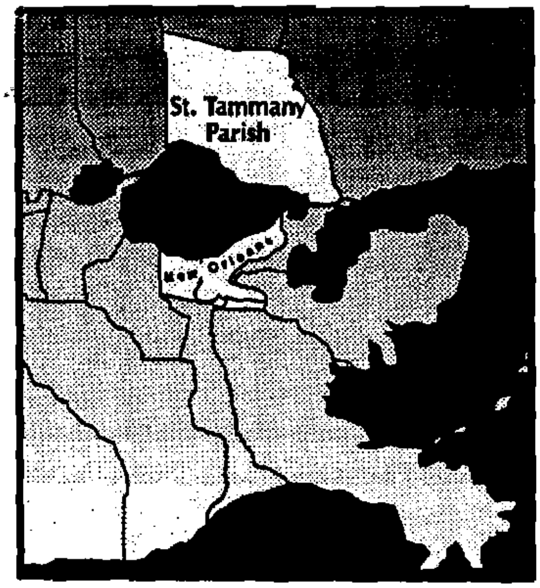
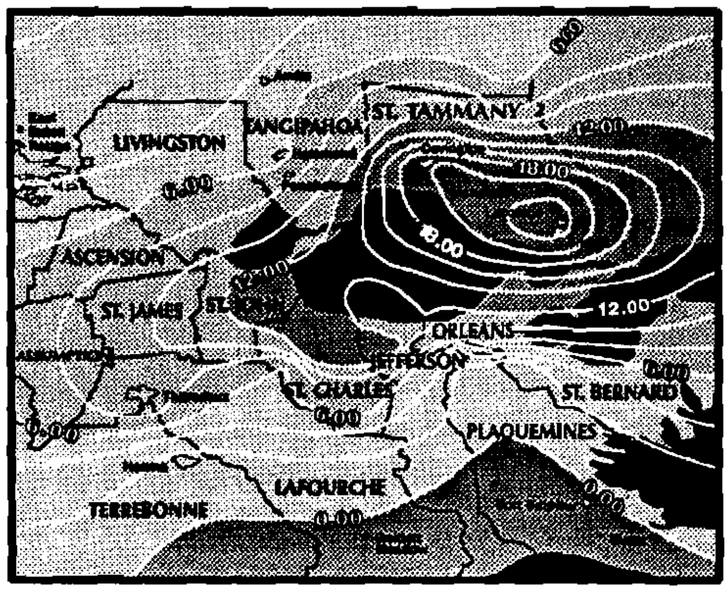
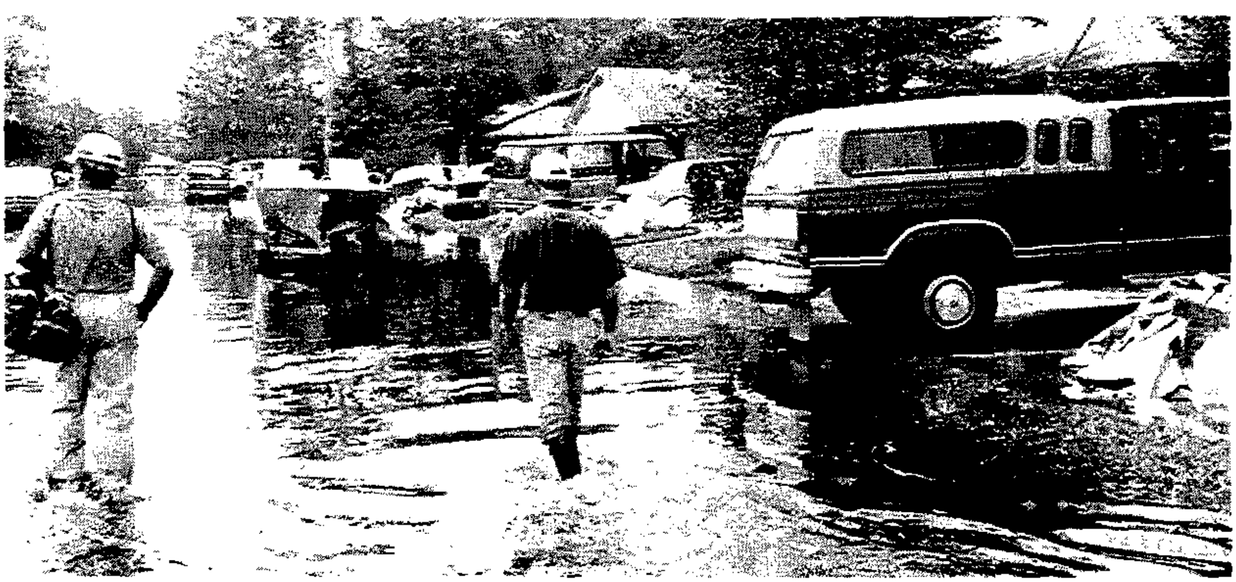
US Army Corps
of Engineers.
New Orleans District

ST. TAMMANY PARISH, LOUISIANA RECONNAISSANCE STUDY







July 1996

SYLLABUS

This report presents the findings of a reconnaissance-level investigation of rainfall flooding associated with storm water runoff and high tides in St. Tammany Parish, Louisiana. The study was conducted under the authority of a resolution adopted by the Committee on Public Works of the United States House of Representatives on 24 September 1992. The Fiscal Year 1995 Energy and Water Appropriations Act included $500,000, added by congress, to initiate a General Investigations reconnaissance study specifically for St. Tammany Parish.

The study area is St. Tammany Parish, which is located in southeast Louisiana on the north shore of Lake Pontchartrain, across the lake from New Orleans. The southern area of the parish is experiencing rapid residential and commercial development. Portions of the study area are subject to flooding caused by rainfall run-off and by hurricane surges, and flooding is increasing due to the increased rainfall run-off caused by development. The flood control study efforts concentrated on problem areas identified by the study team using input from parish and municipal officials and representatives. Four areas with histories of extensive, repetitive flooding were selected for study. These were the Bayou Chinchuba Basin in the Mandeville area, the Abita Springs area, the Lacombe area, and the Slidell area.

The reconnaissance study investigated potential solutions to prevent flooding in St. Tammany Parish caused by heavy rainfall and high tides. Measures that were evaluated during this study include: diversion of flood waters; retention/detention basins; channel enlargement; removal of channel obstructions; flood control structures; and other non-structural measures such as raising houses. Existing computer models developed by the U. S. Army Corps of Engineers, previous hydraulic computer output, U. S. Flood Insurance Administration studies, previous flood control studies in the study area, and historical records were utilized to establish existing conditions.

Structural plans in the Bayou Chinchuba Basin in the Mandeville area and in the Slidell area and non-structural plans in the Bayou Chinchuba Basin, the Abita Springs area, and the Lacombe area were determined economically and environmentally feasible to reduce the magnitude of flood damages in St. Tammany Parish. The identification of feasible plans warrants proceeding to the feasibility phase of the study, contingent upon the identification of a non-Federal sponsor or sponsors willing to cost-share in more detailed feasibility studies and project implementation.

St. Tammany Parish
Reconnaissance Report

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INTRODUCTION

St. Tammany Parish is in the New Orleans metropolitan area in southeast Louisiana. The parish includes the cities of Abita Springs, Covington, Madisonville, Mandeville, and Slidell, and numerous unincorporated areas. The southern portion of the parish, along the north shore of Lake Pontchartrain, is connected directly to the city of New Orleans by Interstate 10 and U. S. Highways 11 and 90 and to Jefferson Parish, by the Lake Pontchartrain Causeway. There are significant flooding problems in the southern portion of the parish. This area is experiencing rapid growth in residential and commercial development, and flooding problems are increasing.

STUDY AUTHORITY

This study is being conducted under the authority of a resolution adopted by the Committee on Public Works of the United States House of Representatives on 24 September 1992. This resolution reads as follows.

> "Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That the Board of the Chief of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on Lake Pontchartrain, Louisiana, as Document 231, Eighty-ninth Congress, First Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of flood control and other purposes for St. Tammany Parish, Louisiana, including water quality improvements for flood waters entering Lake Pontchartrain, Lake Borgne, Chandeleur Sound, and other area water bodies."

The Fiscal Year 1995 Energy and Water Appropriations Act included $500,000 added by Congress, to initiate a General Investigations reconnaissance study specifically for St. Tammany Parish. This study was initiated in April 1995.

STUDY PURPOSE AND SCOPE

The purpose of the St. Tammany Parish reconnaissance study is to determine whether planning of projects to reduce flood damages in the parish should proceed further. This determination is based on whether a plan, or plans, can be developed that meet Federal criteria for water resources projects and that are supported by a non-Federal sponsor. The non-Federal sponsor must be legally and financially capable to cost-share in the more detailed feasibility study and in the implementation of a Federal project.

Funds and time are limited for reconnaissance studies; and, existing information is used whenever possible. Sources of existing information include computer models developed as part of previous studies, Federal Emergency Management Agency (FEMA) Flood Insurance Studies, previous flood control studies in the study area, and historical records.

There are numerous areas in St. Tammany that have experienced flood damages to residential and commercial structures. Flood problems in all of the areas could not be addressed in the reconnaissance study. Several areas were identified for analysis in the study that have high levels of repetitive structural flood damages. Due to this, potential projects in these areas have the highest probability of meeting Federal criteria for water resources projects. Four areas were selected including (a) the Bayou Chinchuba basin in the Mandeville area, (b) the Slidell area, (c) the Town of Abita Springs along the Abita River, and (d) the Lacombe area along Bayou Lacombe.

If more detailed feasibility studies are conducted following the reconnaissance study, those areas not addressed in the reconnaissance could be considered in the more detailed feasibility study.

Structural and nonstructural measures for reducing flood damages for each area selected for study were developed and evaluated. (Non-structural flood protection is a means of changing the use of the flood plain, rather than changing the flood plain). Alternatives were considered to reduce flood caused by both rainfall and high tides. Measures considered to reduce flood and storm damages include clearing and snagging of channels, channel modifications, hurricane protection levees, and raising frequently flooded structures. These alternatives were also evaluated for environmental acceptability.

Stage-frequency curves, reconnaissance scope designs and cost estimates, real estate appraisals, environmental appraisals, and estimates of average annual flood damages prevented were prepared by the interdisciplinary planning team for each of the potential solutions in each of the areas selected for study.

PRIOR STUDIES, REPORTS, AND EXISTING WATER RESOURCE PROJECTS

A reconnaissance report, Tangipahoa, Tchefuncte, and Tickfaw Rivers, Louisiana, dated May 1991, was prepared by the U. S. Army Corps of Engineers, New Orleans District. The report presented the results of a study of flooding problems in the drainage basins on the north shore of Lakes Pontchartrain and Maurepas. Several plans in St. Tammany Parish were found to be economically justified under Federal criteria, including a hurricane protection plan for Mandeville, and channel modifications for flood control on Mile Branch in Covington. Detailed feasibility studies were not conducted because non-Federal sponsors were not identified to cost-share in subsequent feasibility studies and project implementation.

A draft reconnaissance report, Schneider Canal, Louisiana, dated May 1990, was prepared by U. S. Army Corps of Engineers, New Orleans District, under the authority of Section 205 of the Flood Control Act of 1948, as amended. An economically feasible hurricane protection plan was developed for the Schneider Canal portion of Slidell, Louisiana. The study was suspended in August 1990 because a non-Federal sponsor was not identified to cost-share in subsequent feasibility studies and project implementation.

The Southeast Louisiana Flood Control Project was authorized by Section 108 of the Energy and Water Development Appropriations Act, Fiscal Year 1996. The act authorized and directed engineering, design, and construction of flood control improvements in Jefferson, Orleans, and St. Tammany Parishes, Louisiana, in accordance with the following reports; Jefferson and Orleans Parishes, Louisiana, Urban Flood Control and Water Quality Management, July 1992; Tangipahoa, Tchefuncte, and Tickfaw Rivers, Louisiana, June 1991; and Schneider Canal, Louisiana, May 1990. The St. Tammany Parish features that were found to be economically justified in the latter two reports, as discussed in the preceding two paragraphs, were authorized for implementation. These features include a hurricane protection plan for the lakefront area of Mandeville, channel modifications for flood control on Mile Branch in Covington, and a hurricane protection plan for the Schneider Canal area in Slidell. In response to a request from the City of Mandeville, the Mandeville hurricane protection plan will not be implemented. The implementation of the other two features is contingent upon the identification of non-Federal sponsors to cost-share in the design and construction of the projects.

The report, Pearl River Basin, Slidell, Louisiana, and Pearlington, Mississippi, Interim Report on Flood Control, dated June 1986, was prepared by the U. S. Army Corps of Engineers, Vicksburg District. This report resulted in the authorization, by the Supplemental Appropriation Act of Fiscal Year 1985 and the Water Resources Development Act of 1986, of the Pearl River Basin, St. Tammany Parish, Slidell, Louisiana flood control project. The project provides for the construction of a levee system to protect the areas east of Slidell from flooding from the Pearl River. The implementation of the project is contingent upon the non-Federal sponsor, the St. Tammany Levee District, securing funds for the non-Federal share of the project cost.

The Bayou Vincent, Louisiana Project was constructed by the U. S. Army Corps of Engineers, New Orleans District, in 1947 under the authority of Section 2 of the Flood Control Act of 1937, as amended. The project provided for the clearing and snagging of

Bayou Vincent in the Slidell area from Mile 0.0 at Bayou Bonfouca to Mile 0.5 and clearing and snagging and channel excavation to a bottom width of 20 feet from Mile 0.5 to Mile 1.35, which is immediately north of U. S. Highway 190.

A report, Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection, dated November 1962, was prepared by the U. S. Army Corps of Engineers, New Orleans District and subsequently published in House Document 231, 89th Congress. This report resulted in the authorization of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project by Public Law 89-298, October 27, 1965. The project, as originally authorized, provided for the construction of low-level barrier system, including levees, locks, and control structures, across the tidal passes of Lake Pontchartrain to provide hurricane protection in the Lake Pontchartrain Basin. It also provided for the construction of hurricane protection levee systems in Orleans and St. Bernard Parishes and for the improvement of the seawall along the Mandeville lakefront. A project re-evaluation report completed in 1984, resulted in the authorization, by the Chief of Engineers of the U. S. Army, of a high-level levee plan for the New Orleans area. This plan provided for the construction of higher levees in Orleans Parish and the raising of existing levees in Jefferson Parish, in lieu of the barrier structures. The project, as originally authorized, would have reduced hurricane surges along unleveed north and west shores of Lake Pontchartrain, including St. Tammany Parish, by reducing hurricane stages in the lake. The improvement of the seawall along the Mandeville lakefront was also a feature of the high-level plan.

The report, Lake Pontchartrain, North Shore, Louisiana, dated November 1977, was prepared by the U. S. Army Corps of Engineers, New Orleans District. This report resulted in the authorization by the Water Resources Development Act of 1986 (Public Law 99-662) of a Federal project to construct a navigation channel in Bayou Castine at Mandeville, Louisiana, and to replenish the beach on Lake Pontchartrain in Fountainebleau State Park, immediately east of Mandeville. The navigation channel and beach replenishment features were developed for recreation purposes and have not been constructed due to lack of Federal funds. Federal funds for the project have not been budgeted because recreation projects are low priority due to budgetary constraints. Other features were considered in the feasibility study but were not recommended for implementation. These included flood control plans for the City of Mandeville, which were not economically feasible; an economically feasible hurricane protection plan for the Howze Beach area, which was opposed by local interests; and hurricane protection plans for the City of Slidell, which were not economically feasible. The hurricane protection plans considered in this study were developed under the assumption that the hurricane surge barrier feature of the Lake Pontchartrain, Louisiana, and Vicinity Project would be implemented, and hurricane stages in Lake Pontchartrain would be lowered. The hurricane surge barrier project feature has been deauthorized; therefore, the analyses performed in the study do not reflect current conditions.

A report prepared by the U. S. Army Corps of Engineers in 1880 resulted in the authorization and construction of a project to dredge and remove navigation obstructions in the Tchefuncte and Bogue Falaya Rivers between Lake Pontchartrain and Covington, Louisiana. The Corps of Engineers completed a second report in 1927 that resulted in the modification of the project to provide a depth of 8 feet between Lake Pontchartrain and Washington Street in Covington, Louisiana. The project was completed in 1929 as maintenance on the former project. The project was further modified by a third report on the Tchefuncte and Bogue Falaya Rivers, which resulted in the construction of a 10-foot deep by 125-foot wide channel from Lake Pontchartrain (Mile 0.0) to Mile 3.5 of the Tchefuncte River and a channel 8 feet deep in the Tchefuncte and Bouge Falaya Rivers over an unspecified bottom width from that point to Washington Street in Covington, Louisiana. The project was completed in 1959.

A report completed by the U. S. Army Corps of Engineers in 1924 resulted in authorization of 9 miles of a navigation channel in Bayou Bonfouca. The project, which was completed in 1931, provided of a channel 10 feet deep and 60 feet wide between Slidell and deep water in Lake Pontchartrain.

A 1933 report by the U. S. Army Corps of Engineers resulted in the authorization of a navigation project in Bayou Lacombe, including a channel through the bar at the mouth of the bayou, and removal of snags and overhanging trees from the mouth to about mile 8.2. The project was completed in 1938.

