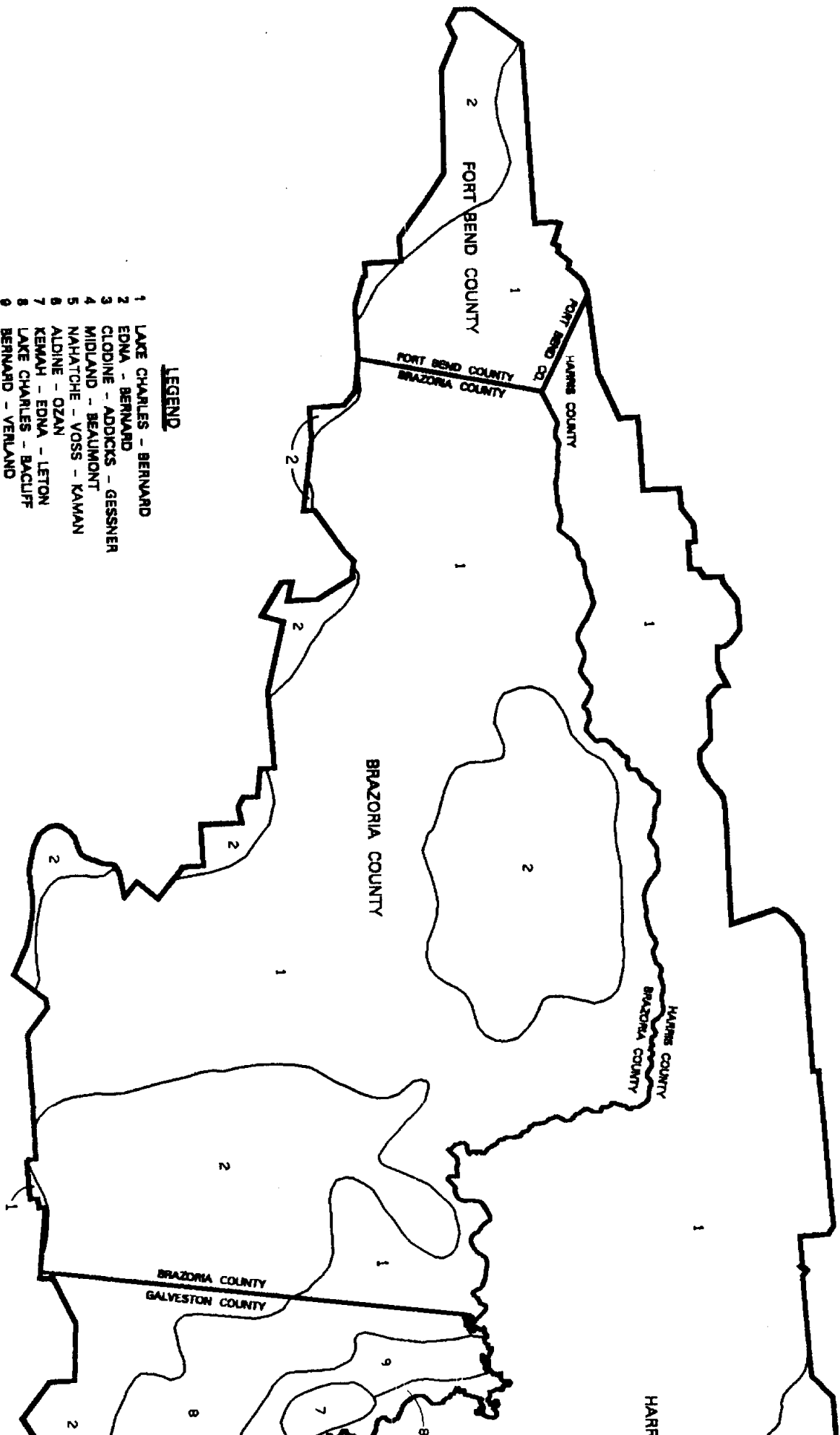
LOCATION C
STATION 1650 TO 1840

LOCATION B
STATION 1020 TO 1450

SCALE: 1" = 10000'



- LEGEND**
- 1 LAKE CHARLES - BERNARD
 - 2 EDNA - BERNARD
 - 3 CLODINE - ADDICKS - GESSNER
 - 4 MIDLAND - BEAUMONT
 - 5 NAHATCHE - VOSS - KAMAN
 - 6 ALDINE - OZAN
 - 7 KEMAH - EDNA - LETON
 - 8 LAKE CHARLES - BACLIFF
 - 9 BERNARD - VERLAND
 - 10 MOCANEY - LETON - ALGQA



LIST OF REFERENCES

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LITERATURE CITED

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CORRESPONDENCE



TEXAS
PARKS AND WILDLIFE DEPARTMENT
4200 Smith School Road • Austin, Texas 78744 • 512-389-4800

ANDREW SANSOM
Executive Director

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May 8, 1991

Mr. Tony Vazquez
Environmental Consultant
Vazquez Environmental Services, Inc.
York Centre Office Building
10235 West Little York, Suite 445
Houston, Texas 77040

Re: Preparation of Environmental Assessment,
Flood Control Alternatives Clear Creek Watershed

Dear Mr. Vazquez:

Department staff have reviewed material concerning the above referenced document and the following comments are provided.

Each flood control alternative should consider impacts to both the existing terrestrial and aquatic communities present within the watershed. The terrestrial evaluation should include an inventory of vegetation types present and how each alternative will impact these communities. Preservation of wetlands within the Clear Creek watershed and within the Galveston Bay system should be considered in development of project alternatives.

If channelization is contemplated as one or more project alternative, then the following issues should be considered.

In general, this Department is opposed to channelization of streams. A relatively straight, uniform channel is seldom encountered in nature. The meandering aspect of a channel and the non-uniformity of side slopes and substrate provide the physical diversity necessary to support a natural ecosystem. Therefore, channelization by its very nature would exert an adverse impact upon the existing biological resources of the Clear Creek watershed.

Mr. Tony Vazquez
Page 2

Non-structural flood control alternatives should be thoroughly evaluated in lieu of channel plans to prevent the removal of high quality stream and riparian vegetation. Zoning ordinances to prevent further encroachment into the floodplain should also be investigated.

If a structural plan is pursued, efforts should be made to avoid filling and/or otherwise impacting adjacent wetlands and wooded habitats as much as practicable.

A search of the Texas Natural Heritage Program Information System revealed occurrences of special species from the watershed area of the proposed project. Available printouts and a code key are attached. Additional special species possibly occurring in the watershed area are also listed below.