The U. S. Army Corps of Engineers, New Orleans District, completed a multi-purpose study of water resources problems and needs in the New Orleans-Baton Rouge Metropolitan area in September 1981. Flood control features in St. Tammany Parish were considered in the study, including levees, pumps, and channel modifications for Bayou Vincent (W-13 Canal) and the W-14 Canal. No plans were found to be economically feasible.

A master drainage plan was prepared for the City of Slidell by a consulting engineer in May 1994. This plan evaluated numerous alternatives such as the modification of the West Diversion Canal, improvements to the Delwood and City Barn pumping stations, and several W-14 Canal improvements (pumping stations and channel improvements). In November 1995, a bond issue was approved by the city of Slidell to fund many of the projects recommended in this master drainage plan.

An August 1994 report prepared for the City of Slidell by a consulting engineer examined the possibility of installing a pump station at the outfall of the W-14 Canal into Fritchie marsh. This plan would prevent water from backing up into the W-14 Canal basin due to high tides in Lake Pontchartrain. The plan provided for the construction of a 4,000 cubic feet-per-second pump system at the outfall, to be constructed in several stages with an initial capacity of 1,650 cubic feet per second.

A July 1989 West St. Tammany Drainage Study was prepared by a consulting engineer for the St. Tammany Parish Police Jury. This report presented the results of computer modeling of the Bayou Chinchuba and Bayou Castine watersheds. Features recommended include implementing a beaver control plan, constructing a diversion canal from Bayou Chinchuba to Lake Pontchartrain along Causeway Boulevard, and enlarging a the detention pond on Bayou Chinchuba at the Colony at Greenleaves.

The St. Tammany Parish Master Drainage Plan prepared by a consulting engineer for the St. Tammany Parish Police Jury in 1984 developed flows for the waterways in the Slidell area based upon conditions which existed at the time and upon 20-year population projections. The appendix to this report contains pertinent to this reconnaissance study.

A report completed in October 1995 by a consulting engineer for the City of Slidell investigated the technical feasibility of constructing detention ponds to reduce peak runoff within the city of Slidell. This report recommended a 29.7 million gallon detention pond be built at Robert Road and the W-14 Canal; and another 21.7 million gallon detention pond be built on the West Diversion Canal at its intersection with North Boulevard and Highway 11. Funds for these detention basins was included in the bond issue approved by voters in the November 1995 election.

A report prepared in October 1995 by the City of Slidell Engineering Office on the modification of Bayou Lane for flood control purposed. These features recommended include cleaning out collector lines, replacing the bridge on Bayou Lane, and building a new 400 cubic feet-per-second pump station. Construction is expected to begin in late summer, 1996.

Plans and specifications for the construction of a 836 cubic feet per second pump station system at Schneider Canal in Slidell, Louisiana, were completed in December 1995. The plan includes 800 linear feet of adjacent levee. The construction contract has been awarded, and construction is underway. This project is intended to reduce flooding in the Schneider Canal basin as a result of tidal influences. This project is being implemented by the City of Slidell under the Louisiana Statewide Flood Control Program.

The Fritchie Marsh Restoration Project was approved by the Louisiana Coastal Wetlands Conservation and Restoration Task Force and included in the report, Second Priority Project List Report, dated November 1992, for implementation under the authority of the Coastal Wetlands Planning, Protection, and Restoration Act, Public Law 101-646. The purpose of the project is to provide more freshwater to the Fritchie Marsh to help remediate the effects of salt water intrusion on the ecosystem. This would be accomplished by dredging Salt Bayou across Apple Pie Ridge and by other structural measures.

Improvements are planned for the Delwood pumping station by the City of Slidell. These improvements would increase the capacity of this pump station from 156 cubic feet per second to 212 cubic feet per second. These improvements would be funded by bonds approved in the November 1995 election.

The City of Slidell also plans to increase the capacity of the City Barn Pumping Station from 267 cubic feet per second to 400 cubic feet per second. Improvements would also have to be made to Bayou Patassat upstream from the pumping station. Funds are available for this project from the bond issue approved in the November 1995 election.

U. S. Army Corps of Engineers, New Orleans District is developing flood warning systems for areas of St. Tammany Parish along the Pearl River, the Bogue Chitto River, the Bogue Falaya River, and the Tchefuncte River. Rain stage gages would be installed to allow emergency management officials to predict stages and evacuate areas subject to flooding. This study is being conducted under the Planning Assistance to States program.

PROBLEM IDENTIFICATION

NATIONAL OBJECTIVES

The Federal objective of water resources project planning is to contribute to national economic development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to the NED are increases in the net value of national output of goods and services, expressed in monetary units.

In general, the Federal objectives for the control of flood waters is to reduce the susceptibility of property to flood damage, including protection from ground water induced damages, and relieving human and financial losses. The Federal government may make improvements, or participate in improvements, for the purpose of flood control provided "the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise not adversely affected." The conditions under which the Federal government may participate in flood control projects were authorized by the Flood Control Act of 1936, as amended, and the Water Resources Development Act of 1986.

EXISTING CONDITIONS

STUDY AREA

The study area is St. Tammany Parish, which is located in southeast Louisiana on the north shore of Lake Pontchartrain, across the lake from the city of New Orleans, as shown on Plate 1. Information on the study area pertinent to this reconnaissance study is presented in this section. There are numerous drainage basins and sub-basins in St. Tammany Parish, as shown on Plate 2. More detailed information is presented on the four areas selected for study: (a) the Bayou Chinchuba basin in the Mandeville area, (b) the Town of Abita Springs along the Abita River, (c) the Lacombe area along Bayou Lacombe, and (d) the Slidell area. These four basins are described below.

Bayou Chinchuba

Bayou Chinchuba originates in southwestern St. Tammany Parish northeast of the town of Mandeville and flows about 6 miles into Lake Pontchartrain (See Plate 3). The bayou has a drainage area of 11.1 square miles, consisting of much of the City of Mandeville. The portion of this drainage basin located east of Causeway Boulevard has undergone rapid residential development in recent years, and this trend is expected to continue. With this increase in development has come an increase in flooding. Many houses in this basin flood regularly, some as often as every other year on average. The May 8-11, 1995, event flooded approximately 200 homes in Mandeville, most of which are located in the Bayou Chinchuba basin. Many more homes that are located outside of the city limits were also flooded. Heavy flooding in this area also resulted from an August 1988 event.

Abita Springs Area

The Abita River flows through the town of Abita Springs and discharges into the Tchefuncte River. Flooding occurs in the town of Abita Spring due to high stages on the Abita River.

Lacombe Area

Lacombe is located in the south central portion of the parish along the north shore of Lake Pontchartrain. The area south of U. S. Highway 190 is subject to flooding from tidal inundation. The area is low, with elevations near lake levels, and floods frequently from high tides or when a strong southerly wind is present. The area is also subject to backwater flooding from Bayou Lacombe.

Slidell Area

The area of incorporated and unincorporated Slidell under study is located along the northeastern shore of Lake

Pontchartrain. (See Plate 3). The Slidell area is actually located in several basins. These basins are the W-14 Canal basin, the W-15 Canal basin, and the Bayou Vincent basin. The W-14 Canal and Bayou Vincent basins outfall to Lake Pontchartrain, while the W-15 Canal currently discharges into the Pearl River. Numerous interconnections between these basins require that they be treated as a single networked basin. This combined drainage basin drains a total of 37.4 square miles. Portions of these basin have been fully developed, while unincorporated areas east and north of the city continue to be developed for residential use at a rapid pace.

The western portion of the Slidell area floods primarily due to heavy rainfall, and the inability of the existing drainage network to handle the resulting flows. Heavy flooding has occurred in this area due to rainfall in April and May of 1995, July 1993, and April 1983. The eastern portion of the Slidell area floods primarily from high stages on the Pearl River. Flooding due to high Pearl River stages has occurred in 1983, 1980, and 1979.

CLIMATOLOGY

The climate of the area is humid subtropical, but is subject to polar influences during winter, as cold air masses periodically move southward over the area displacing warm moist air. Prevailing southerly winds create a strong maritime character. This movement from the Gulf of Mexico helps to decrease the range between hot and cold temperatures and provides a source of abundant moisture and rainfall.

TEMPERATURE

Records of temperatures are available from "Climatological Data" for Louisiana, published by the National Climatic Center. The study area can be described by using temperature normal data observed at Covington. The annual normal temperature for Covington based on the period 1961-1990 is 66.8 degrees Fahrenheit (°F) with monthly mean temperature normals varying from 50.1 °F in January to 81.1 °F in July. Table 1 lists the monthly and annual normals for Covington. Since 1951, temperature extremes at Covington have ranged from a record low temperature of 7 °F occurring twice; on December 13, 1962, and January 21, 1985; to a record high of 103 °F occurring three times, the latest being August 22, 1980.

TABLE 1
MEAN MONTHLY and ANNUAL TEMPERATURE (°F)
30-Year Normals (1961-1990)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Covington	50.1	53.2	60.2	67.1	73.5	78.9	81.1	80.7	77.0	67.5	59.4	52.9	66.8

Source: National Climatic Center

PRECIPITATION

The average annual precipitation for the study area based on National Climatic Center records at Abita Springs, Covington, and Slidell over the period 1974-1995 is 65.50 inches. Table 2, which lists the stations with their monthly and annual totals, shows that the heaviest rainfall usually occurs during the summer, with July being the wettest month with an average of 6.82 inches. October is the driest month, averaging 3.42 inches. Since 1974, the maximum monthly rainfall totals were 26.20 inches in May 1995 at Abita Springs, 15.09 inches in August 1977 at Covington, and 26.14 inches in May 1995 at Slidell. No precipitation was recorded at any of the stations during the month of October, 1978. The maximum day rainfall over the period of record was 13.35 inches in Abita Springs, which fell during May 9, 1995; 6.67 inches in Covington, which was measured December 4, 1982; and 13.42 inches which fell in Slidell on May 10, 1995.

TABLE 2
AVERAGE MONTHLY PRECIPITATION (inches)
(1974-1995)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Abita Springs	6.09	6.15	5.97	5.14	5.75	5.44	6.92	7.62	5.10	3.46	4.71	4.46	66.38
Covington	5.63	5.20	6.21	5.25	5.65	5.13	6.83	6.08	4.39	3.38	4.65	4.78	63.79
Slidell	6.78	5.51	5.67	4.89	6.00	4.42	6.72	6.43	5.29	3.50	4.92	4.75	64.07
AVERAGE	6.17	5.6 2	5.95	5.09	5.80	5.00	6.82	6.71	4.9 3	3.45	4.76	4.66	64.75

Source: National Climatic Center

WIND

Wind data taken at Baton Rouge and New Orleans Moisant Airport are used to describe the study area. The average velocity of the wind for the two stations over the 1973-1994 period is 7.7 miles per hour (mph). Prevailing wind direction is southerly during much of the year in the upper study area, while southeast winds predominate in the lower part. The summer is often disturbed by tropical storms and hurricanes which produce the highest winds in the area. The maximum wind speeds observed (highest one minute speed) since 1963 were 58 mph at Baton Rouge and 69 mph at New Orleans and were a result of Hurricane Betsy in September 1965.

STREAM GAGING DATA

In the western part of the study area, daily stage and discharge measurements are currently taken by the U. S. Geological Survey (USGS) at the Tchefuncte River near Folsom and on a partial-record basis at the Tchefuncte River near Covington and at the Abita River north of Abita Springs . Daily stage readings are recorded by the Corps of Engineers (COE) at the Lake Pontchartrain at Mandeville gage. Past records of the Bogue Falaya River near

Covington gage (USGS), discontinued in 1983, are also available.

For the eastern part of the study area, COE takes stage measurements at the Rigolets near Lake Pontchartrain gage, and USGS has stage records for the 1985-1986 water year at gages on the W-14 Canal at Daney Street and Robert Road. Stage and discharge measurements are available at the W-14 Canal Kingspoint gage for the period 1985-1988. Past records of Bayou Bonfouca at Slidell (COE), discontinued in 1992, Bayou Bonfouca at West Hall Road (USGS) and W15 Canal at Service Road (USGS), both discontinued in 1987, are also available.

Pertinent data such as period of record and maximum and minimum stages and available discharges of the above stations are presented in Tables 3 and 4.

FLOODS OF RECORD

Stream flooding from intense rainfall has occurred on occasion in the study area and surrounding areas. Four of the most severe flood events in the western part of the study area occurred in May 1953, April 1983, April 1995, and May 1995. These floods are described below.

May 1953. The flood of May 1953 was caused by unusually heavy rains beginning at the end of April. During the period 22 April through 9 May 1953, heavy rainfall produced generally high stages on most streams in the area and set the stage for additional flooding following a second storm period between 10 May and 21 May 1953. At the Tchefuncte River near Covington, a peak discharge of 14,800 cubic feet per second occurred on 3 May with a maximum stage of 29.9 feet NGVD.

April 1983. Heavy rains produced the flood in April 1983. During the period 5 April through 8 April, severe thunderstorms produced more than 10 inches of rain over some parts of the Lake Pontchartrain Basin. Franklinton, north of the study area, received 10.56 inches on 6 April. Covington's storm total for 6 and 7 April was 5.3 inches. Several stage and discharge records were exceeded during this flood. The Tchefuncte River near Folsom gage recorded a peak discharge of 29,800 cubic feet per second with a maximum stage of 86.25 feet NGVD on 6 April. The Bogue Falaya near Covington gage had a maximum stage of 28.38 feet NGVD and a peak discharge of 12,700 cubic feet per second on 8 April.

April 1995. The rainstorm on 11 April dumped over 7 inches of heavy rain on Abita Springs and broke the maximum stage record at the Abita Springs gage with a 25.37 feet NGVD reading on 12 April. It also set the maximum discharge record of 6,000 cubic feet per second on the same day. Flooding was also reported in Covington and Mandeville with Covington receiving 5.85 inches of rain.

TABLE 3
STREAM GAGING DATA-STAGES

STATION	PERIOD OF RECORD	MAXIMUM Feet (NGVD)	STAGE Date	MINIMUM Feet (NGVD)	STAGE Date
TCHEFUNCTE RIVER near FOLSOM	1944-95	86.25	4/5/83	66.86c	10/4&6/86
TCHEFUNCTE RIVER at COVINGTON	1951-	65.67	N/A		69,72,74, 78-85,94[a]
ABITA RIVER north of ABITA SPRINGS	1966-95a	25.37c	4/12/95	N/A	-
BOGUE FALAYA near COVINGTON	1964-83[ab]	28.38c	4/8/83	N/A	-
LAKE PONTCHARTRAIN @ MANDEVILLE	1931-94	7. 60[d]	10/28/85	2.25	1/26/38
W-14 CANAL @ DANEY ST.	1985-86[a]	4.20[d]	10/28/95	N/A	
W-14 CANAL @ ROBERT ROAD	1985-86 1987-88[a]	8.83[d]	10/28/85	4.49[e]	4/26/88[f]
W-14 CANAL @ KINGSPOINT BLVD.	1985-88	3.10	4/2/88	0.46	1/26/88
W-15 CANAL @ SERVICE ROAD	1985-87[b]	15.94	3/17/87	N/A	
RIGOLETS near LAKE PONTCHARTRAIN	1931-95	9.00[d]	8/18/69	1.90	1/26/38
BAYOU BONFOUCA AT SLIDELL	1962-92[b]	6.80[d]	8/18/69	-0.60	2/15/63
BAYOU BONFOUCA @ WEST HALL RD.	1985-87[b]	21.02[g]	3/18/87	16.24[e]	1/27/86

[a] Partial record station. [d] Caused by hurricane [f] And other dates
[b] Discontinued [e] From incomplete records
[c] Peak stage at peak discharge below [g] Stages affected by tides
N/A Not available

TABLE 4
STREAM GAGING DATA-DISCHARGES
(CUBIC FEET PER SECOND(CFS))

STATION	PERIOD OF RECORD	MAXIMUM CFS	MAXIMUM DATE	MINIMUM CFS	MINIMUM DATE
TCHEFUNCTE RIVER near FOLSOM	1944-95	29,800	4/5/83	26	9/6/68
ABITA RIVER north of ABITA SPRINGS	1966-95[a]	6,000	4/12/95	N/A	
BOGUE FALAYA near COVINGTON	1964-83[ab]	12,700	4/8/83	N/A	
W-14 CANAL at KINGSPOINT ROAD	1985-87[b]	222[c]	3/18/87	32[c]	9/23/87

[a] Partial stage record
[b] Discontinued
[c] From incomplete records
N/A - Not available
Sources: U. S. Geological Survey/U. S. Army Corps of Engineers

<u>May 1995.</u> This flood was caused by intense rainfall over a three day period, 8 May through 10 May. Covington had a storm total of 10.72 inches, with 10.62 inches falling on the last two days. The Tchefuncte and Bogue Falaya Rivers rose rapidly above flood stage and caused major damage to a few buildings in the area near their confluence. The Tchefuncte River near Folsom gage recorded a maximum stage of 79.51 feet NGVD on 11 May. At Covington, the Tchefuncte River peaked at 27.2 feet NGVD also on 11 May. A local gage at Lee Road had a high stage of 16.9 feet NGVD for the same day. The Bogue Falaya River and Abita Creek also rose rapidly above flood stage and overtopped their banks causing flood damages.

In the eastern part of the study area, headwater flooding due to intense rainfall in the upper reaches of the streams is relatively frequent. Some of the severe floods for this part are discussed below.

<u>May 1958.</u> One of the worst floods of record in the Slidell area occurred on 18 May 1958, when 13.20 inches of rainfall in a 24 hour period was recorded at the Central Fire Station in Slidell. At Bayou Liberty, 10.8S inches was measured. A high water level of 7.1 feet NGVD was recorded in the center of Slidell.

<u>January 1966.</u> On 3 through 5 January 1966, heavy rain fell in Slidell and caused a high stage of 7.4 feet NGVD on the gage at Bayou Vincent. The gage on Bayou Liberty near Slidell exceeded the 6.0-foot limit of gage. The Central Fire Station in Slidell recorded a storm total of 4.87 inches of rain for the three days.

__April 1983.__ The same storm that flooded the western part of the study area on 7 April 1983, caused wide-spread residential and commercial flooding in the eastern part. The stage on Bayou Bonfouca at Slidell gage rose nearly two feet on 7 April. Slidell recorded 8.70 inches of rainfall over a 10-hour period.

__April 1995.__ The heavy rains which flooded the western part of the study area on 11 April also flooded approximately 100 homes in the Slidell area after 5 to 7 inches of rain fell in this part.

__May 1995.__ This storm on 8 through 10 May 1995, caused more severe flood problems in the eastern part than the western part of the study area. More than 22 inches of torrential rain fell in the area over this short period, with nearly all of it falling on 9 and 10 May. The National Weather Service Office in Slidell recorded 15.75 inches overnight. Severe flooding was reported in several communities throughout the area. A high water mark of approximately 8.0 feet NGVD was reported in downtown Slidell near the W-14 Canal.

__Hurricanes.__ Flooding in the lower reaches of the study area has been caused by high tides produced by hurricanes and tropical storms in Lake Pontchartrain. Several of the maximum stage records in Table 3 have been set by hurricanes. Some of the significant hurricanes affecting the study area are: 1915 hurricane (September-October 1915); Hurricane Flossy (September 1956); Hurricane Hilda (October 1964); Hurricane Betsy (September 1965); Hurricane Camille (August 1969); Hurricane Carmen (September 1974); Hurricane Juan (October 1985); and Hurricane Andrew (August 1992).

TIDES

Tides in Lake Pontchartrain are diurnal, with a tidal range of 0.6 feet. The mean high water is approximately 1.6 feet NGVD, and the mean low water is approximately 1.0 feet NGVD. These stages are based on the Lake Pontchartrain at Mandeville gage.

GENERAL GEOLOGY

The following descriptions are based on the general geologic information for two areas of interest in St. Tammany Parish, Louisiana.

Bayou Chinchuba Basin

The Bayou Chinchuba basin is an area of low relief with elevations ranging from near sea level to 20 feet NGVD. The major physiographic features are swamp and marsh, gently sloping Pleistocene Prairie terraces, and steep stream banks with narrow flood plains. Swamp and marsh contain Holocene deposits of poorly drained soft to very soft clays, organic clays, silt, and organic debris. Pleistocene Prairie terrace deposits consist of moderately drained stiff to very stiff clays, silt, and sand with occasional gravel. Holocene alluvium is deposited in the narrow flood plains of streams and rivers and consists of reworked Pleistocene terrace deposits. The drainage in this area is primarily to the south toward Lake Pontchartrain.

Slidell Area

The Slidell area is of low relief with elevations ranging from near sea level in the south to approximately 15 feet NGVD in the north. The major physiographic features are swamp and marsh in the south, gently sloping uplands of Pleistocene Prairie terraces in the north, and steep stream banks with narrow flood plains. Swamp and marsh contain Holocene deposits of poorly drained soft to very soft clays, organic clays, silt, and organic debris. Pleistocene Prairie terrace deposits consist of moderately drained stiff to very stiff clays, silt, and sand with occasional gravel. Holocene alluvium is deposited in the narrow flood plains of streams and rivers and consists of reworked Pleistocene terrace deposits. The drainage in this area is primarily to the south toward Lake Pontchartrain.

ECONOMIC RESOURCES

St. Tammany is one of eight parishes within the New Orleans Metropolitan Statistical Area (MSA). The other seven parishes include Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, and St. John the Baptist. The 1990 Census provides land area and total population estimates within the New Orleans Urbanized Area, which was defined as portions of Jefferson, Orleans, Plaquemines, St. Bernard, and St. Charles Parishes, all south of Lake Pontchartrain. Like most other metropolitan areas across the United States, New Orleans has experienced socioeconomic changes leading to population growth in suburban areas. Table 5 compares population trends in the New Orleans MSA, the New Orleans Urbanized Area, the City of New Orleans, and St. Tammany Parish, including Mandeville, Lacombe, and Abita Springs. The desire for a more suburban life style and the completion of several major transportation projects have contributed to increases in housing demand, residential developments, and population growth in St. Tammany Parish, north of Lake Pontchartrain.

Two of the most important transportation corridors influencing growth trends in St. Tammany Parish are the 25-mile causeway connecting the New Orleans Area with Mandeville and other suburban communities on the North Shore and a largely elevated section of Interstate Highway 10 (I-10). These connections have accommodated rapid transit between the North Shore communities and the I-10 exit ramps serving the New Orleans Central Business District (CBD), the Port of New Orleans, and other employment centers.

As indicated by data in Table 5, the population of the New Orleans MSA increased from 1960 to 1980 at a compound annual rate of almost 1.9 percent, while the population of the state increased at about 1.3 percent. The population of the New Orleans Urbanized Area from 1960 to 1980 increased at an annual rate of about 1.2 percent. The total population of St. Tammany Parish increased at an annual rate of more than 5.4 percent over the same period. Population for the entire MSA experienced a net loss between 1980 and 1990, but the population increased between 1990 and 1995 at an annual rate of almost 0.5 percent. From 1980 to 1995 the population of St. Tammany Parish increased at an annual rate of 2.9 percent. The sources used in developing the table indicate that more than 80 percent of the increase in the MSA between 1990 and 1995 has occurred in St. Tammany Parish.

TABLE 5
COMPARATIVE POPULATION TRENDS-ST. TAMMANY PARISH

AREAS	1960	1970	1980	1990	1995
New Orleans MSA	987,605	1,144,791	1,304,212	1,286,270	1,317,721
Urbanized Area	845,237	961,728	1,078,299	1,040,226	-
New Orleans, City	627,525	593,471	557,927	496,938	486,035
St. Tammany Parish	38,643	63,585	110,869	144,508	170,321
Mandeville, City	1,740	2,571	6,076	7,474	9,847
Slidell, City	6,356	16,101	26,718	24,124	-
Lacombe CDP	-	-	5,146	6,523	-
Abita Springs, Town	655	839	1,072	1,296	1,562
Louisiana, State	3,257,022	3,644,637	4,206,116	4,219,973	4,339,352

SOURCES: U. S. Department of Commerce, Bureau of the Census, 1960-1990; and Louisiana Tech University, Business Research Division, 1995 estimates. (Note: A vacant space (-) indicates that data were not available).

Table 6 compares the trend of year-round housing units in the metropolitan area with housing units in St. Tammany Parish and communities where the four potential project sites are located. According to these data, St. Tammany Parish accounted for approximately 37 percent of the growth in the number of housing units within the New Orleans MAS for the period 1980-1990.

Population and housing trends in St. Tammany Parish and the larger New Orleans metropolitan area are reflections of employment, natural resources development, and increases in technology and transportation. Table 7 compares recent employment and income for St. Tammany Parish, the City of New Orleans, and the New Orleans MAS. The "ERs-based" figures are the resident based estimates of employment. The "Employ-based" figures indicate where the jobs are located, rather than where the employees reside. The 1989 median family income of St. Tammany Parish as reported by the 1990 Census was $35,033, which is 58 percent higher than the figure for the City of New Orleans.

TABLE 6
NUMBER OF HOUSING UNITS-ST. TAMMANY PARISH

AREAS	1960	1970	1980	1990
New Orleans MSA	303,362	371,285	492,121	535,194
Urbanized Area	264,033	316,730	412,474	444,274
New Orleans, City	202,643	208,007	226,105	224,098
St. Tammany Parish	13,685	21,261	40,942	56,678
Mandeville, City	-	-	2,360	3,048
Slidell, City	-	-	-	9,128
Lacombe CDP	-	-	2,168	2,560
Abita Springs, Town	-	-	433	583
Louisiana, State	892,344	1,146,105	1,537,183	1,685,908

SOURCES: U. S. Department of Commerce, Bureau of the Census, 1960-1990; University of New Orleans "New Orleans and the South Central Gulf Real Estate Market Analysis" Vol. XXV January, 1996.

TABLE 7
COMPARISON OF EMPLOYMENT AND TRENDS-ST. TAMMANY PARISH

AREAS	1990 Census Employment Res-based	1990 La. Dept. of Labor, Empl-based	1994 La. Dept. of Labor, Res-based	1994 La. Dept. of Labor, Empl-based	1989 Median Family Income
New Orleans MSA	533,656	547,856	556,400	564,934	-
New Orleans, City	186,036	266,871	188,200	265,12S	$22,182
St. Tammany Parish	49,208	33,680	68,500	43,186	$35,033
Mandeville	3,333	-	-	-	$37,788
Slidell	-	-	-	-	$30,656
Lacombe CDP	2,610				$27,114
Abita Springs	-				-

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1990 Census of Population, "General Social and Economic Characteristics, Louisiana" and "Summary Population and Housing Characteristics, Louisiana"; State of Louisiana, Department of Labor, "Employment and Total Wages Paid by Employers Subject to the Louisiana Employment Security Law" Second Quarter 1990 and 1994; and Employment data unpublished available from the Louisiana Department of Labor.

Information on the general economic and trends are presented in the following paragraphs on the four areas addressed in this study: the Bayou Chinchuba basin near Mandeville; the Lacombe south of U. S. Highway 190; the Abita Springs area, and the Slidell area.

Bayou Chinchuba Basin

The Bayou Chinchuba study area includes the Golden Glen subdivision (the area of the most severe flooding in this basin) within the City of Mandeville, Louisiana. While the population of St. Tammany Parish increased by a compound annual rate of 4.3 percent between 1960 and 1995, the population of Mandeville has increased at an annual rate of more than 5 percent. North Shore residents have expressed concern over proposals for residential construction with smaller lot sizes than were customary in the recent past, which could lead to increases in population density. This problem may be another reflection of increasing demand for residential development in the Mandeville area, and the need for related drainage and flood control requirements. Continuing upstream development has caused greater flood problems in the Bayou Chinchuba area.

Abita Springs

Abita Springs is a small community north of I-12, a few miles east of Covington. In addition to the gradual economic recovery of the larger New Orleans MSA, improvements to U. S. Highway 190, which links Mandeville to the Covington-Abita Springs area, have increased the potential for residential growth in the area. While it is an incorporated town, most of the land in the community is residential, rather than commercial or industrial. There are a few commercial establishments in the town, and many residents depend on sales and services available in nearby Covington and larger communities of the MSA.

Lacombe

Lacombe is located between the communities of Mandeville and Slidell, near Lake Pontchartrain. The demand for residential development in Lacombe has been somewhat lower than in those two communities. However, one of the interests of individuals and families who decide to live in suburban communities is a preferred distance from the urbanized area. Lacombe has aided in meeting this demand and may continue to do so since its total land area is much larger than either Mandeville or Slidell. A large part of the land area identified as Lacombe, however, may be subject to the Federal regulations limiting construction in areas identified as wetlands.

Slidell Area

The city of Slidell, with a population of 24,124, was the most populated city in St. Tammany Parish in 1990. Slidell is situated on the north shore of Lake Pontchartrain, approximately 30 miles northeast of downtown New Orleans. It is traversed by three interstate highway systems and numerous other Federal and state highways. Interstate 59 provides north-south service, Interstate 12 provides westward service through Baton Rouge, and Interstate 10 connects Slidell to New Orleans and Biloxi. Slidell also has close access to several navigable water sources. These include the Pearl and Tchefuncte Rivers, Lake Pontchartrain, and Lake Borgne (which connects Slidell to the Gulf of Mexico). In spite of frequent storms resulting from the semitropical climate of the area and the low elevation, attraction to the Slidell area has grown. The mild climate and availability of natural resources, in conjunction with its location and access to the interstate highway system, have generated economic development and population growth along the Louisiana Gulf Coast, particularly in St. Tammany Parish and the city of Slidell.

Slidell is commonly referred to as a "bedroom community" of New Orleans. The Interstate 10 system linking Slidell to New Orleans was completed in the late 1960's, and, by 1980, the population of Slidell increased by more than 300 percent while parish-wide increases for this same period were around 65 percent. This growth can be attributed to a combination of factors. The location of the area is approximately 5 minutes from Interstate 10 and within 45 minutes of downtown New Orleans. Many of the families building or buying houses in Slidell are former residents of New Orleans who have moved to obtain better school systems and to escape higher taxes, higher crime rate, and overcrowding which is normally associated with large metropolitan areas. In addition, the infrastructure already exists in Slidell to allow development of the area.

LAND USE

There are three main types of land use in each study area: residential, commercial, and public. No industrial or agricultural activity was noted within any of the study areas. Residential property includes single-family residences which are owned by the residents individually or by landlords. Commercial property includes retail, wholesale, warehousing, office and professional buildings, etc. Public property includes civic centers, court houses, schools, park facilities, and others owned by public agencies.

ENVIRONMENTAL RESOURCES

Biological Resources

Biological resources can be categorized as to land cover types or habitats relative to the elevation of the land. Wooded habitats and marshes have significant value. Open lands are not considered to be significant habitats because of their relative abundance when compared to other habitats.

Mixed Pine/Hardwood Forests. The mixed pine/hardwood forest is found on higher, drier sites. Hardwoods are the eventual result of normal plant succession on these areas, but normal succession typically does not occur because of disturbance by man's activities. Fire also results in disturbance that results in pines as a major component in these forests. Loblolly pine is the most common dominant; however, longleaf, and slash pines are also common. Hardwoods include southern red, post, cherrybark, willow, water, laurel, and swamp chestnut oaks, along with sweetgum, red maple, blackgum, southern magnolia, American beech, and hickories. The amount of soil moisture typically determines which of the species will occur. Animal populations are moderate in these forests. Common species are deer, gray squirrel, cottontail rabbit, raccoon, opossum, coyotes, and fox; turkeys may occur in these areas as well.

Pine Flatwoods. The pine flatwoods community occurs on flat, low relief areas having a clay layer near the surface that tends to result in a high water table during a significant part of the year. Fire is again a disturbance factor that is a major influence in the normal plant succession of these forests. Loblolly is the typical pine, but slash and longleaf are common. Live oak is typically the most common hardwood, but water and laurel oak are also common. Other species include sweetbay, red maple, and blackgum. Depressions may have extensive stands of baldcypress and loblolly pine. Wax-myrtle, gallberry, and swamp redbay are common understory species. The exotic Chinese tallow is rapidly invading this community. Animal populations are moderate in these forests. The same species that occur in the mixed pine/hardwood forests also occur in the pine flatwoods. Swamp rabbits are also likely to occur in these forests.

Bottomland Hardwoods. The bottomland hardwood community occurs on low soils of relatively flat relief. These forests are typically inundated during some portion of the growing season. Fingers of these forests may extend into the mixed pine/hardwood forests described above. The one thing that separates these forests from the pine flatwoods community is the general scarcity of pines in the overstory and midstory. In the southern part of the parish, this community is not as common as the previous community. Chinese tallow is also rapidly invading this community. Bottomland hardwood forests typically occur in stream flood plains and are adjacent to swamp areas. Major trees include water and willow oaks, sweetgum, red maple, and American elm.

Bottomland hardwood forests generally provide good habitat for several wildlife species. The same species that occur on the pine flatwoods occur here with the exception of the cottontail rabbit. Additionally, flooded bottomland hardwood forests provide excellent feeding habitat for wintering wood ducks. Rapidly decaying vegetation resulting from inundation provides the source of detritus for many users within the aquatic food web.

Swamps. Swamp areas are found on the lowest elevations. They are found adjacent to bottomland hardwood areas as well as marsh areas. These communities may be surrounded by water for some or all of the time. Baldcypress, tupelogum, and swamp red maple are typical species. Baldcypress and tupelogum germinate on damp soils, but long submergence will kill young seedlings even of these hardy species. Thus, extensive stands of young baldcypress and tupelogum that occur as a result of these specific environmental conditions are few. Red maple is often found as a sprout from a root of an older tree that has been overturned by winds or other means. Since swamps are flooded for a significant period of the year, ground cover and understory is not as dense as bottomland hardwoods. Swamps are used by most of the same creatures using bottomland hardwoods, but since the long periods of inundation and, thus, less dense vegetation, habitat quality for many of those species is not as high. Swamps provide spawning and nursery areas for fish and loafing/feeding areas for wintering waterfowl. Great blue herons, other herons, and egrets are common wading bird inhabitants of swamps of the area. Raccoon, mink, deer, and gray squirrel are common mammalian species.