Federal and State Endangered--

Hymenoxys texana (prairie dawn) G2 S2 - likely occurs in western portion of watershed area; in poorly drained depressions or at the base of mima mounds in open grassland in almost barren areas; endemic; flowering March-early April

Tympanuchus cupido attwateri (Attwater's Greater Prairie-chicken) G4T1 S1 - endemic

Bufo houstonensis (Houston Toad) G1 S1 - endemic

State Endangered--

Opheodrys vernalis blanchardi (Western Smooth Green Snake) G5T5 S1

Federal Category 2--

Chloris texensis (Texas windmill-grass) G2 S2 - three additional occurrence records within watershed area are not yet available; upper Gulf Coastal prairie remnant species; endemic; sandy to sandy loam soils in bare areas in grasslands and disturbed sites, such as ditches and roadsides; flowering in fall

Machaeranthera aurea (Houston machaeranthera) G2 S2 - upper Gulf Coastal prairie remnant species; endemic; serally barren or thinly vegetated grasslands, disturbed pastures, roadsides, etc. on loamy to sandy loam soils; flowering late October-November

Mr. Tony Vazquez
Page 3

Other Rare Species--

Malaclemys terrapin littoralis (Texas Diamondback
Terrapin) G5T3 S3

Rana areolata (Crawfish Frog) G4 S3

Nerodia fasciata clarkii (Gulf Salt Marsh Snake)
G5T4 S3

Managed Areas--

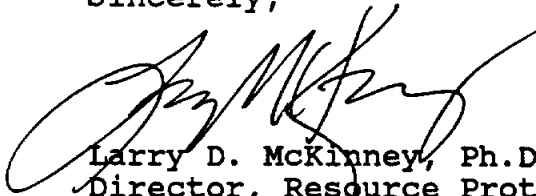
Armand Bayou Nature Park

The Heritage Program information included here is based on the best data currently available to the state regarding threatened, endangered, or otherwise sensitive species. However, these data do not provide a definite statement as to the presence or absence of special species or natural communities within your project area, nor can these data substitute for an evaluation by qualified biologists. This information is intended to assist you in avoiding harm to species that occur on your site. Please contact the Texas Parks and Wildlife Department's Heritage Program before publishing or otherwise disseminating any specific locality information.

There are many Land and Water Conservation Fund, and Local Park Fund projects that may be impacted depending on the scope of the proposed work. A review of the project will be needed again after more detailed proposals are complete.

I appreciate your coordination on this project.

Sincerely,



Larry D. McKinney, Ph.D.
Director, Resource Protection Division

LDMcK:RGF:wja

Attachments

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

ME: TYMPANUCHUS CUPIDO ATTWATERI

COMMON NAME: ATTWATER'S GREATER PRAIRIE-CHICKEN

OTHER NAME:

FEDERAL STATUS: LE

STATE STATUS: E

GLOBAL RANK: G4T1

STATE RANK: S1

IDENTIFIED: Y

TRACK: Y

SENSITIVITY: N

COUNTY: Galveston

USGS TOPO MAPS: LEAGUE CITY

TOPO QUAD: 2909551

ELEMENT OCCURRENCE NUMBER: 020

MAP MARGIN NUMBER: 1

DATE LAST OBSERVED: 1985-SPRNG

PRECISION: S

DATE FIRST OBSERVED:

OCCURRENCE RANK: D

DATE SURVEYED: 1985-SPRNG

SURVEY COMMENTS: POOR SITE

MANAGED AREAS:

DIRECTIONS:

HOUSTON GULF AIRPORT

DESCRIPTION:

SMALL AIRPORT ON COASTAL PRAIRIE

QUALITATIVE/QUANTITATIVE DATA:

3 MALE CHICKENS SEEN ON AERIAL AND GROUND SURVEYS MADE DURING SPRING
BOOMING SEASON

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

ADEQUATE LEGAL PROTECTION

OTHER COMMENTS:

INDICATIVE OF A SMALL POPULATION IN AREA; SITE MAPPED IS POOR

SOURCE OF INFORMATION:

USF&WS. 1985. UNPUBLISHED MAPS OF 1985 PRAIRIE CHICKEN SURVEY
RESULTS. 8 PP.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

ME: BUFO HOUSTONENSIS

COMMON NAME: HOUSTON TOAD

OTHER NAME:

FEDERAL STATUS: LE

STATE STATUS: E

GLOBAL RANK: G1

STATE RANK: S1

IDENTIFIED: Y TRACK: Y

SENSITIVITY: N

COUNTY: Harris

USGS TOPO MAPS: PASADENA
PARK PLACE
FRIENDSWOOD
PEARLAND

TOPO QUAD: 2909562
2909563
2909552
2909553

ELEMENT OCCURRENCE NUMBER: 004

MAP MARGIN NUMBER: 1

DATE LAST OBSERVED: 1976

PRECISION: M

DATE FIRST OBSERVED: 1953

OCCURRENCE RANK: X?

DATE SURVEYED:

SURVEY COMMENTS: NOT SEEN HERE IN SEVERAL YEARS

MANAGED AREAS:

DIRECTIONS:

SOUTHEAST HOUSTON, NORTH OF CLEAR CREEK, WEST OF I-45, EAST OF
TELEPHONE ROAD, SOUTHEAST AND SOUTH OF HOBBY AIRPORT. ALSO ELLINGTON
AIR FORCE BASE.

DESCRIPTION:

SANDY SUBSTRATE, POOLS - EPHEMERAL & PERMANENT FRESH WATER. URBAN
AREA, ENCROACHING URBANIZATION.

QUALITATIVE/QUANTITATIVE DATA:

A NUMBER OBSERVED UNTIL MID 70'S. NEEDS SANDY SUBSTRATE AND EPHEMERAL
RAIN POOLS TO BREED. BREEDS IN FEBRUARY. OCCASIONAL HYBRIDS WITH OTHER
BUFO SPP. FACILITATED BY HABI-TAT MODIFICATION

MANAGEMENT COMMENTS:

REINTRODUCE IN PROTECTED HABITAT

PROTECTION COMMENTS:

WORK WITH HRRS, BRZR CO. PARKS TO ENSURE HABITAT MAINTENANCE

OTHER COMMENTS:

NOT A PROTECTABLE OCCURRENCE, NOT SEEN RECENTLY. URBANIZATION HAS
PROBABLY ELIMINATED HABITAT.

SOURCE OF INFORMATION:

U.S. FISH AND WILDLIFE SERVICE. 1983. RECOVERY PLAN FOR THE
HOUSTON TOAD (BUFO HOUSTONENSIS): DRAFT. ALBQ., N.M.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

ME: BUFO HOUSTONENSIS
COMMON NAME: HOUSTON TOAD

OTHER NAME:

FEDERAL STATUS: LE

STATE STATUS: E

GLOBAL RANK: G1

STATE RANK: S1

IDENTIFIED: Y

TRACK: Y

SENSITIVITY:

COUNTY: Fort Bend

USGS TOPO MAPS: ALMEDA

TOPO QUAD: 2909554

ELEMENT OCCURRENCE NUMBER: 006

MAP MARGIN NUMBER: 1

DATE LAST OBSERVED:

PRECISION: M

DATE FIRST OBSERVED: 1953

OCCURRENCE RANK: D

DATE SURVEYED:

SURVEY COMMENTS: NOT SEEN HERE IN YEARS, VAGUE LOCALITY.

MANAGED AREAS:

DIRECTIONS:

2 MILES WEST OF FRESNO, FORT BEND COUNTY

DESCRIPTION:

SANDY SUBSTRATE. EPHEMERAL POOLS AND STOCK TANKS.

QUALITATIVE/QUANTITATIVE DATA:

NEEDS SAND SUBSTRATE, WATER IN POOLS. BREEDS IN FEBRUARY AFTER RAINS.

RELICTUAL FROM MORE EQUABLE CLIMATE. OCCASIONALLY HYBRIDIZES WITH
OTHER BUFO SP.