Marshes. Both fresh and brackish marshes are found near Lake Pontchartrain. Fresher marshes are further inland and brackish marshes are found adjacent to the lake. Common plants of fresh marshes include maidencane, bull tongue, alligatorweed, pickerelweed, and spikerush. Common plants of brackish marsh include wiregrass, three cornered grass, coco, and widgeongrass. Marshes are important nursery areas for juveniles of many estuarine organisms. They serve as year-round habitat for many water birds and furbearers. They are also very important habitat for wintering waterfowl.

Threatened and Endangered Species

Species listed as threatened or endangered in the area include the Louisiana quillwort, bald eagle, brown pelican, Gulf sturgeon, gopher tortoise, red-cockaded woodpecker, and ringed sawback turtle. The American alligator is listed as endangered due to similarity of appearance to other crocodilian species. The Louisiana quillwort is a plant of blackwater streams of flatwoods portions of the parish. The bald eagle and brown pelican are found in coastal areas. The Gulf sturgeon may be found in any of the bayous or rivers flowing into Lake Pontchartrain. The gopher tortoise is found in upland areas of dry, sandy soils. The red-cockaded woodpecker is found in pine forests containing overmature trees infested with red heart disease. The ringed sawbacked turtle is found in streams of the Pearl River basin.

Cultural Resource Background

Only a small portion of the proposed project areas have been surveyed by professional archaeologists. Nonetheless, previous investigations in the parish can help us determine the probability of finding significant cultural resources within a given project area and determining what prehistoric and historic cultural traditions and/or phases might be present.

Archeological investigations in St. Tammany Parish began with the survey and recording of prehistoric shell middens along the north shore of Lake Pontchartrain in the 1950's. A series of large multi-component prehistoric shell middens were recorded by Saucier and Gagliano from Pass Manchac east to the Pearl River. Between 1968 and 1996, 34 professional cultural resource investigations have taken place within St. Tammany Parish. The Louisiana cultural resource site files indicate that 82 prehistoric and historic archeological sites have been recorded as a result of these investigation. Many of these sites are multi-component and contain one or more prehistoric and/or historic cultural traditions. Cultural resource survey investigations conducted to date have revealed the presence of a complete prehistoric cultural sequence, that is, Paleo-Indian, Archaic, Poverty Point, Tchefuncte, Marksville, Troyville, Coles Creek and Later Mississippian variants.

Historical records indicate that historic Indian villages associated with the Acolapissa, Pensacola, Choctaw, Attakapas and Chitimacha were present at various times from 1530 to 1850. However, considerable ethnohistoric research and field surveys would be necessary to identify the exact location of villages associated with these tribes.

The earliest Euro-American presence in St. Tammany area began in the late 1690's with the arrival of French Explorer, Pierre le Moyne, Sieur d'Iberville. Iberville explored the north shore of Lake Pontchartrain visiting Bayou Castine in present day Mandeville and the Pearl River near present day Slidell. French control of the region ended in 1763 and Spain became the new governing authority. By 1779 Spanish control of the area was secured. Present day St. Tammany parish remained under Spanish control until 1810 when Anglo-American settlers revolted and the United States annexed the area. In 1811, a regiment of United States troops were stationed north of Covington along the Bogue Falaya river. The following year Louisiana became a state. In 1816, present day Covington (known at that time as Wharton) was incorporated as one of the first towns in St. Tammany parish. During this time period St. Tammany parish developed a thriving pitch, ship building, and brick making industry. These industries continued through the early 1900's. In the 1960's, the construction of the causeway bridge across Lake Pontchartrain served as a catalyst for increased economic growth and development.

Eighteen National Register (NR) historic standing structures and two NR Districts are located in St. Tammany parish. The majority of these structures date between 1840 and 1900. One historic district is located in Covington and the other is located in Abita Springs. While there are many potentially eligible NR archeological sites (both prehistoric and historic), all of the NR sites on-file represent standing historic structures. Many previously recorded cultural resource sites have been destroyed and continue to be destroyed by housing developments, business complexes, and increased erosion rates along the many bayous and the shoreline of Lake Pontchartrain.

WATER QUALITY

Water Quality Stations

The Louisiana Department of Environmental Quality (LDEQ) monitors the quality of water in the following water bodies in St. Tammany Parish.

- Lower Tchefuncte River
- Bayou Bonfouca
- W-14 Canal Main Diversion Canal
- West Pearl River
- Bayou Lacombe
- Bogue Falaya River
- Lake Pontchartrain

The data for the entire period of record for each of these water bodies are listed in tables in Appendix A, Engineering Appendix.

Water Use Designation

The LDEQ has established seven water use designations for surface waters in the State of Louisiana. The seven designated water uses include primary contact recreation, secondary contact recreation, fish and wildlife propagation, drinking water supply, oyster propagation, agriculture, and outstanding natural resource waters. All the streams in study area monitored for water quality are designated for the uses that follow.

- Primary Contact Recreation
- Secondary Contact Recreation
- Fish and Wildlife Propagation

Lake Pontchartrain, east of the Highway 11 bridge is designated for oyster propagation as well. The following streams in the study area are also designated outstanding natural resource waters.

- West Pearl River
- Bayou Lacombe
- Bogue Falaya River

Only Bayou Lacombe and the West Pearl River are considered fully supportive of their designated uses. W-14 Canal is considered to be not supportive of its designated uses. Other waterbodies are considered to be partially supportive of their designated uses.

HTRW CONSIDERATIONS

A reconnaissance level preliminary HTRW assessment was conducted of each alternative plan site based upon appropriate information gathered in this stage of study. The preliminary screening of HTRW data and land use information for each alternative plan site utilized previously compiled HTRW assessments, the National Priorities List (NPL), Comprehensive Environmental Response Cleanup and Liability Information System (CERCLIS), the Louisiana Site Remediation Information System (LASRIS), and the Louisiana Toxic Release Inventory (LTRI) for 1994 were examined. Additionally, each project area was visually inspected by vehicle along public highway access routes. If feasibility studies are conducted, a comprehensive regulatory file search and visual inspection of potential project areas would be required to determine if HTRW testing is necessary.

Two NPL sites, better known as Superfund sites, in the Slidell area are of significant HTRW interest because they could potentially be affected by flood control plans developed for the Slidell. These are the Bayou Bonfouca and Southern Shipbuilding sites. These sites are located in and along Bayou Bonfouca, which could be affected by plans to improve the W-13 Canal. Site remediation under the authority of the Comprehensive Environmental Response and Liability Act (Superfund) has been accomplished at the Bayou Bonfouca site. Remediation started at the Southern Shipbuilding site in late 1995. Sheet piling on both sides of the bayou has been left in place at the Bonfouca site to aid in holding the banks in place. Implementation of the channel modifications and bridge replacement of the W-13 Canal basin would result in increased flood stages in Bayou Bonfouca downstream of the W-13 Canal work area. Stage increases would be greater in the upper segment, just below West Hall Avenue, and would be minimized with distance progressed downstream. Thus, stage increases would occur at the Bayou Bonfouca site and at the Southern Shipbuilding site. Any effects of these stage increases upon either or both of these sites would be determined upon consultation with the Environmental Protection Agency. Other, non-superfund sites of HTRW interest are listed in Table 8.

FUTURE WITHOUT-PROJECT CONDITIONS

Future conditions in St. Tammany Parish that are pertinent to this reconnaissance study are discussed in this section.

DRAINAGE

The growth of residential and commercial development in St. Tammany Parish is expected to continue. This development will increase rainfall runoff and discharges into drainage basins. Much of the existing development in the parish has been in the lower reaches of drainage basins, near Lake Pontchartrain, especially near the major roadways connecting the parish and the New Orleans area. Areas suitable for development near the lake are diminishing, and growth is expected to continue to shift to the upper reaches of drainage basins.

Flooding of residential and commercial structures that are

TABLE 8
Non-Superfund Study Area Sites
on Major Lists for Potential HTRW

List	Site	Location
LTRI[1]	LasTec Labco	Carnation St., Slidell
LTRI CERCLIS[2] LASRIS[3]	Southern Coatings	Hwy. 190 W., Slidell
LTRI	The Marble Quarry, Inc.	Hwy. 3228, Mandeville
LTRI	Pearl River Polymers	Pump Slough Road, Pearl River
CERCLIS	Alton Trash Dump	End of 15th Street, Alton
CERCLIS	Winston Burnett	4 miles north of Route 59, Slidell
LASRIS	Glindco	Off Hwy. 90 E, Slidell

[1]LTRI is Louisiana Toxic Release Inventory (LTRI) for 1994
[2]CERCLIS is Comprehensive Environmental Response Cleanup and Liability Information System
[3]LARIS is the Louisiana Site Remediation Information System

below the Flood Insurance Administration's 100-year base flood elevation will increase, and newer structures constructed above the base flood elevation may begin to flood. The increases in rainfall runoff will be partially offset by mitigation measures such as detention ponds. Flood damage to new development will be moderated by the parish's and incorporated areas' participation in the National Flood Insurance Program. This program requires that new construction be built above the 100-year base flood elevation and that new development should not produce more run-off from the 10-year storm than it did prior to development. However, these requirements do not seem to have achieved their desired effects.

In the Bayou Chinchuba basin in the Mandeville Area, the Louisiana Department of Transportation and Development is developing plans to replace the U. S. Highway 190 box culvert over Bayou Chinchuba with two 80-foot bridges. The current box culvert significantly restricts flow passing the highway. The proposed replacement bridges would increase flow passing the highway, increasing stages between U. S. Highway 190 and North Causeway Boulevard, especially in the Golden Glen Subdivision. This

Development in the upper Bayou Chinchuba Basin is expected to continue. Flood insurance regulations require that increased rainfall run-off from new development associated with storms exceeding a 0.10 probability storm (10-year flood) be mitigated. For storm greater than the 0.10 probability storm, the potential for downstream flooding will increase.

Parish and municipal agencies have improved drainage and flood control but, in some areas, have been unable to keep pace with the increasing severity of flooding.

ENVIRONMENTAL RESOURCES

Biological Resources

Mixed Pine/Hardwood Forests. The mixed pine/hardwood forest is susceptible to development for agriculture, particularly in northern parts of the parish. Agricultural development in the form of conversion of forestland to pastureland is likely, since the dairy industry is maintaining itself and horse farming is a growing industry. This will result in reductions of this community.

Pine Flatwoods. The pine flatwoods community is common in the southern parts of the parish. This is the area in which significant residential and commercial development is occurring. Growth in both the Mandeville and Slidell areas is resulting in significant losses to this community. Conditions resulting in the development of these areas are expected to continue which would result in continued reductions of this community.

Bottomland Hardwoods. The bottomland hardwood community occurs in the southern parts of the parish also. The residential and commercial development that is occurring in the Mandeville and Slidell areas is resulting in losses to this community also. This development and the associated reductions are expected to continue to this community.

Swamps. Swamp areas are the least likely to be developed of any of the wooded communities. Since these areas are definitely wetlands, deposition of fill material into these areas would certainly require compliance with Section 404(b)(1) of the Clean Water Act. This does not mean that none would be developed, but the regulatory process would, quite likely, limit development of more of this community than it would others. The present rate of development is expected to be continued in the future.

Marshes. Historical marsh losses that have been occurring in the Fritchie marsh area near Slidell, the area between U. S.Highway 11 and Bayou Bonfouca, and that area south of Lacombe are expected to continue, although possibly at a reduced rate. However, sediments from the Pearl and Tchefuncte Rivers will contribute marsh-building sediments to the adjacent marshes. The net overall effect is uncertain.

THREATENED AND ENDANGERED SPECIES

Populations of species listed as threatened or endangered in the area may, in response to the initiation of recovery programs, be removed from the list. For instance, conservation efforts have resulted in a status change to the American alligator. However, projections of what species native to the area that will or will not be on the list is beyond the scope of this study.

PROBLEMS, NEEDS, AND OPPORTUNITIES

The problems, needs, and opportunities identified in this study were primarily due to flooding in the four basins which were studied. These are discussed below.

BAYOU CHINCHUBA

The portion of Bayou Chinchuba upstream of Causeway Boulevard has a history of repeated flooding. This area experienced extensive flooding during the May 1995 event was caused by heavy rains over a three-day period and high lake stage due to the runoff from this storm. The Golden Glen, Forest Park, and Greenleaves subdivisions were heavily impacted by this storm. Extensive flooding also resulted from an August 1988 event.

Many of the homes in the Golden Glen Subdivision were built to an elevation of 10 feet NGVD or less prior to the issuance of the Flood Insurance Rate Maps in 1989 when the base flood (100-year) elevation was raised to 12-14 feet NGVD. This subdivision was not particularly prone to flooding when it was first developed; however, with increasing upstream development, the frequency of flooding has increased. Most new developments in the basin include a detention pond designed to reduce the flow of the 0.10 probability storm (10-year flood) by 25 percent. Although detention basins have been required on all new subdivisions since 1984, it is unclear just how much the rapid residential growth has affected the bayou. However, field reviews showed that most of the new detention ponds required to prevent additional flows created by development normally were filled with water and had very little detention space.

Continued development in the upper Bayou Chinchuba Basin is expected to increase flooding in the downstream areas, particularly in the Golden Glen Subdivision. If the U. S. Highway 190 box culvert over Bayou Chinchuba is replaced with two bridges, and the increased discharges through the bridges are not mitigated, flooding in the downstream areas, particularly in Golden Glen subdivision would increase significantly. With or without the replacement of the box culverts under U. S. Highway 190 bridge, there is a need for measures to reduce the flood damages in the Bayou Chinchuba Basin.

Abita Springs

The Abita River occasionally overflows its banks due to headwater flooding, flooding residences in the town of Abita Springs. This flooding also results from an inadequate channel due to debris (mostly fallen trees) which significantly reduce the channel capacity. Local residents are concerned over the aesthetic qualities of the Abita River, which is a scenic, natural waterway. There is a need to reduce flood damages in the Abita Springs area while preserving the aesthetic qualities of the Abita River.

Lacombe

The Lacombe area is located in south-central St. Tammany Parish along Bayou Lacombe. This area is subject to tidal flooding from Lake Pontchartrain and to rainfall flooding from overflow from Bayou Lacombe and Big Branch. A significant number of residences in the area are subject to flooding, and the frequency of flooding has increased in recent years. There is a need for measures to reduce flood damages in the Lacombe area.

Slidell Area

The Slidell area addressed in this study includes portions of three drainage basins. The W14 Canal basin is the most developed of the three basins considered in this study. The W-14 Canal basin drains most of the incorporated area of Slidell, as well as a small area north of the city limits. The canal was built in the 1940's by the Louisiana Office of Public Works (now part of the Louisiana Department of Transportation and Development). The lower portion of the W-14 Canal was enlarged to a 60-foot bottom width canal in the mid-1970's. The upper reaches, where most of the flooding occurs, has never been enlarged. The W-14 Canal drainage basin bears little resemblance to its 1940's condition. The development in this basin has overburdened the existing canal. A 0.3 to a 0.5 annual probability storm (a 2-3 year recurrence interval) causes this canal to overflow its banks.

The W-15 Canal Basin lies immediately to the West of the W-14 Canal Basin. It is connected to the W-14 Canal by the bi-directional W-15 Canal Lateral (Reine Lateral) Canal and to Gum Bayou by the Poor Boy Canal. The W-15 Canal is subject to flooding from rainfall in the W-15 Canal basin and from the backwater effects of the Pearl River which can result from widespread intense rainfall in the upper reaches of the Pearl River Basin. The W-15 Canal basin has been rapidly developed over the past 15 years. Although not as densely developed as the W-14 Canal basin, the increased development has contributed to flooding in this basin. The W-15 Canal was also built in the 1940's by the Louisiana Office of Public Works, and has not been significantly improved since.

Bayou Vincent is west of the W-14 Canal and is connected to the W-14 Canal by the West Diversion Canal. The Bayou Vincent basin is a mixture of developed and undeveloped tracts. The portion being examined in this study is that reach below Interstate Highway 12 (I-12) and above Old Spanish Trail. Flooding in this area is due to headwater, rainfall, and inadequate channel capacities.

Significant numbers of residential and commercial structures are subject to repetitive flooding in the Slidell area, and the frequency of flooding appears to be increasing. There is a need for measures to reduce flooding problems in the area.

PLAN FORMULATION

PLANNING OBJECTIVES

Planning Objectives stem from national, state, and local water and related land resource management needs specific to the study area. These objectives were developed through coordination with potential local sponsors including the cities of Slidell, Mandeville, Abita Springs, and St. Tammany Parish Police Jury; and through applicable laws, executive orders, and regulations. The following planning objectives were established to be responsive to the identified problems, needs, and opportunities; applicable laws; executive orders; and regulations:

a) reduce flood damages in St. Tammany Parish,

b) minimize adverse impacts to the environment associated with any proposed plans,

c) minimize to the extent possible the destruction of archaeological and historical resources associated with any proposed plans,

d) incorporate, to the extent practicable, recreation facilities in the proposed plans to increase recreational opportunities,

e) mitigate for all unavoidable impacts to significant cultural and fish and wildlife resources associated with any proposed plans, and

f) incorporate to the extent possible, features for the enhancement of fish and wildlife habitat into any proposed plans.

PLANNING CONSTRAINTS

This study was conducted within the constraints of the "Economic and Environmental Principles for Water and Related Land Implementation Studies," published in March 1983 by the U. S.

Water Resources Council, and by applicable Department of the Army Regulations and other documents which provide guidance pertaining to the implementation of these principles and guidelines.

This study investigated several measures to alleviate flood damages in St. Tammany Parish. The analysis focused upon areas that experienced structural damages as a result of severe storm events. Street, yard, parking lot, and other minor flooding problems were not considered in this investigation.

PLAN DEVELOPMENT

PLAN FORMULATION RATIONALE

The purpose of plan formulation was to identify economical justified and environmentally acceptable solutions to flooding problems in St. Tammany Parish. To develop these plans, municipal officials from the incorporated areas of St. Tammany Parish were contacted to determine if there were any areas under their jurisdiction that might qualify for protection under this study. The St. Tammany Parish Engineering Office was contacted for the same purpose. In addition to discussions with these officials, previous reports prepared by the New Orleans District and reports prepared by consulting engineers for various governmental bodies in St. Tammany Parish were reviewed. Newspaper reports also identified areas of significant damages.

As a result of this analysis and coordination, four areas were selected for study: Mandeville, Abita Springs, Lacombe, and Slidell. Plans providing relatively low levels of flood protection were developed to address problems in these areas. Plans providing a lower level of flood protection are more likely to be economically justified under Federal criteria. Plans could be developed further and optimized in studies following the reconnaissance phase. Existing conditions stage-frequency curves were developed for these areas using prior reports, flood insurance studies, and existing computer models. The ten-year frequency storm was chosen as the design event for the Slidell area plans since it is the City of Slidell's goal to provide protection from the 0.10 annual probability (10-year recurrence interval) event. No design event was chosen for the other areas considered.

The area along the eastern boundary of St. Tammany Parish in the vicinity of Slidell is subject to repetitive flood damages from the Pearl River. A feasibility report to address these flooding problems resulted in the authorization of the Slidell, Louisiana, and Pearlington, Mississippi, flood control project. The project has not been constructed as the non-Federal sponsor has been unable to obtain funding for their share of the project. Since a project exists to provide flood protection from the Pearl River in the Slidell area, additional measures were not addressed in this reconnaissance study.

Structural and non-structural plans were considered during this study. Structural plans reduce damages by lowering flood stages, while non-structural plans reduce damages by raising, removing, or flood-proofing structures. Plans for raising flood-prone structures were the only non-structural plans presented in the following sections. Other non-structural measures were found to be economically feasible and could be developed in more detailed feasibility studies. Only nonstructural plans were considered for Abita Springs and Lacombe, while only structural plans were considered for Slidell. Both types of plans were considered for the Bayou Chinchuba basin in Mandeville.

Structural plans were not considered for the Abita Springs area because the only structural plan would require clearing and snagging and/or channelization of the Abita River, which is a scenic, natural stream. Local residents want to preserve its scenic, natural qualities. Structural plans were not considered for the Lacombe Area because development in the area is subject to hurricane flooding and headwater flooding from Bayou Lacombe. Hurricane protection was considered in a previous study and found to be not feasible, under Federal criteria. Plans developed in the study are described below.

Bayou Chinchuba Basin

Alternative 1 - Raising structures in the Golden Glen Subdivision.

Alternative 2 - Clearing and Snagging Bayou Chinchuba from North Causeway Boulevard to State Highway 59 and widening the openings of North Causeway Boulevard and West Causeway Approach Bridges.

Alternative 3 - Channel enlargement in Bayou Chinchuba from Lake Pontchartrain to the Lakes at Greenleaves subdivision, clearing and snagging from there to State Highway 59, and widening the openings of North Causeway Boulevard and West Causeway Approach Bridges.

Abita Springs Area

Raising structures in the flood plain.

Lacombe Area

Raising structures in flood plain.

Slidell Area

A comprehensive plan for the W-13 Canal Basin (Bayou Vincent), W-14 Canal Basin, and the W-15 Canal Basin including:

· Two detention ponds, one at Robert Road and the W-14 Canal and one at North Boulevard and Highway 11.
· W-13 Canal Channel Enlargement from I-12 downstream to West Hall Avenue.
· Replace West Hall Avenue Bridge over W-13 Canal.
· Clear and Snag W-14 Canal from I-12 downstream to I-10 and Channel Enlargement from Independence Avenue downstream to Fremaux Avenue.
· Replace Florida Avenue bridge over the W-14 Canal.
· Place a water control structure in W-15 Canal Lateral that would allow flow only out of the W-14 Canal, not into it.
· Enlarge and realign the entrance to the Poor Boy Canal so that it captures all of W-15 Canal upstream of that point.

DEVELOPMENT AND SCREENING OF PLANS

Two different evaluation processes were used during the St. Tammany Parish reconnaissance study to determine whether plans were economically justified under Federal criteria. One process was used in evaluating structural plans, and another process was used for evaluating non-structural plans.

The process used for structural plans consisted of preparing reconnaissance-scope designs and cost estimates for each alternative under consideration. Stage-frequency curves for these plans were developed for with- and without-project conditions. Estimates of benefits were prepared based on the differences between damages expected to occur with and without the plan. Costs and benefits were converted to an equivalent average annual value using the current Federal discount rate of 8-3/8 percent and a 50-year project life.

The process for evaluating non-structural Plans was done using the URBAN program developed by the Corps of Engineers Vicksburg District to estimate both the costs and the benefits associated with nonstructural plans. Structure elevations were estimated by a hand-leveling technique using the best available maps for base elevations. Structure values were obtained using the Marshall and Swift Valuation Program. Stage-frequency curves were obtained from existing flood insurance studies or other reliable sources. The URBAN program computed the estimated cost of raising the structures above the 100-year base flood elevation and the damages prevented by their raising. The program output contains average annual costs and benefits, and benefit-cost ratios for non-structural plans based on the current Federal discount rate of 8-3/8 percent and a 50-year project life. The non-structural plans assume that all structure owners would participate in a project to raise their structure. If feasibility studies were conducted, structure owner's would be surveyed to more accurately determine the participation and the project costs and benefits.

A description of the evaluation process of each alternative is described below. Plan locations are shown on Plate 3.

Bayou Chinchuba - Alternative 1

This plan is a non-structural plan that consists of elevating those homes that prove to be economically justified above the 100-year base flood elevation. Approximately 90 homes in the Golden Glen Subdivision were evaluated to determine if elevating those homes was economically feasible. Even though the level of the flood waters would not be affected under this plan, benefits are derived due to homes that would no longer be experiencing flood damages from water inundating them. Damages to vehicles would not be affected under this plan. Except for garages, construction would be prohibited under the raised structures, to preclude additional flood damages.

Elevations of structures in the Golden Glen Subdivision were determined by hand-leveling using USGS Quadrangle Maps for base elevations. Stage-frequency curves were taken from the existing flood insurance study for St. Tammany parish. Costs and flood reduction benefits were calculated using the URBAN program. The URBAN program also developed a benefit-cost ratio and the number of structures that are economically justified to raise. This plan is economically justified and is presented in more detail in the following section, PLANS CONSIDERED FURTHER.

Bayou Chinchuba - Alternative 2

This plan consists of clearing and snagging Bayou Chinchuba starting at North Causeway Boulevard and working upstream to the weir at the Lakes of Greenleaves. The plan is shown on Plate 4. Clearing and snagging would resume at the upstream end of the Lakes of Greenleaves and continue to Highway 59. The clearing and snagging of Bayou Chinchuba would require modifications to the bridges at both North Causeway Boulevard and at West Causeway Approach Road. Since the Louisiana Department of Transportation and Development currently has plans to replace the box culvert over Bayou Chinchuba at U. S. Highway 190 with an 80-foot clear span bridge in 1998, it was assumed that this bridge was replaced as part of the existing conditions.

With-project stage-frequency curves were developed by using the existing flood insurance study computer model of the Bayou Chinchuba basin and making those changes to the model to reflect the proposed plan. Stage lowerings resulting from this plan are shown in Table 9.

Benefits were calculated using the SID-EAD program written by the Corps of Engineer's Hydrologic Engineering Center. A data base of existing structure elevations for the Bayou Chinchuba basin was available from the Tchefuncte, Tangipahoa, and Tickfaw Rivers, Louisiana, study. This data base was run using the stage-frequency curves developed for this alternative.

TABLE 9
BAYOU CHINCHUBA - ALTERNATIVES 2 AND 3
STAGE LOWERINGS

	PROBABILITY OF STORM					
	0.50		0.10		0.01	
LOCATION	ALT 2	ALT 3	ALT 2	ALT 3	ALT 2	ALT 3
LA HWY 59	0	0	0	0	0	0
IL CENT RR	0	0.1	0	0	0	1.0
GL LAKE	0.2	0.7	0.2	1.1	0.4	1.5
GL BRIDGE	0.2	0.7	0.2	0.8	0.3	1.6
GL DAM	0.2	0.7	0.4	1.4	0.3	1.9
US HWY 190	0.5	0.7	1.0	2.4	0.9	2.4
CORIN ST	0.5	1.2	1.2	3.5	1.0	3.9
N. CAUSEWAY	0.2	2.2	0.8	3.6	0.8	3.8
W. CAUSEWAY	0.1	2.5	0.5	3.0	0.6	3.3

Bayou Chinchuba - Alternative 3

This plan, which is shown on Plate 5, was developed to pass the 0.1 annual probability (10-year) storm within its banks. It includes a 200-foot wide channel from Lake Pontchartrain to North Causeway Boulevard, a 125-foot wide channel from North Causeway to U. S. Highway 190, a 60-foot wide channel from U. S. Highway 190 to the Lakes at Greenleaves, and clearing and snagging above the Lakes at Greenleaves to State Highway 59. This plan would require the widening of the bridges on both North Causeway Boulevard and West Causeway Approach.

The stage-frequency curves for this plan were developed in the same manner as they were for Bayou Chinchuba - Alternative 2. Stage reductions are shown in Table 9. This plan was not developed further in this reconnaissance study because of the extensive environmental and aesthetic impacts associated with its construction and because of its low probability for economic justification relative to Bayou Chinchuba - Alternative 2.

Abita Springs Area Plan

This plan is a non-structural plan that consists of elevating those homes that prove to be economically justified above the 100-year base flood elevation. Flooding in Abita Springs results from high stages on the Abita River and its North and South Tributaries. Stagefrequency information for these streams was obtained from the flood insurance study for St. Tammany Parish. Benefits of this plans are obtained by raising structures above the elevation at which they would experience damage. Costs and benefits were developed in the same manner as those for Bayou Chinchuba - Alternative 1. This plan is economically justified and is presented in more detail in the following section, PLANS CONSIDERED FURTHER.

Lacombe Area Plan

This plan is a non-structural plan that consists of elevating those homes that prove to be economically justified above the 100-year base flood elevation. Flooding in the Lacombe area is due to high tides resulting from Hurricanes and other storm events. Stage-frequency curves for the tidal area were obtained from the St. Tammany Parish flood insurance study. Costs and benefits were obtained in the same manner as the Abita Springs plan. This plan is economically justified and is presented in more detail in the following section, PLANS CONSIDERED FURTHER.

Slidell Area Plan

This plan consists of modifications for flood control in three drainage basins in the Slidell Area: W-13 Canal (Bayou Vincent), W-14 Canal, and W-15 Canal (French Branch). There are interconnections between these basins (West Diversion Canal, W-15 Lateral Canal, and the Poor Boy Canal). Existing HEC-2 models were used as the basis of the analysis of the W-13 Canal and W-15 Canal. A new HEC-1 model was prepared for the W-14 Canal basin, and this was input into HEC-RAS (River Analysis System, the successor to HEC2).

Economic benefits were calculated using the with- and withoutproject stage-frequency curves produced in the above manner. A complete survey of the study area was taken using hand levels and 2-foot contour interval topographic maps developed as part of the Lake Pontchartrain and Vicinity project. Saltwater stage-damage curves developed as part of that same study were also used to calculate benefits.

Due to the interconnected nature of these basins, numerous assumptions had to be made to simplify the analysis such that it could be done using the HEC-1, HEC-2, and HEC-RAS computer models. These assumptions are described below, by basin.

W-13 Canal. The enlargement of the W-13 Canal stream was analyzed. The existing conditions HEC-2 model was used to analyze the impacts of channel enlargement on the flood profiles. The design analyzed began just downstream of West Hall Road and continued upstream about 2.8 miles to the downstream side of the eastbound I-12 Highway (see Plate 6). The improved channel would consist of a 40-foot bottom width with 1 vertical on 2 horizontal side slopes. The channel would be deepened in some reaches to provide a more consistent invert slope. The existing West Hall Road bridge (44 feet long; low chord, 9.0 ft NGVD) causes significant head loss, and a replacement bridge (116 feet long; low chord, 10.0 feet NGVD) was designed for this alternative. No other bridges would be modified under this alternative. Instead, the existing channels under these bridges would be cleared and snagged.

W-14 Canal. Features in the W-14 Canal Basin include two detention ponds (one at Robert Road and the W-14 Canal and one at North Boulevard and Highway 11); clearing and snagging of the channel from Interstate 12 to Interstate 10; and enlargement of the W-14 Canal to a 40-foot base width and 1 horizontal on 2 vertical side slopes from Gause Boulevard to Fremaux Avenue (U. S. Highway 190) and 1,000 feet north of Gause Boulevard. (See Plate 7).

Review of the stages for the 0.1, 0.02, 0.01, and 0.002 (10-, 50-, 100-, and 500-year) annual probability events from the flood insurance study showed that the peak stages for W-14 Canal and W-15 Canal at the location of the W-15 Canal lateral are almost the same. Therefore, it was necessary to compare the runoff hydrographs for the W-14 Canal and W-15 Canal where the W-15 Canal lateral connects with each canal. A rough HEC-1 model was developed for W-15 Canal above the W-15 Canal lateral using the same approach as the HEC-1 model for W-14 Canal. The peak flow and time to peak for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability runoff hydrographs for each canal were compared. Flow in the W-14 Canal peaks before the W-15 Canal so that water flows from the W-14 Canal to the W-15 Canal at the peak W-14 Canal flow. When the W-15 Canal peaks, flow in the lateral is in the opposite direction, from the W-15 Canal to the W-14 Canal, and may increase the duration of high water in the W-14 Canal and contribute to flooding. This resulted in a decision to include a control structure to prevent flow from moving in the east to west direction.

The two diversion channels were modeled using an outflow rating curve. The W-14 Canal diversion maximum outflow was 130 cubic feet per second for a 0.1 (10-year) annual probability event. To estimate flows in the W-15 Lateral Canal, a rough HEC-2 model was set up. The downstream starting water surface elevation was developed from water levels in the W-15 Canal coincident with runoff conditions on the W-14 Canal. Flows in the HEC-RAS model for the W-14 Canal downstream of the W-15 Lateral Canal and for the rough W-15 Lateral Canal HEC-2 model were adjusted until the water surface elevations at their confluence matched. For the 10-year event, a maximum of 250 cubic feet per second is diverted from W-14 Canal to the W-15 Canal. Peak discharges in the W-14 Canal downstream of the W-15 Lateral Canal occur during the period when there are inflows from the W-15 Canal (via the W-15 Lateral Canal).

W-15 Canal. This alternative enlarges the existing Poor Boy Canal from the W-15 Canal eastward to Gum Bayou (approximately 1 mile in length). In addition, the entrance to the Poor Boy Canal from W-15 Canal is realigned to provide a more efficient transition. (See Plate 6). The enlarged canal diverts all of the

W-15 Canal watershed above the Poor Boy Canal for events up to the 0.01 (100-year) annual probability event. The existing Poor Boy Canal is estimated to have a 10-foot bottom width, 1 vertical on 2 horizontal side slopes and an invert of approximately 9.0 feet NGVD. The proposed enlargement consists of a 25-foot bottom width, 1 vertical on 2 horizontal side slopes, and the existing invert. The channel passes under three existing highways shown on the vicinity map. (See Plate 6). Sets of two, 10-foot by 10-foot concrete box culverts are required under each highway (2 sets under I-59) to be placed at the existing channel invert.

Stage-reductions for this alternative are presented in Table 10. The Slidell area plan is economically justified and is presented in more detail in the following section, PLANS CONSIDERED FURTHER.