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

COLLECTED BY JOHN C. WATTRING. OLD, VAGUE LOCALITY RECORD.

SOURCE OF INFORMATION:

BROWN, L. E. 1971. NATURAL HYBRIDIZATION & TREND TOWARD EXTINCTION
IN SOME RELICT TX TOAD POP. SW NAT 16(2):185-199.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

IE: OPHEODRYS VERNALIS BLANCHARDI
COMMON NAME: WESTERN SMOOTH GREEN SNAKE

OTHER NAME:

FEDERAL STATUS: STATE STATUS: E
GLOBAL RANK: G5T5 STATE RANK: S1
IDENTIFIED: Y TRACK: Y SENSITIVITY:
COUNTY: Harris

USGS TOPO MAPS: PEARLAND

TOPO QUAD: 2909553

ELEMENT OCCURRENCE NUMBER: 003
MAP MARGIN NUMBER: 2 DATE LAST OBSERVED: 1964-
PRECISION: S DATE FIRST OBSERVED:
OCCURRENCE RANK: DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:

0.6 MILES SOUTH OF THE INTERSECTION OF ALAMEDA-GENOA ROAD W/ TELEPHONE
ROAD, HOUSTON.

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SPECIMEN COLLECTED ON JUNE 15, DEAD-ON-ROAD. IN THE AUTHORS PRIVATE
COLLECTION.

SOURCE OF INFORMATION:

WORTHINGTON, R.D. 1974. REMARKS ON THE DISTRIBUTION OF THE SMOOTH
GREEN SNAKE, O.V.BLANCHARDI... SW NAT 18: 344-346.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

ME: CHLORIS TEXENSIS
COMMON NAME: TEXAS WINDMILL-GRASS
OTHER NAME:

FEDERAL STATUS: C2	STATE STATUS:
GLOBAL RANK: G2	STATE RANK: S2
IDENTIFIED: Y	TRACK: Y
COUNTY: Harris	SENSITIVITY:

USGS TOPO MAPS: LA PORTE

TOPO QUAD: 2909561

ELEMENT OCCURRENCE NUMBER: 004
MAP MARGIN NUMBER: 2
PRECISION: S
OCCURRENCE RANK:
SURVEY COMMENTS:

DATE LAST OBSERVED: 1984-10-20
DATE FIRST OBSERVED: 1984
DATE SURVEYED:

MANAGED AREAS:

DIRECTIONS:

SENZ ROAD AT INTERSECTION WITH HIGHWAY 225 IN LOMAX. [SENS ROAD]

DESCRIPTION:

ON MOWED VERGE

QUALITATIVE/QUANTITATIVE DATA:

IN FLOWER AND FRUIT. SMALL POPULATION OF CA. 100 PLANTS.

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:

BROWN, LARRY E. (8274). 1984. SPECIMEN # NONE TX.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

NAME: CHLORIS TEXENSIS

COMMON NAME: TEXAS WINDMILL-GRASS

OTHER NAME:

FEDERAL STATUS: C2

STATE STATUS:

GLOBAL RANK: G2

STATE RANK: S2

IDENTIFIED: Y TRACK: Y

SENSITIVITY:

COUNTY: Harris

USGS TOPO MAPS: LA PORTE

TOPO QUAD: 2909561

ELEMENT OCCURRENCE NUMBER: 014

MAP MARGIN NUMBER: 3

DATE LAST OBSERVED: 1984-10-26

PRECISION: M

DATE FIRST OBSERVED: 1962

OCCURRENCE RANK:

DATE SURVEYED:

SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:

EAST OF THE 5900 BLOCK OF JANUS STREET, WEST OF SAN JACINTO COLLEGE IN
PASADENA, SOUTH OF SPENCER HIGHWAY

DESCRIPTION:

AMONG PRAIRIE GRASSES IN A BARE DEPRESSION IN MOWED FIELD

QUALITATIVE/QUANTITATIVE DATA:

IN FRUIT. A FEW PLANTS.

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

BROWN #5896 (SMU) 17 OCTOBER 1962; ALSO BROWN #8312 (SMU) 26 OCTOBER
1984

SOURCE OF INFORMATION:

BROWN, LARRY E. (5896). 1962. SPECIMEN # NONE SM.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

NAME: CHLORIS TEXENSIS

COMMON NAME: TEXAS WINDMILL-GRASS

OTHER NAME:

FEDERAL STATUS: C2

STATE STATUS:

GLOBAL RANK: G2

STATE RANK: S2

IDENTIFIED: Y TRACK: Y

SENSITIVITY:

COUNTY: Harris

USGS TOPO MAPS: LA PORTE

TOPO QUAD: 2909561

ELEMENT OCCURRENCE NUMBER: 006

DATE LAST OBSERVED: 1984-10-26

MAP MARGIN NUMBER: 4

DATE FIRST OBSERVED: 1984

PRECISION: M

OCCURRENCE RANK:

DATE SURVEYED:

SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:

VANDERWOOD [UNDERWOOD] STREET NORTH OF INTERSECTION WITH SPENCER
AVENUE IN DEER PARK

DESCRIPTION:

BARE SPOT IN TALL GRASS PRAIRIE, SMALL FIELD AMONG BUILDINGS

QUALITATIVE/QUANTITATIVE DATA:

IN FRUIT AND IN FLOWER 26 OCTOBER 1984; SMALL POPULATION

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

ALSO REPRESENTED BY BROWN #8298 (SMU), 26 OCTOBER 1984

SOURCE OF INFORMATION:

BROWN, LARRY E. (8309). 1984. SPECIMEN # NONE TX.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

NAME: MACHAERANTHERA AUREA
COMMON NAME: HOUSTON MACHAERANTHERA
OTHER NAME:
FEDERAL STATUS: C2
GLOBAL RANK: G2
IDENTIFIED: Y TRACK: Y
COUNTY: Harris

STATE STATUS:
STATE RANK: S2
SENSITIVITY:

USGS TOPO MAPS: LA PORTE

TOPO QUAD: 2909561

ELEMENT OCCURRENCE NUMBER: 011
MAP MARGIN NUMBER: 5
PRECISION: S
OCCURRENCE RANK:
SURVEY COMMENTS:

DATE LAST OBSERVED: 1983-10-15
DATE FIRST OBSERVED: 1983
DATE SURVEYED: -

MANAGED AREAS:

DIRECTIONS:

ALONG UNDERWOOD STREET JUST NORTH OF INTERSECTION WITH SPENCER HIGHWAY
IN LA PORTE

DESCRIPTION:

OPEN SANDY AREA WITHIN PRAIRIE

QUALITATIVE/QUANTITATIVE DATA:
IN FLOWER

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:

BROWN, L. E. (6742). 1983. SPECIMEN # NONE SM.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

ME: MALACLEMYS TERRAPIN LITTORALIS
COMMON NAME: TEXAS DIAMONDBACK TERRAPIN

OTHER NAME:

FEDERAL STATUS:

STATE STATUS:

GLOBAL RANK: G5T3

STATE RANK: S3

IDENTIFIED: Y

TRACK: Y

SENSITIVITY:

COUNTY: Harris
Chambers

USGS TOPO MAPS: LEAGUE CITY

TOPO QUAD: 2909551

ELEMENT OCCURRENCE NUMBER: 020

MAP MARGIN NUMBER: 3

DATE LAST OBSERVED: 1947-03-09

PRECISION: M

DATE FIRST OBSERVED:

OCCURRENCE RANK:

DATE SURVEYED:

SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:

SEABROOK.