TABLE 10
SLIDELL AREA PLAN
STAGE LOWERINGS

	PROBABILITY OF STORM		
LOCATION	0.50	0.10	0.01
W-13 CANAL BASIN			
I-12	1.9	1.1	0.6
ICGRR NW	1.5	0.7	0.7
ICGRR WEST	2.1	0.9	0.6
US HWY 190	1.7	1.4	0.6
West HALL RD	0.5	1.0	1.1
W-14 CANAL BASIN			
NORTH BLVD	1.1	1.2	1.0
ROBERT RD	0.9	0.6	0.4
GAUSE BLVD	2.9	2.3	0.9
FREMAUX AVE	0.7	0.3	0.8
I-10	0.0	0.0	0.4
W-15 CANAL BASIN			
I-10	1.5	1.2	0.5
PEARL AC RD	1.4	1.2	0.5
GAUSE BLVD	1.2	1.2	-2.4
MILITARY RD	0.7	1.0	0.5
OLD RIV RD	1.3	0.9	0.5

PLANS CONSIDERED FURTHER

Based on the development and screening of alternative plans, several of the plans developed for this reconnaissance study were found to be economically justified under Federal criteria. These plans are:

- Bayou Chinchuba - Alternative 1
- Bayou Chinchuba - Alternative 2
- Lacombe Area Plan
- Abita Springs Plan
- Slidell Area Plan

Information on these plans is presented in the following sections. This information includes the engineering design analysis, real estate requirements, a summary on the economic analyses, and a summary of the environmental impacts of each structural plan. A summary of economic analysis is presented for each non-structural plan.

BAYOU CHINCHUBA - ALTERNATIVE 1

Approximately 36 residential structures in the Golden Glen Subdivision in Mandeville would be raised with this alternative. These structures were selected from a total of 97 structures which were selected based on their history of costly, repetitive flooding. Structure raising was the only non-structural measure considered in this analysis. Other non-structural measures could be considered in more detailed feasibility studies.

Real Estate Requirements

There are no real estate requirements for the implementation of Bayou Chinchuba - Alternative 1.

Economic Analysis

The economic and engineering analyses for Bayou Chinchuba - Alternative 1 were conducted using the URBAN computer program developed by the U. S. Army Corps of Engineers, Vicksburg District. This program computes the benefits of several types of non-structural plans based upon the stage-frequency curves that must be given as input. This program also computes the cost of each plan based upon floor elevations and structure types and costs compiled by the Hydrologic Engineering Center of the U. S. Army Corps of Engineers. Estimates of the costs and benefits of this plan are presented in Table 11. As shown in Table 11, Bayou Chinchuba - Alternative 1 is economically justified with a benefit-cost ratio of 5.9.

TABLE 11
SUMMARY OF ECONOMIC ANALYSIS
BAYOU CHINCHUBA - ALTERNATIVE 1

Number of Structures Raised	36
First Costs	$ 3,200,000
Average Cost Per Structure	$ 89,000
Average Annual Costs	$ 252,000
Average Annual Benefits	$ 1,482,000
Net Benefits	$ 1,230,000
Benefit-Cost Ratio	5.9

Plan Implementation Responsibilities

All of the costs for Bayou Chinchuba - Alternative 1 are apportioned to non-structural flood control. The Federal government is responsible for the design and construction of the proposed project and would pay 75 percent of the total project cost. The non-Federal sponsor must provide 25 percent of the total project cost and all of the lands, easements, and rights-of-way and relocations of utilities required to construct the project. For non-structural flood control plans, the non-Federal share cannot exceed 25 percent of the project cost, even if the total cost of lands, easements, and rights-of-way and relocations of utilities exceeds 25 percent of the total project cost. The non-Federal sponsor is responsible for all operation and maintenance costs for flood control projects. The apportionment of the first cost for Bayou Chinchuba - Alternative 1 between Federal and non-Federal interests is presented in Table 12.

TABLE 12
APPORTIONMENT OF FIRST COSTS
BAYOU CHINCHUBA - ALTERNATIVE 1

	Federal	Non-Federal	Total
Construction Cost	$2,400,000	$800,000	$3,200,000
LEERD's[1]	0	0	0
TOTAL	$2,400,000	$800,000	$3,200,000

[1]LEERD's are lands, easements, rights-of-way, and relocations of utilities

Impacts to Cultural Resources

The raising of 36 homes in the Golden Glen subdivision would not affect cultural resources. All of the homes are less than 50 years old. No cultural resources investigations would be required for this plan.

Summary of Analyses

Bayou Chinchuba-Alternative 1 would provide for raising approximately 36 structures in the Bayou Chinchuba Basin to reduce flood damages. The plan was found to be economically justified, under Federal criteria, and environmentally acceptable. The first cost is estimated at $3,200,000, average annual costs are $252,000, and average annual benefits are $1,482,000. The benefit-cost ratio is 5.9.

BAYOU CHINCHUBA - ALTERNATIVE 2

This plan, shown on Plate 4, provides for the clearing and snagging of the reach of Bayou Chinchuba between North Causeway Boulevard and State Highway 59, exclusive of the Lakes at

Greenleaves. Four bridges, two at North Causeway Boulevard and two at West Causeway Approach, would have to be modified to convey the flows resulting from the upstream channel clearing and snagging. The analysis of this proposal assumes that the box culverts under U. S. Highway 190 will be replaced with two, 80-foot clear span bridges as currently planned by the Louisiana Department of Transportation and Development for 1998.

Clearing and Snagging

The channel of Bayou Chinchuba would be cleared from West Causeway Approach to the weir at the Lakes of Greenleaves. Clearing and snagging would resume at the upstream end of the Lakes of Greenleaves and would continue to Louisiana Highway 59.

Bridge Modifications

The openings under the North Causeway Boulevard and West Causeway Approach Road bridges over Bayou Chinchuba would be widened to allow the flows from the modified channel to pass unimpeded. The bridges on both North Causeway Boulevard and West Causeway Approach Road currently have a top width of 125-feet. These bridges would require structural modifications to widen the openings to a 152foot span. This plan would require the removal of the Corin Street Bridge over Bayou Chinchuba in the Golden Glen Subdivision.

Relocations

The only relocations required as part of this alternative are two electrical conduits, one telephone conduit, and a gas line that are attached to the Corin Street Bridge. These utilities would be relocated to a nearby pile supported crossing that would be built to accommodate these relocations. The estimated cost of these relocations is $12,000.

Cost Estimates

The estimated implementation cost of Bayou Chinchuba - Alternative 2 is $3,300,000. An breakdown of this cost is shown in Table 13. The estimated maintenance cost of this project is $21,000. Maintenance would include annual spraying of the channel banks with herbicide and clearing and snagging of the channel as needed. The annual cost of this plan is estimated at $293,000.

Real Estate Requirements

Clearing and snagging of Bayou Chinchuba requires a temporary work area easement over about 8 acres. This area is undeveloped woodlands with potential to be developed into residential lots. Approximately 5 owners would be affected by the project. The estimated real estate cost of this plan is $41,000.

TABLE 13
COST ESTIMATE FOR BAYOU CHINCHUBA
ALTERNATIVE 2
(MAY 1996 PRICE LEVELS)

ITEM	FACTOR (%)	UNIT COST ($)	COST ($)
FIRST COST			
Mobilization and Demobilization		80,000	80,000
Clearing and Snagging		215,000	215,000
Widening Causeway Bridges (4)		630,000	2,016,000
SUBTOTAL			2,311,000
Contingencies	25		578,000
Engineering and Design	6		173,000
Supervision and Administration	8		231,000
SUBTOTAL			3,293,000
Real Estate		41,000	41,000
Relocations-Utilities		12,000	12,000
TOTAL FIRST COST			**3,346,000**
		ROUNDED	**3,300,000**
AVERAGE ANNUAL COSTS (50-Year Project Life, 7-5/8 % Interest Rate)			
OPERATION AND MAINTENANCE COST			
Channel Maintenance 3.3 Miles @ $6,500 per Mile			21,450
		(ROUNDED)	21,000
INTEREST AND AMORTIZATION COST			
Total First Cost			3,346,000
interest During Construction			128,000
Gross Investment Cost			3,474,000
Interest and Amortization Factor			X .07824
TOTAL ANNUAL COST			272,000
TOTAL ANNUAL COST			**293,000**

Economic Analysis

The analysis of this plan was performed using the SID-EAD program developed by the U. S. Army Corps of Engineers Hydrologic Engineering Center. The structure inventory used was an existing database developed as part of the Tangipahoa, Tchefuncte, and Tickfaw Rivers, Louisiana, reconnaissance study. Damages were computed using depth-damage curves developed for analyses of the Lake Pontchartrain and Vicinity Hurricane Protection Project. Benefits were calculated using stagefrequency curves that were developed as part of the engineering analysis of this alternative. It was also assumed that each household owned one automobile that would be located adjacent to the structure at an elevation of 1.5 feet below the structure.

Benefits Estimates. Benefit categories were limited to inundation reduction benefits for existing structures and automobiles only. No benefits were computed for inundation reduction on future construction or for other benefit categories such as Flood Insurance Administration cost reductions, emergency benefits, or fill cost reductions.

Estimates of average annual with- and without-project damages were computed using updated hydrologic data and the structure inventory gathered for the prior study; the inventory was updated using Marshall and Swift construction cost indexes. (Prices were updated to the September 1995 price levels.)

New hydrologic data were used for this study since, as discussed earlier in this report, replacement of a bridge over Bayou Chinchuba is expected to increase flood risk in the area. The without-project elevation-frequency data used for this analysis does account for the bridge raising, and consequently, computed future without-project expected annual damages are higher than would be expected considering previous flood experience in the area.

Residential construction taking place subsequent to the first quarter of 1991, when the structure inventory was compiled, was not included in this analysis. However, it is unlikely that inundation reduction benefits are understated to any significant degree, as the new construction is required by FEMA regulations to have taken place above the 0.01 (100-year) annual probability flood level. Hydrologic and hydraulic studies determined that the implementation of this alternative plan would not significantly lower stages for flood events greater than that with a 0.01 (100-year) annual probability recurrence interval.

Average annual benefits for the clearing and snagging plan are $467,000, or approximately $6,000,000 in present value terms. Sixty percent of the benefits come from inundation reduction to residential structures; 34 percent come from reduction of damages to residential contents, and 6 percent are reductions in vehicle damages. A summary of the benefits associated with this plan is presented in Table 14. The majority of damages and benefits are in the Golden Glen Subdivision. Twenty-two percent of existing average annual flood damages would be prevented by the implementation of this alternative. A summary of the economic analysis is presented in Table 15. As shown in this table, Bayou Chinchuba - Alternative 2 is economically justified with a benefit-cost ratio of 1.6.

TABLE 14
SUMMARY OF AVERAGE ANNUAL DAMAGES AND BENEFITS
BAYOU CHINCHUBA - ALTERNATIVE 2

Commercial Damages	$ 0
Residential Damages	1,654,000
Automobile Damages	144,000
Total Damages Without-Project	$ 1,798,000
Damages With-Project	1,331,000
Total Average Annual Benefits	$ 467,000

TABLE 15
SUMMARY OF ECONOMIC ANALYSIS
BAYOU CHINCHUBA - ALTERNATIVE 2

Average Annual Costs	$ 293,000
Average Annual Benefits	$ 467,000
Net Annual Benefits	$ 174,000
Benefit-Cost Ratio	1.6

Plan Implementation Responsibilities

All of the costs for Bayou Chinchuba - Alternative 2 are apportioned to structural flood control. The Federal government is responsible for the design and construction of the proposed project and would pay up to 75 percent of the total project cost. The non-Federal sponsor must provide all of the lands, easements, and rights-of-way and relocations of utilities required to construct the project and a minimum cash contribution of 5 percent of the total project cost. For structural flood control plans, the minimum non-Federal share is 25 percent of the project cost, and the maximum is 50 percent of the project cost. The non-Federal sponsor is responsible for all operation and maintenance costs for flood control projects. The apportionment of the first cost for Bayou Chinchuba - Alternative 2 between Federal and non-Federal interests is presented in Table 16.

TABLE 16
APPORTIONMENT OF FIRST COSTS
BAYOU CHINCHUBA - ALTERNATIVE 2

	Federal	Non-Federal	Total
Construction Cost	$2,475,000	$772,000	$3,247,000
LEERD's[1]	0	53,000	53,000
TOTAL	$2,475,000	$825,000	$3,300,000

[1]LEERD's are lands, easements, rights-of-way, and relocations of utilities

Environmental Analysis

An environmental analysis was performed for the clearing and snagging alternative for Bayou Chinchuba. The impacts on various environmental attributes follow.

Biological Resources. The clearing and snagging alternative developed for this area would result in impacts primarily to the mixed/pine hardwood, bottomland hardwood, and swamp communities. The community that would be affected most on the west side of North Causeway Boulevard (North Causeway) is swamp and bottomland hardwoods. The bayou in part of this area is poorly defined, as flows move through the swamp. The communities on the east side of North Causeway that would be affected are mixed pine/hardwood and bottomland hardwoods. The swamp and bottomland hardwood areas are reduced in width within approximately 500 feet upstream of North Causeway. Developed lands extend completely to the bayou in the Golden Glen subdivision, so habitat value is low in this area. The effects of clearing and snagging would include an actual change of the bayou by removal of any downed trees, some live standing trees, branches, accumulated leaf packs, and debris to increase conveyance capabilities. Any clearing and snagging of this material would result in a reduction of in-stream habitat diversity. The effects of clearing and snagging of the bayou on the east side of North Causeway to the Greenleaves area would depend upon the habitat adjacent to the channel. The channel in the lower portion up to the previously mentioned area goes through a widened flood plain swamp and bottomland hardwood area, and, beyond this area, the width of the natural stream flood plain in the upper area is reduced. This flood plain narrows quickly to about 100 feet in width, and, near U. S. Highway 190, the flood plain narrows to about 60 feet and may exist on only one side of the channel. Some wider areas occur upstream of this area.

Impacts to Cultural Resources. No comprehensive cultural resource survey has taken place along Bayou Chinchuba. Amateur and professional archaeologists working in the vicinity of the bayou have recorded 10 cultural resource sites. Four of these sites, 16ST25, 16ST70, 16ST91 and 16ST132 are located immediately adjacent to the project area at the point where Bayou Chinchuba crosses North Causeway Boulevard. None of these prehistoric sites are listed on the National Register of Historic Places and all have most likely been destroyed by recent commercial development and highway construction. The clearing and snagging of Bayou Chinchuba will not affect cultural resources as long as stumps are not removed and the banks of the bayou are not disturbed. If stumps and/or bank contouring is part of the clearing and snagging process, a comprehensive cultural resource survey of the bayou would be required.

HTRW Assessment. Bayou Chinchuba runs through primarily residential areas. Commercial/industrial development occurs around the junction of the bayou with North Causeway Boulevard, northwest of Lewisburg on the west bank of the bayou, and at the upper northeast limits of the bayou along the west side of Louisiana Highway 59. (See Plate 4). Several automotive service stations are located in the vicinity of the bayou along North Causeway Boulevard. Time Saver #61 is one of these facilities. This site is several thousand feet south of the bayou and should have no affect on, or be affected by, any of the proposed plan. The city of Mandeville sewage treatment facility is located west of this site, along the west bank. It discharges directly into the bayou and may be considered a potential regulatory problem. A commercial/industrial area is located along Highway 59 at the upper end of the drainage area. Small and large businesses associated with construction contractors, building supplies, and heavy equipment occur along both sides of the highway. Many are generators of potential contaminants. A comprehensive regulatory file search and visual inspection of these businesses would be conducted during the feasibility study. A business that manufactures cultured marble for countertops and similar products, which is considered to be of some significance, is in the Chinchuba watershed.

Water Quality Impacts. The initial clearing of the land for site preparation and development of access routes will lead to an immediate increase in runoff and erosion. Thus, the problems associated with turbidity will appear almost at the time construction commences. Reduced stream bank cover due to clearing and snagging helps to further elevate the increased runoff and erosion problem. The effects of increased turbidity on a stream can affect the water quality in several ways. The shading effect of suspended sedimentary particles decreases the light penetration and interferes with the photosynthetic production of oxygen. At the same time these particles absorb solar energy from the sunlight and transform this energy into heat; thus, temperatures of the bayou are elevated. Due to this, oxygen levels could be temporarily decreased. Environmental protection practices normally implemented at construction sites can be effective in reducing the gross erosion and soil loss that can cause shoaling and elevated levels of suspended solids at some relatively short distance downstream of the project site.

Clearing, snagging, and dredging disturb the bottom sediment of a stream. The primary effects are the creation of deep holes or linear channels and the temporary suspension of large clouds of sedimentary particles. The nature of pollution caused by disturbing the bottom sediment is in a large measure dependent on the material being disturbed. If there is a large amount of organic matter (trees, roots, shrubs, etc.) in the channel or on its banks, decomposition products of this matter may be present. Also, most of the sediments removed or disturbed are from the deep unoxidized layer of soil and are thus in a chemically reduced state. Such materials have very high chemical and biological oxygen demands.

While these adverse impacts are temporary in nature and will diminish soon after the completion of the project, the permanent loss of stream bank cover due the clearing and snagging will likely result in a long-term increase in stream temperature.

These higher water temperatures could result in lower dissolved oxygen levels during low flow conditions. No significant differences in nutrient and contaminant fecal levels are expected because these levels are mainly related to types of land use and their distribution within the drainage basin. Generally, channel clearing and snagging facilitates water flow and flushing, especially at times of moderate to high flows. As a result of the increased assimilative capacity of the stream, the water quality with respect to many parameters, and particularly dissolved oxygen content, may increase after the channel modification.