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

TAKEN FROM THE BAY BY FISHERMAN.

SOURCE OF INFORMATION:

BROWN, B. C. 1947. BRYCE C. BROWN COLLECTION (BAYLOR UNIVERSITY)
3910, ONE SPECIMEN.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

NAME: RANA AREOLATA

COMMON NAME: CRAWFISH FROG

OTHER NAME:

FEDERAL STATUS:

STATE STATUS:

GLOBAL RANK: G4

STATE RANK: S3

IDENTIFIED: Y

TRACK: Y

SENSITIVITY:

COUNTY: Harris

USGS TOPO MAPS: PASADENA

TOPO QUAD: 2909562

ELEMENT OCCURRENCE NUMBER: 004

MAP MARGIN NUMBER: 3

DATE LAST OBSERVED: 1948-02-18

PRECISION: M

DATE FIRST OBSERVED:

OCCURRENCE RANK:

DATE SURVEYED:

SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:

SOUTH HOUSTON

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

COLLECTED 5 AND 18 FEBRUARY, UMMZ 115835-6

SOURCE OF INFORMATION:

ETHERIDGE, R.E. 1948. UNIV. MICHIGAN MUSEUM OF ZOOLOGY 115835-6, 5
SPECIMENS.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
15 APR 1991

NAME: NERODIA FASCIATA CLARKII
COMMON NAME: GULF SALT MARSH SNAKE
OTHER NAME:

FEDERAL STATUS: STATE STATUS:
GLOBAL RANK: G5T4 STATE RANK: S3
IDENTIFIED: Y TRACK: Y SENSITIVITY:
COUNTY: Harris

USGS TOPO MAPS: LEAGUE CITY

TOPO QUAD: 2909551

ELEMENT OCCURRENCE NUMBER: 002
MAP MARGIN NUMBER: 2 DATE LAST OBSERVED:
PRECISION: M DATE FIRST OBSERVED:
OCCURRENCE RANK: DATE SURVEYED:
SURVEY COMMENTS:

MANAGED AREAS:

DIRECTIONS:
SEABROOK

DESCRIPTION:

QUALITATIVE/QUANTITATIVE DATA:

MANAGEMENT COMMENTS:

PROTECTION COMMENTS:

OTHER COMMENTS:

SOURCE OF INFORMATION:
UNKNOWN COLLECTOR. NO DATE. UNIVERSITY OF KANSAS MUSEUM OF NATURAL
HISTORY #61070-2, 3 SPECIMENS.

TEXAS NATURAL HERITAGE PROGRAM
TEXAS PARKS AND WILDLIFE DEPARTMENT
MANAGED AREA INFORMATION

NAME: ARMAND BAYOU NATURE PARK
COUNTY NAME(S): Harris

USGS TOPO QUADS: LEAGUE CITY

ESTABLISHED: SIZE: 208400
DESCRIPTION: GULF COASTAL PRAIRIE, WOODED AREAS IN THE
FLOODPLAINS OF MAJOR STREAMS, MARSHES ADJACENT TO
BUFFALO BAYOU

COMMENTS: THREE NOTEWORTHY TEXAS ENDEMICS: CHLORIS TEXENSIS,
MACHAERANTHERA AUREA, AND WILLKOMMIA TEXANA; ALL
PRESENT TOGETHER IN ONE PRAIRIE ADJACENT TO
UNDERWOOD STREET IN DEER PARK

MANAGEMENT:

MANAGER: WILLIAM D. GRIMES
MGR.INST.: RESOURCE MANAGER
ADDRESS: 8600 BAY AREA BOULEVARD
P.O. BOX 58828
HOUSTON , TX 77258
PHONE: (713) 474-2551

CODE KEY

FEDERAL STATUS

- LE - Listed Endangered
- LT - Listed Threatened
- LELT - Listed Endangered in part of range, Threatened in a different part
- PE - Proposed to be listed Endangered
- PT - Proposed to be listed Threatened
- PEPT - Proposed Endangered, Threatened
- S - Synonyms
- C1 - Candidate, Category 1. USFWS has substantial information on biological vulnerability and threats to support proposing to list as endangered or threatened. Data are being gathered on habitat needs and/or critical habitat designations.
- C1* - C1, but lacking known occurrences
- C1** - C1, but lacking known occurrences, except in captivity/cultivation
- C2 - Candidate, Category 2. Information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial data on biological vulnerability and threats are not currently known to support the immediate preparation of rules. Further biological research and field study will be necessary to ascertain the status and/or taxonomic validity of the taxa in Category 2.
- C2* - C2, but lacking known occurrences
- C2** - C2, but lacking known occurrences, except in captivity/cultivation
- 3 - Taxa no longer being considered for listing as threatened or endangered. Three subcategories indicate the reasons for removal from consideration.
- 3A - Former Candidate, rejected because presumed extinct and/or habitats destroyed
- 3B - Former Candidate, rejected because not a recognized taxon; i.e. synonym or hybrid
- 3C - Former Candidate, rejected because more common, widespread, or adequately protected
- blank - Not currently listed

STATE STATUS

- E - Listed as Endangered in the State of Texas
- T - Listed as Threatened in the State of Texas
- blank - Not currently listed

GLOBAL RANK

- G1 - Critically imperiled globally, extremely rare, 5 or fewer occurrences. [Critically endangered throughout range.]
- G2 - Imperiled globally, very rare, 6 to 20 occurrences. [Endangered throughout range.]
- G3 - Very rare and local throughout range or found locally in restricted range, 21 to 100 occurrences. [Threatened throughout range.]
- G4 - Apparently secure globally.
- G5 - Demonstrably secure globally.
- GA - Accidental in North America, now G#NA.
- GE - An exotic species established in North America, now G#NE.
- GH - Of historical occurrence through its range.
- GU - Uncertain; most likely rank/uncertain (G2?), range (G1G2)
- GX - Believed to be extinct throughout range.
- Q - Qualifier denotes questionable rank or taxonomic assignment.
- T - Subrank of subspecies or variety.

STATE RANK

- S1 - Critically imperiled in state, extremely rare, very vulnerable to extirpation, 5 or fewer occurrences.
- S2 - Imperiled in state, very rare, vulnerable to extirpation, 6 to 20 occurrences.
- S3 - Rare in state, 20+ occurrences.
- S4 - Apparently secure in state.
- S5 - Demonstrably secure in state.
- SA - Accidental in state.
- SE - An exotic species established in state.
- SH - Of historical occurrence in state. May be rediscovered.
- SX - Apparently extirpated from State.

PRECISION

- S or SC - Occurrence mapped to seconds of latitude/longitude. SC indicates element occurrence is a confirmed occurrence.
- M - Occurrence mapped to minutes of latitude/longitude, approximately 2 km or 1.5 mi radius.
- G - Occurrence mapped general to quad or place name precision only, precision within about 8 km or 5 mi radius.
- U - Unmappable record.

OCCURRENCE RANK

- A - Excellent
- B - Good
- C - Marginal
- D - Poor
- X - Destroyed
- blank - Unknown

**Recommendations to Minimize Effects of
Channelization on Fish and Wildlife**

1. A non-structural flood control plan should be thoroughly evaluated in lieu of a structural channel plan. This would prevent removal of high quality stream and riparian vegetation.
2. Strict zoning ordinances should be adopted and enforced to prevent further floodplain encroachment from exacerbating runoff and associated flooding while also adversely affecting fish and wildlife habitat.
3. If a structural plan is selected efforts should be made to avoid filling and/or otherwise impacting adjacent wetland and wooded habitats as much as practical.
4. Impacts of a structural plan can be reduced by implementing one-sided construction.
5. Construction of a benched floodway above the existing streambed should be considered in order to limit disturbance of aquatic habitats.
6. Channel banks and other disturbed areas should be revegetated with a mixture of native grasses and forbs that provide wildlife food and cover.
7. Mature trees should be avoided. If this is not practical, then additional trees, particularly those which produce nuts or acorns, should be reestablished at a frequency of at least one tree planted for every tree lost.

April 4, 1991

Andrew Sipocz
Texas Parks & Wildlife Department
P.O. Box 8
Seabrook, TX 77586

Tony Vazquez
Vazquez Environmental Services, Inc.
10235 West Little York, STE. 445
Houston, TX 77040

Dear Mr. Vazquez:

This is in response to your request for information regarding baseline data on existing biological conditions within Clear Creek and its tributaries. The only information Mr. Fred LeBlanc or I have immediately available is the U.S. Army Corps of Engineers Preconstruction Authorization Planning Report for the Clear Creek Flood Control Project. The report should be available from the Galveston District of the Corps. We have only one copy of the two volume report in our office.

Fred and I are currently involved in the planning of wetland habitat creation for mitigating the expected detrimental effects of the project. This is in concert with the U.S. Fish & Wildlife Service's and Corp's efforts. However, most of the data we use to assess impacts and possible mitigation options is not generated by our field office, and rather is available from a number of sources.

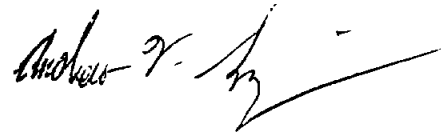
The Texas Parks and Wildlife Department's Natural Heritage Program and Endangered Species Program provides information detailing the location and status of threatened and endangered animals and plants within the state. Mr. Robert Murphy heads the program: 4200 Smith School Rd., Austin, TX 78744 (512)389-4997.

The U.S. Fish & Wildlife Service in Clear Lake also tracks the status and locations of federally endangered and threatened animals and plants within the state. Ms. Kathy Nemic generally bears this responsibility, while Mr. Mike Morgan is involved in mitigation planning for the Clear Creek Flood Control Project: 17629 El Camino Real, Suite 211, Houston, TX 77058 (713)750-1700.

The Fisheries Division of The Texas Parks and Wildlife Department routinely collects samples of fish and other marine life in Galveston Bay adjacent to Clear Lake. The purpose is to provide baseline data and trend data for the Bay's marine life. Occasionally they collect within Clear Lake itself. Brenda Bowling is the biologist currently heading the collection and data summarization efforts. Her address and phone are the same as mine.

If we can be of further service please contact us,

Sincerely,

A handwritten signature in cursive script, appearing to read "Andrew R. Smith", followed by a long horizontal flourish line.

TEXAS WATER COMMISSION



B. J. Wynne, III, Chairman
John E. Birdwell, Commissioner
Cliff Johnson, Commissioner

John J. Vay, General Counsel
Michael E. Field, Chief Hearings Examiner
Gloria A. Vasquez, Chief Clerk

Allen Beinke, Executive Director

March 28, 1991

Mr. Tony Vazquez
Vazquez Environmental Services, Inc.
York Centre Office Building
10235 West Little York, Suite 445
Houston, Texas 77040

Re: Letter of Correspondence Dated March 21, 1991 - Request for
Information, Clear Creek, Harris/Galveston Counties

Dear Mr. Vazquez:

A copy of your letter dated March 21, 1991, was forwarded to me by Mr. Charles Eanes in his effort to assist you in obtaining pertinent information concerning the Clear Creek Watershed. I would suggest you contact the Harris County Flood Control District regarding flood assessment data/documents for the Clear Creek Watershed.

With reference to requested information on threatened or endangered species, critical habitat, wetlands, and special aquatic habitats, the Resource Protection Division of the Texas Parks and Wildlife Department (TPWD), in cooperation with the U.S. Fish and Wildlife Service routinely provides information concerning natural resources for specific study areas, therefore, I recommend contacting Mr. Bob Spain of the TPWD Austin office at 512/389-4635.

If I can be of further assistance to you, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink that reads "Bruce A. Moulton". The signature is written in a cursive style.

Bruce A. Moulton
Assistant Chief
Surface Water Section

BAM:pf



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6

1445 POSS AVENUE SUITE 1200

DALLAS TEXAS 75202-2733

April 15, 1991

Vazquez Environmental Services, Inc.
York Centre Office Building
10235 West Little York, Ste. 445
Houston, Texas 77040

Dear Mr. Vazquez:

The U.S. Environmental Protection Agency (EPA), Region 6 office in Dallas, Texas has received your solicitation for information regarding the environmental effects of the proposed Clear Creek Watershed flood control project.

We have no substantive comments to offer on the proposed project at this time. However, we appreciate your efforts to identify any environmental issues early in the development of the environmental assessment. To assist you in your task of consulting with the various resource agencies, we have included an information packet that you might find helpful.

If you have any questions, or if I may be of further assistance in this matter, please do not hesitate to contact me or Yvonne Vallette of my staff at (214) 655-2260.

Sincerely yours,

A handwritten signature in cursive script that reads "Norm Thomas".

Norm Thomas
Chief
Federal Activities Branch (6E-F)

Enclosures



TEXAS WATER DEVELOPMENT BOARD

Charles W. Jenness, *Chairman*
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Walter W. Cardwell, III, *Member*
William B. Madden, *Member*

April 8, 1991

Dr. Tony Vazquez
Environmental Consultant
Vazquez Environmental Services, Inc.
York Centre Office Building
10235 West Little York, Ste. 445
Houston, Texas 77040

Dear Dr. Vazquez:

Thank you for your letter to the Texas Organization for Endangered Species (T.O.E.S.) requesting ecological information on Clear Creek Watershed. Please be advised that there is a Clear Creek within every river basin in the State of Texas. Therefore, I will need a specific description of the watershed location and preferably a map showing the boundary of the project impact.

I would recommend that you also contact the Resource Protection Division and Natural Heritage Program at Texas Parks & Wildlife Department headquarters, and the Instream Uses Unit of the Texas Water Commission for additional information you are concerned with regarding your project impact.

Sincerely,

A handwritten signature in black ink that reads "Ray C. Mathews Jr." with a large, sweeping flourish over the first part of the name.