Summary of Analyses

Bayou Chinchuba-Alternative 2 would provide for clearing and snagging Bayou Chinchuba and widening the opening under North Causeway Boulevard and West Causeway Approach. The plan was found to be economically justified, under Federal criteria, and environmentally acceptable. The first cost is estimated at $3,300,000, average annual costs are $283,000, and average annual benefits are $467,000. The benefit-cost ratio is 1.6.

ABITA SPRINGS PLAN

This plan would provide for the raising of 45 structures along the Abita River in the Abita Springs area. The areas of Abita Springs located within the 10-year overflow area of the Abita River and its north and south tributaries were surveyed for this analysis. There were 60 single-family residences, 1 mobile home, and 11 commercial structures identified within the overflow area. Many of the homes surveyed were below the 100-year flood elevation. Current policy prohibits inclusion of benefits for preventing flooding to homes built below the 100-year flood level in areas where the local government participates in the Federal Emergency Management Agency flood insurance program. However, the majority of homes in the area appear to be greater than 20 years old, would predate parish participation in the program, and would be exempted from this rule. A summary of the economic analysis for the structure raising plan is presented in Table 17.

TABLE 17
SUMMARY OF ECONOMIC ANALYSIS
ABITA SPRINGS AREA PLAN

Number of Structures Evaluated	45
First Costs	$1,472,000
Cost Per Structure	$ 33,000
Annual Costs	$ 115,000
Annual Benefits	$ 227,000
Net Benefits	$ 112,000
Benefit-Cost Ratio	2.0

Plan Implementation Responsibilities

All of the costs for the Abita Springs Area Plan are apportioned to non-structural flood control. The Federal government is responsible for the design and construction of the proposed project and would pay 75 percent of the total project cost. The non-Federal sponsor must provide 25 percent of the total project cost and must provide all of the lands, easements, and rights-of-way and relocations of utilities required to construct the project. For non-structural flood control plans, the non-Federal share cannot exceed 25 percent of the project cost, even if the total cost of lands, easements, and rights-of-way and relocations of utilities exceeds 25 percent of the total project cost. There is no operation and maintenance costs for the plan. The apportionment of the first cost for the Abita Springs Area Plan between Federal and non-Federal interests is presented in Table 18.

TABLE 18
APPORTIONMENT OF FIRST COST
ABITA SPRINGS AREA PLAN

	Federal	Non-Federal	Total
Construction Cost	$1,104,000	$368,000	$1,472000
LEERD's[1]	0	0	0
TOTAL	$1,104,000	$368,000	$1,472,000

[1]LEERD's are lands, easements, rights-of-way, and relocations of utilities

Impacts to Cultural Resources. This proposed project will involve the raising of approximately 45 homes within the town limits of Abita Springs. Many of these homes fall within the boundaries of the Abita Springs National Register District, which is bounded by Louisiana Highways 435, 59, and 36. Historic homes and structures (over 50 years old) affected by this alternative will have to be recorded and evaluated to determine the positive and/or negative affect of the proposed structural raising. This effort would be coordinated with the Louisiana State Historic Preservation Officer and their staff architectural historian.

Summary of Analyses

The Abita Springs Area plan would provide for raising approximately 345 structures along the Abita River in the Abita Springs Area to reduce flood damages. The plan was found to be economically justified, under Federal criteria, and environmentally acceptable. The first cost is estimated at $1,472,000, average annual costs are $115,000, and average annual benefits are $227,000. The benefit-cost ratio is 2.0.

LACOMBE AREA PLAN

This plan provides for the raising of 84 structures subject to frequent flooding in the area generally south of U. S. Highway 190 and west of Bayou Lacombe. A survey was conducted in May 1996 to identify every structure at risk in the study area. There were 425 single-family residences and 82 mobile homes, and 24 commercial structures that were surveyed. The raising of 84 structures was found to be economically justified, under Federal criteria.

Economic Analysis. The summary of economic analysis of structure raising presented in Table 19 indicates that a plan for raising 84 houses in the Lacombe area would be economically justified, under Federal criteria.

TABLE 19
SUMMARY OF ECONOMIC ANALYSIS
LACOMBE AREA PLAN

Number of Structures Evaluated	84
First Costs	$2,000,000
Cost Per Structure	$ 24,000
Annual Costs	$ 158,000
Annual Benefits	$ 392,000
Net Benefits	$ 234,000
Benefit-Cost Ratio	2.5

Plan Implementation Responsibilities

All of the cost for the Lacombe Area Plan are apportioned to non-structural flood control. The Federal government is responsible for the design and construction of the proposed project and would pay 75 percent of the total project cost. The non-Federal sponsor must provide 25 percent of the total project cost and must provide all of the lands, easements, and rights-of-way and relocations of utilities required to construct the project. For non-structural flood control plans, the non-Federal share cannot exceed 25 percent of the project cost, even if the total cost of lands, easements, and rights-of-way and relocations of utilities exceeds 25 percent of the total project cost. The non-Federal sponsor is responsible for all operation and maintenance costs for flood control projects. The apportionment of the first cost for the

Lacombe Area Plan between Federal and non-Federal interests is presented in Table 20.

TABLE 20
APPORTIONMENT OF FIRST COSTS
LACOMBE AREA PLAN

	Federal	Non-Federal	Total
Construction Cost	$1,500,000	$500,000	$2,000,000
LEERD's[1]	0	0	0
TOTAL	$1,500,000	$500,000	$2,000,000

[1]LEERD's are lands, easements, rights-of-way, and relocations of utilities

<u>Impacts to Cultural Resources.</u> The structural raising of homes and structures in the Lacombe area will affect a small number of historic buildings. Historic homes and structures (over 50 years old) affected by this plan would have to be recorded and evaluated to determine the positive and/or negative affect of the proposed structural raising. This effort would be coordinated with the Louisiana State Historic Preservation Officer and their staff architectural historian.

Summary of Analyses

The Lacombe Area plan would provide for raising approximately 84 structures in the Lacombe area to reduce flood damages. The plan was found to be economically justified, under Federal criteria, and environmentally acceptable. The first cost is estimated at $2,000,000, average annual costs are $158,000, and average annual benefits are $392,000. The benefit-cost ratio is 2.5.

SLIDELL AREA PLAN

This plan, shown on Plate 6, includes features in three basins in the Slidell area: the W-13, W-14, and W-15 Canals Basins. Features of the plan are presented below, by basin.

W-13 Canal (Bayou Vincent)

<u>Channel Enlargement.</u> During the analysis of the W-13 Canal basin, it was determined that channel enlargement would be the best method to address the flooding which occurs on the W-13 Canal. The channel enlargement would extend from the south side of Interstate Highway 12 to just downstream of the West Hall Avenue Bridge. The proposed channel would have a 40-foot bottom width. This channel would also be deepened in some locations to provide a consistent invert slope.

Bridge Replacement. The bridge over the W-13 Canal at West Hall Avenue causes significant head losses. The current bridge has an opening 44 feet wide, with a low chord elevation of 9.0 feet NGVD. This bridge would be replaced with a new bridge which would be 116 feet wide with a low chord elevation of 10.0 feet NGVD.

Relocations. As a result of the bridge replacement proposed for this basin, a 4-inch diameter gas line and an 8-inch diameter water line will have to be removed from the existing bridge supports and relocated. A power line which supports telephone and cable will also have to be relocated. The cost of relocations for this basin is estimated to be $13,000.

W-14 Canal Basin

Detention Ponds. Two detention ponds, developed by the City of Slidell in accordance with plans developed by their consulting engineers, are included in this plan. The first detention pond is located west of U. S. Highway 11 near North Boulevard. The second pond is located upstream of the intersection of Robert Road and the W-14 Canal.

The detention pond on Highway 11 near North Boulevard will provide a storage area of 67 acre-feet over an area of approximately 13.4 acres. The inlet to this pond will be controlled by a 50-foot long rectangular weir with a crest elevation of 12.5 feet NGVD. An outlet culvert with a flap gate will be provided to draw down the detention pond after flood flows have subsided. Enlargement of the West Diversion Canal is also required to convey water to and from this detention pond. Additional culverts under Highway 11 will be required.

The second detention pond will be located on the south bank of the W-14 canal, just upstream from Robert Road. This pond will have a capacity of 125 acre-feet on a 25 acre site. The inlet weir to this detention pond will be a 100-foot long rectangular weir with a crest elevation of 12.5-feet NGVD. An outlet culvert with a flap gate will be provided to draw down the detention pond after flood flows have subsided.

Channel Modification. The W-14 Canal basin was analyzed using HEC-1 and HEC-RAS. New hydraulic models of this basin were constructed using existing information. These analyses indicated that the W-14 Canal needs to be cleared and snagged from Interstate Highway 12 downstream to Interstate Highway 10. The detention ponds previously discussed were also included in this plan. Channel enlargement would be required in the reach of W-14 Canal between Independence Avenue and Fremaux Avenue. The existing channel would be widened to a 40foot bottom width.

W-15 Lateral Canal Structure. A water control structure would be constructed in the W-15 Lateral Canal, a bi-directional canal which connects the W-14 Canal with the W-15 Canal, to allow water to flow from the W-14 Canal to the W-15 Canal, but not from the W-15 Canal into the W-14 Canal.

Bridge Replacement. The bridge over the W-14 Canal at Florida Avenue would require replacement due to its restrictive opening. The current bridge has a 56-foot wide opening. The replacement bridge would have an 80-foot wide opening.

Relocations. Numerous relocations for this basin are required in the area of the proposed channel modifications and bridge replacement. Among the utilities being relocated are power lines, telephone lines, and television cables. Similar utilities, including a 24-inch diameter steel waterline and 4-inch diameter gas pipeline, will have to be replaced at the site of the Florida Avenue Bridge. The estimated cost of the relocations in this basin is $51,000.

W-15 Canal Basin (French Branch)

The W-15 Canal drains the eastern portion of Slidell between the W-14 Canal Basin and the West Pearl River. This canal is connected to the W-14 Canal by the W-15 Lateral Canal. The Poor Boy Canal connects the W-15 Canal with Gum Bayou, another canal to the east of the W-15 Canal. The only option developed under this alternative is to enlarge the Poor Boy Canal to a 25-foot bottom width channel and divert the all flood flows from the W-15 Canal down to Gum Bayou. This plan results in a lowering of stages downstream of the Poor Boy Canal even with the cut-off of the diversion from W-15 Canal to W-14 Canal.

Relocations. The only utility relocations required in this basin are at the location where Poor Boy Canal crosses Louisiana Highway 1090 (Military Road). Relocations are limited to one 4-inch diameter steel gas line attached to the existing bridge. This line must be relocated at an estimated cost of $10,000.

Hydraulic Design

There are numerous interconnections between basins, and several assumptions regarding flow distributions were made to allow for the modeling of these waterways using the HEC-1, HEC-2, and HEC-RAS models. These assumptions were based on observations made by New Orleans District personnel during post-May 1995 flood activities and during subsequent rainfall events. These assumptions would require verification in the feasibility phase to assure that they are correct and that the hydraulic analysis is representative of existing and with-project conditions.

Cost Estimates

The estimated implementation cost for the Slidell Area plan is $21,200,000 This cost includes the costs for flood control improvements in all three basins. Table 21 is a summary of the estimates of the first and average annual costs for this plan. Operation and maintenance costs include annual spraying of the channel banks with herbicides and clearing and snagging of the channels as needed and the operation and maintenance costs of the detention pond structures and W-15 Lateral Canal structure.

Real Estate Requirements

The Slidell Area Plan provides for the clearing and snagging and enlargement of four channels. The easements to be acquired are Drainage Ditch, Clearing and Snagging, temporary Work Area, and Detention Pond. Construction of the project will affect about 7.35 acres of residential land and about 89 acres of potential residential land. The project will impact approximately 231 owners, 19 of those will be eligible to receive Public Law. 91-646, title II benefits since their residences/businesses will be acquired. Some of those tracts will receive severance damage payments as well. The total real estate cost for this plan is $6,302,000.

Economic Analysis

The economic analysis for the Slidell Area plan required the development of designs and cost estimates for the proposed plan, the identification of categories of possible flood control benefits, the determination of with- and without-project damages and costs incurred to determine benefits, and a comparison of average annual benefits and costs to determine economic feasibility. The basic parameters of this analysis included May 1996 price levels, a discount rate of 7-5/8 percent, and a 50-year project life.

The basic economic evaluation in the Slidell project area included the comparison of the urban flood damage setting for "without-project" and "with-project" conditions. Without-project conditions, or existing conditions, reflect conditions expected to prevail in the absence of any proposed plan. With-project conditions reflect conditions in the project area with a proposed flood control plan.

Damages for this plan were calculated in the same manner as was described for Bayou Chinchuba - Alternative 2. Since there was no existing database of structures in the Slidell area, one was compiled by taking a complete inventory of structures. Elevations for these structures were approximated by hand-leveling. Topographic maps prepared as part of the Lake Pontchartrain and Vicinity Project were used to obtain base elevations from which structure elevations were computed.

TABLE 21
COST ESTIMATE
SLIDELL AREA PLAN
(MAY 1996 PRICE LEVELS)

ITEM	FACTOR (%)	QUAN-TITY	UNITS	UNIT COSTS	COST ($)
FIRST COSTS					
West Hall Street Bridge		1	Each	400,000	400,000
W-13 Channel Enlargement		1	Each	1,340,000	1,340,000
North Blvd Detention Weir		1	Each	150,000	150,000
North Blvd Detention Pond		1	Each	1,000,000	1,000,000
Robert Road Detention Weir		1	Each	110,000	110,000
Robert Road Detention Pond		1	Each	1,700,000	1,700,000
W-14 Canal Modifications			1	Each	1,893,000
W-15 Lateral Canal Structure		1	Each	500,000	500,000
Florida Avenue Bridge		1	Each	300,000	300,000
Poor Boy Canal Diversion		1	Each	943,000	943,000
LA Hwy 1091 Culvert		1	Each	563,000	563,000
Interstate 59 Culvert		1	Each	1,000,000	1,000,000
LA Hwy 1090 Culvert		1	Each	563,000	563,000
SUBTOTAL					10,462,000
Contingencies	25				2,541,000
Supervision and Administration	8				1,041,000
Engineering and Design	6				780,000
SUBTOTAL					14,824,000
Real Estate					6,302,000
Relocations-Utilities					74,000
TOTAL FIRST COST					**21,200,000**
AVERAGE ANNUAL COSTS (Year Project Life, 7-5/8 % Interest Rate)					
OPERATION AND MAINTENANCE COST					
Channel Maintenance 9.4 Miles@$6,500/Mile					61,000
Structures Operation and Maintenance					5,000
AVERAGE ANNUAL OPERATION AND MAINTENANCE COST					66,000
INTEREST AND AMORTIZATION COST					
Total First Cost					21,200,000
Interest During Construction					800,000
Gross Investment Cost					22,000,000
Interest and Amortization Factor					X .07824
AVERAGE ANNUAL IMPLEMENTATION COST					1,721,000
TOTAL AVERAGE ANNUAL COST					**1,787,000**

The Marshall and Swift computer program was used to estimate the value of the structures in the study area. This program is used to estimate the value of a structure based upon the materials from which it is constructed, the construction type, the square footage, and the zip code.

This structure inventory was input in to the URBAN computer program developed by the Vicksburg District. Based upon the structure elevations, structure values, automobile elevations, and the with- and without-project stage-frequency curves, estimates of annual with- and without-project damages and benefits were calculated. A summary of average annual benefits is presented in Table 22.

TABLE 22
SUMMARY OF AVERAGE ANNUAL BENEFITS
SLIDELL AREA PLAN

Structural	$3,445,000
Automobile	$ 121,000
Emergency Cost Reduction	$ 411,000
Total Average Annual Benefits	$3,977,000

Project justification is based on a potential project having a benefit-cost ratio greater than 1.0. As shown in Table 23, the Slidell Area plan is economically justified with a benefit-cost ratio of 2.5.

TABLE 23
SUMMARY OF ECONOMIC ANALYSIS
SLIDELL AREA PLAN
BENEFIT-COST ANALYSIS

Average Annual Cost	$1,787,000
Average Annual Benefits	$3,977,000
Net Average Annual Benefits	$2,190,000
Benefit-Cost Ratio	2.2

Plan Implementation Responsibilities

All of the costs for the Slidell Area plan are apportioned to structural flood control. The Federal government is responsible for the design and construction of the proposed project and would pay up to 75 percent of the total project cost. The non-Federal sponsor must provide all of the lands, easements, and rights-of-way and relocations of utilities required to construct the project and a minimum cash contribution of 5 percent of the total project cost. For structural flood control plans, the minimum non-Federal share is 25 percent of the project cost, and the maximum is 50 percent of the project cost. The non-Federal sponsor is responsible for all operation and maintenance costs for flood control projects. The apportionment of the first cost for the

Slidell Area Plan between Federal and non-Federal interests is presented in Table 24.

TABLE 24
APPORTIONMENT OF FIRST COSTS
SLIDELL AREA PLAN

	Federal	Non-Federal	Total
Construction Cost	$13,764,000	$1,060,000	$14,824,000
LEERD's[1]	0	$6,376,000	$ 6,376,000
TOTAL	$13,764,000	$7,436,000	$21,200,000

[1]LEERD's are lands, easements, rights-of-way, and relocations of utilities

Environmental Impacts

An environmental analysis was performed for the Slidell Area plan. The impacts on various environmental resources follow.