Raymond C. Mathews, Jr.
Chairman, Animal Committee
Texas Organization For Endangered Species

cc: Dr. Mike Tewes
Texas Organization For Endangered Species
P.O. Box 12773
Austin, Texas 78711

TEXAS WATER COMMISSION



B. J. Wynne, III, Chairman
John E. Birdwell, Commissioner
Cliff Johnson, Commissioner

John J. Vay, General Counsel
Michael E. Field, Chief Hearings Examiner
Gloria A. Vasquez, Chief Clerk

Allen Beinke, Executive Director

March 26, 1991

Mr. Tony Vazquez
Vazquez Environmental Services, Inc.
York Centre Office Building
10235 West Little York, Suite 445
Houston, Texas 77040

Re: Request For Information-Clear Creek Watershed

Dear Mr. Vazquez:

This is in response to your letter dated March 21, 1991. Enclosed is a Summary of Clear Creek water quality data from the 1990 Texas Water Quality Inventory. Additional information may be obtained by requesting the intensive survey documents (IS/IMS) referenced by contacting our library at (512) 463-7834 or by contacting the Texas Natural Resources Information System at (512) 463-8402 and requesting computer printouts of monitoring data from the stations referenced in the survey.

A copy of your letter has been provided to Mr. Bruce Moulton of the Water Rights and Uses Division so that he may provide you with any additional information from their records.

We hope this information will assist you in your endeavor.

Sincerely,

A handwritten signature in cursive script that reads "Charles Eanes".

Charles Eanes
Water Quality Division

cc: Mr. Bruce Moulton, Water Rights & Uses Division

**THE STATE OF TEXAS
WATER QUALITY INVENTORY**

10th Edition
1990

Pursuant to
SECTION 305(b)
FEDERAL CLEAN WATER ACT

LP 90-06

Texas Water Commission

June 1990

Segment 1101 of the San Jacinto-Brazos Coastal Basin

NAME: Clear Creek Tidal

DESCRIPTION: from the confluence with Clear Lake in Galveston/Harris County to a point 100 meters (110 yards) upstream of FM 528 in Galveston/Harris County

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 14 miles (22 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat

MONITORING STATIONS: 1101.0050, 1101.0100, 1101.0150

INTENSIVE SURVEYS: 16 Sep 1976 Q,X,D,F,C,S,P,I,B IMS-62 (Shaw: Sep 1977)
10 Sep 1979 Q,X,D,R,F,C,B IS-5 (Kirkpatrick: Jan 1980)

PERMITTED FACILITIES (FINAL):

Domestic	9 outfalls	18.23 MGD
Industrial	0 outfalls	0.00 MGD
Total	9 outfalls	18.23 MGD

KNOWN WATER QUALITY PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Dissolved oxygen levels are occasionally below 4.0 mg/L. This segment does not meet swimmable criteria due to elevated fecal coliform bacteria in half the samples.

POTENTIAL WATER QUALITY PROBLEMS:

Total and orthophosphorus levels are persistently elevated, and inorganic nitrogen is frequently elevated. Chlorophyll *a* is periodically elevated.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

Point source discharges measurably affect water quality in this segment.

CONTROL PROGRAMS:

- A. Existing: The Clear Lake Rule (31 TAC Sections 333.1-333.3), adopted in March, 1981, imposes a treatment level (30-day average) of 5 mg/L BOD₅, 12 mg/L TSS, and 2 mg/L NH₃-N on all domestic sewage treatment plant discharges. Comparable effluent limitations are also required for industrial discharges.
- B. Programs to be implemented: None in the immediate future.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None at this time.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

Affects water quality of Clear Lake (Segment 2425).

WATER QUALITY STATUS

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (COUNTING FROM 1985 THROUGH 1988) OF WATER QUALITY INFORMATION FOR SEGMENT 1107.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	4.0	30	1	12.0	6.8	4	3.3
TEMPERATURE (F)	95.0	30	55.4	90.8	72.5	0	0
PH	6.5-9.0	24	7.2	8.7	7.9	0	0
CHLORIDE (MG/L)	N/A	29	108	12200	2344	0	0
SULFATE (MG/L)	N/A	27	31	1320	276	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	N/A	24	405	15425	4318	0	0
FECAL COLIFORMS (#/100 ML)	200	26	10	13000	244	13	887

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50

Segment 1102 of the San Jacinto-Brazos Coastal Basin

NAME: Clear Creek Above Tidal

DESCRIPTION: from a point 100 meters (110 yards) upstream of FM 528 in Galveston/Harris County to Rouen Road in Fort Bend County

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 44 miles (71 kilometers)

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat

MONITORING STATIONS: 1102.0100, 1102.0200

INTENSIVE SURVEYS: 16 Sep 1976 Q,X,D,F,C,S,P,I,B IMS-62 (Shaw: Sep 1977)
10 Sep 1979 Q,X,D,R,F,C,B IS-5 (Kirkpatrick: Jan 1980)

PERMITTED FACILITIES (FINAL):

Domestic	23 outfalls	30.35 MGD
Industrial	8 outfalls	0.09 MGD
Total	31 outfalls	30.44 MGD

KNOWN WATER PROBLEMS/WATER QUALITY STANDARD COMPARISON:

Dissolved oxygen levels are occasionally below 5.0 mg/L. This segment does not meet swimmable criteria due to frequently elevated levels of fecal coliform bacteria.

POTENTIAL WATER QUALITY PROBLEMS:

Supersaturated dissolved oxygen levels occur occasionally, and chlorides, total dissolved solids and fecal coliforms are rarely elevated. Inorganic nitrogen is frequently elevated, and total and orthophosphorus levels are persistently elevated.

RELATIVE SIGNIFICANCE OF POINT AND NONPOINT SOURCE POLLUTANTS:

Point source waste loads measurably affect water quality in this segment.

CONTROL PROGRAMS:

- A. Existing: The Clear Lake Rule 31 (TAC Sections 333.1-333.3), adopted in March, 1981, imposes a treatment level (30-day average) of 5 mg/L BOD₅, 12 mg/L TSS, and 2 mg/L NH₃-N on all domestic sewage treatment plant discharges. Comparable effluent limitations are also required for industrial discharges.
- B. Programs still to be implemented: None in the immediate future.

FACTORS NEEDING CLARIFICATION WITH RESPECT TO CAUSE/EFFECT RELATIONSHIPS:

None at this time.

KNOWN RELATIONSHIPS TO OTHER ENVIRONMENTAL PROBLEMS:

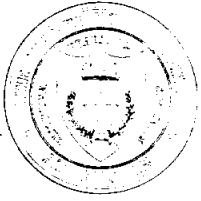
Affects water quality of Clear Creek tidal (Segment 1101) and Clear Lake (Segment 2425).

WATER QUALITY STATUS:

THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (OCT. 1, 1985 THRU SEPT. 30, 1989) OF WATER QUALITY INFORMATION FOR SEGMENT 1102.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	27	4.5	17.0	8.4	3	4.8
TEMPERATURE (F)	95.0	27	54.3	87.8	72.1	0	0
PH	6.5-9.0	24	7.1	8.6	7.9	0	0
CHLORIDE (MG/L)	200	27	31	224	137	2	218
SULFATE (MG/L)	100	25	21	120	43	1	120
TOTAL DISSOLVED SOLIDS (MG/L)	600	25	191	630	492	2	626
FECAL COLIFORMS (#/100 ML)	200	25	10	15000	231	15	619

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50



COLLEGE OF LIBERAL ARTS
THE UNIVERSITY OF TEXAS AT AUSTIN

Texas Archeological Research Laboratory • Balcones Research Center
Austin, Texas 78712-1100 • (512) 471-5960

September 25, 1991

Alejandro C. Flores
Dannenbaum Engineering Corporation
P.O. Box 22292
Houston, Texas 77227

Re: Clear Creek Regional Flood Control Plan
Historical and Archeological Sites

Dear Mr. Flores:

This letter is submitted in response to a file search received in this office on 26 August 1991 concerning the above-referenced project and the possible location of archeological or historical sites within its boundaries.

Our research has determined that there are 88 archeological/historical sites located within the project area, also the Armand Bayou Archeological District listed in the National Register of Historic Places encompasses a section of the project area on the League City quad. Nine of the 88 sites mentioned are within this district. Please see the following pages for brief descriptions of each site in the study area. There are no Galveston County sites listed in the National Register of Historic Places 1966-1988 catalogue which would be impacted by the proposed work. Site locations have been plotted on the enclosed project maps, but please remember that these locations are confidential and should not appear in any public documents.

We hope this response adequately fulfills your request for information. If you have any questions please let us know.

Sincerely,

A handwritten signature in cursive script that reads "Rosario Casarez".

Rosario Casarez
Research Associate

Enclosures

Dannbaum Engineering Corporation
Clear Creek Regional Flood Control Plan - Historical and Archeological Sites

Harris County

- 41HR29: shell concentration, originally recorded 1957, site reported as completely destroyed by erosion in 1973
- 41HR46: no information provided on this site, originally reported in 1952
- 41HR75: shell midden; pottery sherds, bone recovered; site disturbed by wave action; recorded 1/67 and 4/68; current condition unknown
- *41HR81: shell/trash midden; potsherds, projectile points, animal bone, Rangia shell recovered; disturbed by erosion; this site is part of the Armand Bayou Archeological District, National Register of Historic Places; recorded 4/68, revisited and tested 1990; site scheduled to be excavated by University of Houston Clear Lake - School of Humanities Project over a three year period, current condition unknown
- 41HR84: seven flat-topped circular mounds; projectile points, burned clay, flint flakes, animal bone, five of the mounds have been either extensively disturbed or destroyed by pothunter who leased land for this purpose; recorded 1968, current condition unknown
- 41HR90: shell midden; potsherd, lithic debitage, site disturbed by wave action erosion; recorded 1983
- 41HR92: shell midden; potsherds, lithic debitage; originally recorded 1955, in 1973 most of site had been destroyed by wave action, in 1983 site could not be located
- 41HR93: small shell deposit, potsherd; site may not be a cultural deposit, but displaced material from an old road bed, area extensively disturbed and essentially destroyed
- 41HR94: shell midden; potsherds; site disturbed by wave action; could not be located in 1983, site may be deeply buried or destroyed
- 41HR95: shell midden; potsherds, lithic debitage, flakes, projectile point; site impacted by wave action and bulkhead construction; recorded 1955, revisited 1973 and 1982; site considered to have potential for listing as State Archeological Landmark
- *41HR141: clam shell midden; projectile point; disturbed by erosion; recorded 1970
- *41HR142: clam shell midden; flint flakes, bone; site impacted by erosion; recorded 1970
- *41HR143: clam shell midden; Rangia shell; site undisturbed when recorded in 1970
- *41HR146: sand knoll with occupational debris; potsherds, dart point, flint chips; site condition undisturbed; recorded 1970

Dannenbaum Engineering Corporation
 Clear Creek Regional Flood Control Plan - Historical and Archeological Sites

Harris County (cont.)

- *41HR147: clam and oyster shell midden; projectile point, flint flakes, pottery bowls; originally recorded 1970, 1974 - site reported destroyed by dredging
- *41HR148: oyster and clam shell midden; potsherds; recorded 1970, 1974 - site reported destroyed
- 41HR151: Rangia shell midden; potsherd, flakes, site disturbed by erosion and construction, recorded 1970, revisited 1983
- *41HR153: shell midden; potsherds, bone, flint flakes; site impacted by numerous burrow holes; recorded 1970
- 41HR161: mound with occupational debris; potsherds, projectile points, charred wood, bone fragments, flint flakes; recorded 1971, revisited 1973, site in good condition
- 41HR162: lithic material associated with sandy knoll mound; potsherd, flake, recorded 1973, site impacted by erosion (minimal) and pothunting
- 41HR163: lithic material associated with two small sandy loam mounds; potsherds, flint chips and flakes; recorded in 1973, site was in good condition at that time
- 41HR164: lithic scatter located on a sandy loam mound; flint flake observed; site in good condition, recorded 1973
- 41HR165: lithic scatter on sandy loam mound; flint flake observed; site had not been disturbed or eroded when recorded in 1973
- 41HR166: lithic site; flint flakes; site disturbed by rodent activity; recorded 1973
- 41HR167: lithic site; flint flakes; site in good condition; recorded 1973
- 41HR168: lithic material associated with sandy loam mound; flint flakes and chips; site disturbed by pothunting; recorded 1973
- 41HR169: site consist of scatter of chips, shell; disturbed by bike trail and erosion, may be disturbed by future construction; recorded 1973; current condition unknown
- 41HR170: lithic site; flakes, chips, shell; site destroyed by bulldozers; recorded 1973
- 41HR171: cultural debris in association with sandy loam mound; flint flake, potsherd; disturbed by pothunting and animal burrowing; recorded 1973
- 41HR191: lithic site on sandy loam mound; potsherds, projectile points; disturbed by slight erosion; recorded 1973
- 41HR192: four sandy loam mounds with cultural debris; flint flakes, chips potsherds; disturbed by pothunting; recorded 1973

Dannenbaum Engineering Corporation
 Clear Creek Regional Flood Control Plan - Historical and Archeological Sites

Harris County (cont.)

- 41HR193: lithic material located on a series of four small mounds; potsherds, flint chips, flakes, disturbed by some pothunting; recorded 1973
- 41HR194: lithic material located on five sandy loam mounds; flakes, potsherds, some mounds disturbed by pothunting; recorded 1973
- 41HR195: lithic material associated with two mound; flakes, chips, potsherds; one of the mounds has been pothunted; recorded 1973
- 41HR319: fence with scatter of metal, glass, wood, bricks indicating a house site; site destroyed by oil well activity; recorded 1977
- 41HR528: historic house and associated cemetery, built c. 1855, two-story frame structure, four identified graves in cemetery; land was part of land grant from Mexican government to Ritson Morris 1832; land given to his daughter Virginia and new husband Alfred B. Menard (half brother to Michel Menard, founder of Galveston); recorded 1984 and 1985; entire site was due to be bulldozed; current condition unknown
- 41HR538: thin Rangia shell lense, probably remains of small shell midden; potsherd found in association; severly disturbed by erosion; recorded 1984
- 41HR632: terrace site; potsherds, projectile point fragment, bone fragments; disturbed by erosion; recorded 1989; recording archeologist determined site to have high research potential and recommended site for testing prior to any construction activity, site was due to be impacted by Clear Creek channelization; current condition unknown; considered to have potential for listing in National Register of Historic Places and as State Archeological Landmark
- 41HR633: small sandy mound with associated cultural debris; dart point base, burned clay lumps, possible charcoal fragment; recorded 1989; site recommended for testing if it is to be impacted by construction; channelization of Clear Creek was due to cut through site, current condition unknown; considered to have potential for National Register and State Archeological Lanckmark listing
- 41HR634: campsite; biface, flint flake; disturbed by erosion; recorded 1989; no further work recommended at site
- 41HR634: house site, mid-19th century; house moved to Sam Houston City Park; two cisterns at site, fragmentary bottles, ceramic fragments, brick and mortar fragments; site disturbed by flooding and channel maintenance, recommended for testing, considered to have potential for listing in National Register and State Archeological Landmark
- 41HR636: cemetery with adjacent animal cemetery, mid-19th century to 20th century; headstones present; site is minimally maintained by Whitcomb family (owners); site also protected under state statutes
- 41HR696 - 41HR699: recently assigned numbers, no information in files

Dannenbaum Engineering Corporation
 Clear Creek Regional Flood Control Plan - Historical and Archeological Sites

Galveston County

- 41GV8: campsite; potsherds, flint flakes, Rangia shell; site disturbed by erosion; site initially recorded 1973, it could not be located in 1989
- 41GV9: campsite; potsherds, flint flakes, charcoal fragments; disturbed by erosion and channelization of Clear Creek; recording archeologist recommends site for testing if construction will affect it; recorded 1968, revisited 1989
- 41GV10: Rangia shell midden; flint flakes, potsherds, animal bone, charcoal; site heavily impacted by erosion, pothunting and channel improvements; recorded 1968, revisited and tested 1983 and 1987; site recommended for further testing; considered to have potential for National Register and State Archeological Landmark listing
- 41GV11: Rangia shell midden; potsherds, flint flakes, arrow points, disturbed by erosion; site recommended for testing; initially recorded 1968, revisited and tested 1983; considered to have potential for National Register and State Archeological Landmark listing
- 41GV12: Rangia shell midden; potsherds, dart point; disturbed by erosion and concrete bulkheading; recorded 1968, revisited 1984
- 41GV13: Rangia shell midden; potsherds; disturbed by erosion and construction of bulkheading; recorded 1968 revisited 1984
- 41GV14: Rangia shell midden; potsherds, bone; disturbed by erosion and possible future construction; recorded 1968, revisited 1984
- 41GV15: Rangia shell midden; potsherd; disturbed by erosion; recorded 1968, revisited 1984 - no cultural material observed at that time
- 41GV16: Rangia shell midden and historic component of unknown nature; potsherds (aboriginal), brick-lined cistern, historic trash and wooden shed; disturbed by heavy erosion; recorded 1968, revisited and tested 1984
- 41GV17: Rangia shell midden; no artifacts reported; site impacted by placement of concrete bulkhead and dumping of fill and trash; reported 1968; revisited and tested 1983 - site not located during this visit
- 41GV19: Rangia shell midden; potsherds, reworked shells, historic glass, ceramics, metal; disturbed by erosion and bulkhead construction, recorded 1956, revisited 1973 and 1984
- 41GV20: oyster shell midden; potsherds, arrow points, bone awl; disturbed by subsidence and bulkhead construction; recorded and excavated 1955-56 and 1960, revisited 1973 and 1983
- 41GV21: Rangia shell midden; potsherds, bone tool; site has been destroyed by erosion; recorded 1956, revisited 1983
- 41GV22: Rangia shell midden; potsherds, flint flakes, disturbed by erosion; recorded 1956, revisited 1983, 1986; considered to have potential for National Register and State Archeological Landmark listing

Dannenbaum Engineering Corporation
Clear Creek Regional Flood Control Plan - Historical and Archeological Sites

Galveston County (cont.)

- 41GV44: Rangia shell midden; recorded 1970, revisited 1973, 1984; site considered destroyed by erosion
- 41GV49: terrace site; potsherds, flakes, chips; site disturbed by pothunters; recorded 1973
- 41GV53: Rangia shell midden; burned shell and clay concretions suggesting hearths, lithic debitage, potsherds, bone; disturbed by Highway 270 construction and erosion; recorded 1973, revisited 1983, 1987; site recommended for protection and mitigation; site considered to have potential for National Register and State Archeological Landmark listing
- 41GV54: terrace site; flint flakes, oyster and Rangia shell fragments; disturbed by erosion; recorded 1973, revisited 1990; no further work recommended
- 41GV55: Rangia shell midden; potsherds, flakes, chips; disturbed by erosion; recorded 1973, revisited and tested 1983; considered to have potential for State Archeological Landmark
- 41GV56: open lithic scatter; flakes; recorded 1973, revisited 1983; site considered destroyed by erosion in 1973; site had been covered with asphalt in 1983
- 41GV57: lithic material associated with sandy loam mound; flint flakes; disturbed by minor pothunting and clearing for housing development; recorded 1973
- 41GV58: lithic material on two sandy loam mounds; potsherds; recorded 1973; site was in good condition at time
- 41GV60: cultural material observed in sandy river terrace; potsherd; recorded 1973; disturbed by erosion
- 41GV61: lithic material in sandy loam mound; flint flakes; disturbed by pothunters; recorded 1973
- 41GV62: lithic material associated with sandy loam mound; flake; disturbed by pothunting; recorded 1973
- 41GV63: sandy loam mound, no cultural material observed, site had been disturbed by pothunters; recorded 1973
- 41GV75: isolated chert flake found in a thin shell stratum; site destroyed by erosion; recorded 1956, revisited 1983
- 41GV76: small mound with Rangia shell layer; potsherds, bone; this is considered a significant site due to its upland location; avoidance is highly recommended by recording archeologists; site was undisturbed when recorded in 1983; considered to have potential for National Register and State Archeological Landmark listing
- 41GV77: small sandy mound; potsherds, flakes; site was recommended for avoidance by channelization or mitigation if avoidance was not possible; recorded 1983; potential for National Register and State Archeological Landmark listing

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Galveston County (cont.)

- 41GV82: aboriginal habitation or campsite, historic material also present; aboriginal potsherds, deer bone, historic crockery fragments, glass fragments, depression ware glass fragments; disturbed by erosion, future construction of marina will destroy site; site recommended for testing; recorded 1985; current condition unknown
- 41GV91: campsite; potsherd, thin shell layer; disturbed by erosion and future residential development; site recommended for further evaluation to determine potential for National Register or State Archeological Landmark eligibility; recorded 1986
- 41GV100: campsite; potsherds; disturbed by erosion and light vehicular traffic; recommended for testing to determine eligibility for National Register or preservation if not affected by future construction; recorded 1986; also considered to have potential for listing as State Archeological Landmark
- 41GV103: campsite; potsherds; disturbed by erosion; site recommended for testing if due to be impacted by construction; recorded 1989; considered to have potential for National Register and State Archeological Landmark listing
- 41GV104: campsite; chert chip; disturbed by erosion, fitness trail and channelization of Clear Creek; no recommendations for further work; recorded 1989; site has potential for listing as State Archeological Landmark
- 41GV105: historic bridge ca. 1919, only pilings left, no further work recommended
- 41GV120 - 41GV123: recently assigned numbers, no information in files
- *41HR88: 19th century house site; brick fragments, glass and china fragments, brass trunk lock, steel buckle, base of brick wall exposed in pothole; site impacted by extensive pothunting; aboriginal material found in association with historic material; recorded 1968

*within Armand Bayou Archeological District

APPENDIX A
FIELD RECONNAISSANCE PHOTOS