<u>Biological Resources.</u> The detention pond excavation alternatives developed for this area would result in impacts primarily to the mixed pine/hardwood, bottomland hardwood, and wooded swamp communities. The two detention ponds being considered for excavation, U. S. Highway 11 pond and Robert Road pond consist of approximately 12.1 and 18.3 acres, respectively. The excavation of those ponds would result in the creation of the floodwater retention areas. These areas are presently wooded with mixed pine/hardwoods and bottomland hardwoods. Portions of all of these areas are wetlands. Numerous wetland determinations relative to Section 404 have been made in the Slidell area. These areas would be changed from wooded non-wetlands and wetlands that become almost dry seasonally to wetlands that would quite likely be permanently wet. All existing habitats would be converted to essentially wetland habitats by excavation of the detention ponds. The wooded habitat lost by the excavation of the railroad site is higher quality than the other sites. If excavation is completed to approximately the level of the adjacent drainage canal, then wetland plants will likely slowly become established in the ponds. If excavation is completed to below that level, then the area would be open water throughout the year. If the latter scenario results, wetland plants would likely be established only at the pond edges.

The clearing and snagging, channel enlargement, and detention pond excavation alternatives developed for this area would result in impacts primarily to the mixed pine/hardwood, bottomland hardwood, and wooded swamp communities : Impacts to these streams are not considered to be significant since these streams are the recipients of large amounts of urban runoff. The water control structure at the west end of the lateral canal between W-14 Canal and W-15 Canal which would allow flows from W-14 Canal to W-15

Canal, but not W-15 Canal to W-14 Canal, would be of no significance to biological resources considering the discharge of waters during storm events through both affected channels. Since several tributary streams as well as the major channels would be modified by clearing and snagging or channel enlargement, the impacts would be significant from the extensiveness standpoint, but not from a quality standpoint. These channels provide little in the way of habitat due to the poor quality of source waters and their minimal flows except during flood periods.

Impacts to Cultural Resources. Approximately one-half of the project area has a high potential for the presence of significant cultural resource sites. Heartfield, Price, and Greene Inc. conducted a limited cultural resource survey investigation across the extreme eastern portions of the project area. As a result, six cultural resource sites were located. Three of the sites, two historic and one prehistoric, are located close to the current project area along Doubloon Branch Bayou. The two historic sites (16ST109 and 16ST114) are not eligible for nomination to the National Register of Historic Places, while the third site (16ST47), appears eligible. 16ST47 represents a prehistoric shell midden with intact cultural deposits. This site would need to be evaluated and tested to determine National Register eligibility and the impacts resulting from the proposed action. Additionally, a comprehensive cultural resource survey and testing investigation would be required for high probability areas.

HTRW Assessment. There are two NPL (Superfund) sites located on Bayou Bonfouca, downstream of the confluence with W-13 Canal. Stage increases resulting from enlargement of the W-13 Canal would be greater in the upper segment, just below West Hall Avenue, and would diminish with distance downstream. Stage increases would occur at both sites. Any effects of these stage increases upon either or both of these sites would be determined upon consultation with the Environmental Protection Agency.

Although the source of urban runoff in all three basins is primarily residential areas from which little HTRW concern would be expected, some commercial development does exist. Many contaminate generators (some HTRW generators) can be anticipated throughout the project area. A more detailed examination of RCRA files would be conducted during the feasibility study when more specific project information has been determined and inspection of potential HTRW sites is practical.

Water Quality Impacts. The construction of the Slidell Area plan would result in short-term deviations of some water quality parameters as a result of project implementation similar to those discussed for the Bayou Chinchuba-Alternative 2. Disturbances or displacement of soil and vegetative cover generally cause only temporary and localized increases in the potential for erosion or production of other pollutants. Water quality conditions are expected to return to pre-project conditions or in some cases improved conditions soon after project implementation.

Summary of Analyses

The Slidell Area Plan would provide for modifications in the W-13 Canal basin (Bayou Vincent) and in the W-14 and W-15 Canal basins to reduce flood stages. The plan was found to be economically justified, under Federal criteria, and environmentally acceptable. The first cost is estimated at $21,200,000, average annual costs are $1,787,000, and average annual benefits are $3,977,000. The benefit-cost ratio is 2.2.

SUMMARY OF PLAN FORMULATION

The St. Tammany Parish reconnaissance study has provided sufficient analysis to indicate the feasibility of several flood control plans intended to alleviate flood damages in several areas of St. Tammany Parish. In total, six plans were evaluated covering four areas. Two additional plans were developed, but were not fully evaluated since they were judged to be non-implementable. Five of the plans developed were determined to be economically justified and environmentally acceptable. These plans would be further developed in the feasibility phase to assure that the best plan for these areas are developed.

STUDY PARTICIPANTS AND COORDINATION

A Notice of Study Initiation for the St. Tammany Parish, Louisiana, reconnaissance study was distributed to Federal, State, and local agencies and interested parties in March of 1995. This notice contained information pertaining to the study and its processes. A questionnaire on information about flooding in St. Tammany Parish was also included as part of the public notice.

Close coordination was maintained with parish and municipal officials throughout the course of the study. Study alternatives were selected through coordination with these officials. The U. S. Fish and Wildlife service participated in the study. Their Planning Aid Letter is Appendix D of this report. Coordination with homeowners in the Slidell and Mandeville areas was also maintained.

IMPLEMENTATION REQUIREMENTS

FEASIBILITY STUDY REQUIREMENTS

The feasibility phase is cost shared equally between the Federal government and the non-Federal sponsor. At least 50 percent of a non-Federal sponsor's share (25 percent of the total feasibility phase cost) must be provided in cash; the remaining 50 percent may be contributed as in-kind services or products.

The estimated study costs for the feasibility phase are presented in the project study plan prepared during the reconnaissance phase. The cost estimates are supported by an overall scope of study and a detailed discussion of the separable tasks required to produce a feasibility report. A draft feasibility cost-sharing agreement would accompany the project study plan. The final feasibility cost-sharing agreement would define the feasibility cost sharing requirements and assign the tasks and associated dollar values for the non-Federal in-kind services.

PROJECT IMPLEMENTATION REQUIREMENTS

All plans recommended in the feasibility report would require non-Federal cost sharing for implementation. A Project Cooperation Agreement (PCA) defines the requirements in detail for the project.

Lands, easements, rights-of-way, relocations, and disposal areas (LERRD's) are the responsibility of the local sponsors. The cost of acquiring the required LERRD's is included in the total project cost and is creditable toward the sponsor's share of implementation costs.

The local cost sharing responsibilities for preconstruction, engineering, and design and the actual construction of a project are based on the extent of the LEERD'S. The minimum local contribution is 25 percent of the total project cost, and the maximum is 50 percent. A minimum cash contribution equal to 5 percent of the overall project cost is also required.

NON-FEDERAL SPONSORS

Potential local sponsors include the St. Tammany Parish Police Jury, the cities of Mandeville and Slidell, the town of Abita Springs, and the Louisiana Department of Transportation and Development. Funds for the pariticipation of the city of Slidell in a feasibility study were approved by voters in a recent bond election. Others have expressed interest in a feasibility study, contingent upon their share of the study cost.

CONCLUSIONS

The St. Tammany Parish, Louisiana, reconnaissance study has provided sufficient analysis to demonstrate the feasibility of several plans to alleviate flooding in St. Tammany Parish. Five plans were found to be economically justified and environmentally acceptable in four locations. Non-structural plans were found to be feasible in the Bayou Chinchuba Basin, the Abita Springs area, and the Lacombe area. Structural plans were found to be feasible in the Bayou Chinchuba Basin and in the Slidell area.

The St. Tammany Parish, Louisiana, reconnaissance study indicates that further studies are warranted, and that this study should proceed to the feasibility phase.

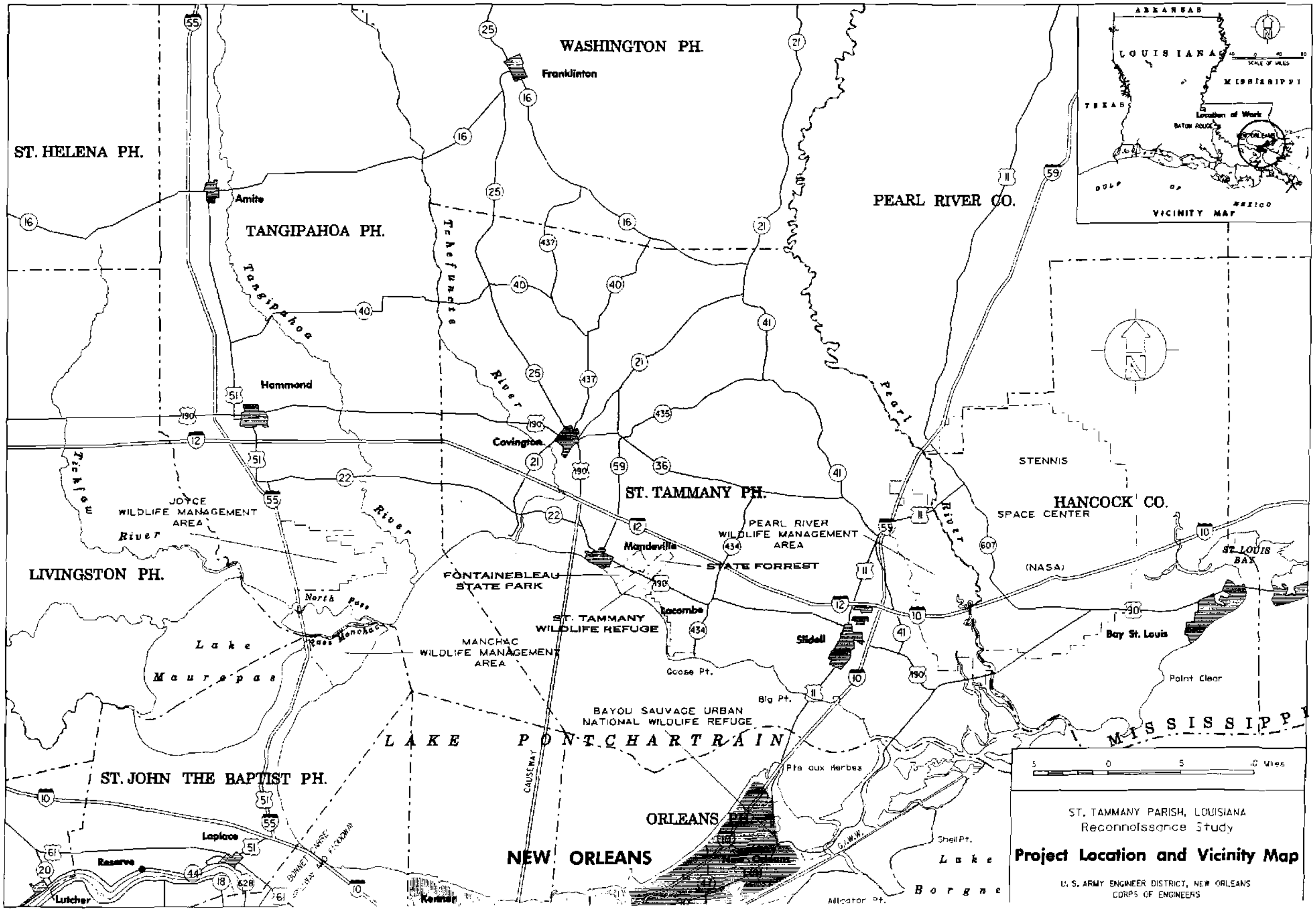
RECOMMENDATIONS

The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local or state programs or the formulation of a national Civil Works construction program. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, the potential sponsor and other interested agencies will be afforded an opportunity to comment further.

Based on the findings presented in this reconnaissance report, I recommend that the St. Tammany Parish, Louisiana, study proceed into the feasibility phase, contingent upon the availability of funds and the execution of a feasibility cost-sharing agreement with a non-Federal sponsor.

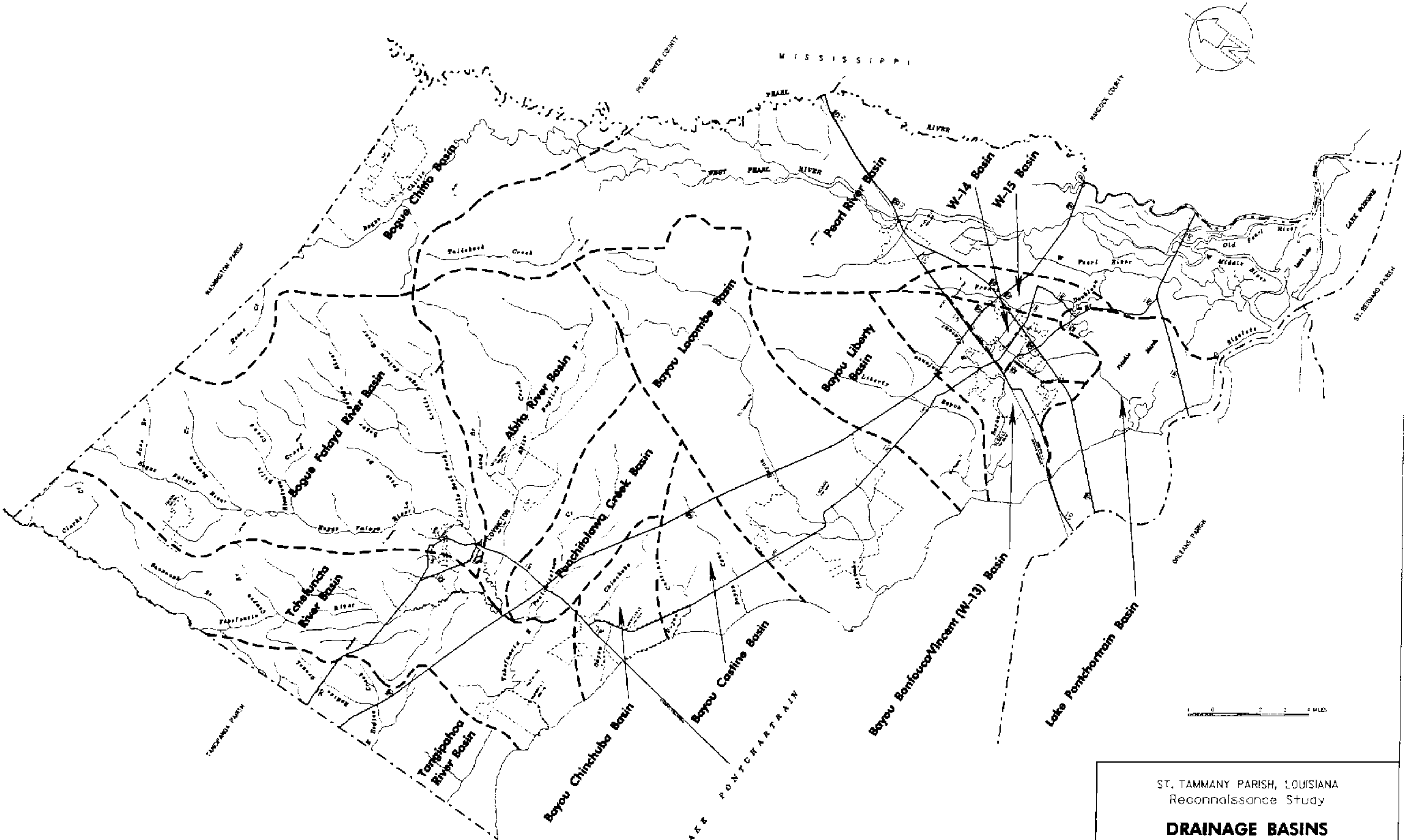
William L. Conner

William L. Conner
Colonel, U. S. Army
District Engineer



WASHINGTON PH.
Franklinton
ST. HELENA PH.
Amite
TANGIPAHOA PH.
PEARL RIVER CO.
Tangipahoa
Tchefuncte
River
Pearl
Hammond
Covington
STENNIS
SPACE CENTER
(NASA)
HANCOCK CO.
ST. TAMMANY PH.
JOYCE
WILDLIFE MANAGEMENT
AREA
Tickfaw
River
PEARL RIVER
WILDLIFE MANAGEMENT
AREA
Mandeville
STATE FORREST
LIVINGSTON PH.
FONTAINEBLEAU
STATE PARK
ST. TAMMANY
WILDLIFE REFUGE
Lacombe
Slidell
Bay St. Louis
ST LOUIS BAY
North Pass
Pass Manchac
Lake
Maurepas
MANCHAC
WILDLIFE MANAGEMENT
AREA
Goose Pt.
Point Clear
Big Pt.
BAYOU SAUVAGE URBAN
NATIONAL WILDLIFE REFUGE
LAKE PONTCHARTRAIN
MISSISSIPPI
CAUSEWAY
Pte aux Herbes
ST. JOHN THE BAPTIST PH.
ORLEANS PH.
NEW ORLEANS
Laplace
Reserve
Lutcher
Kenner
Shell Pt.
Lake Borgne
Alligator Pt.
G.I.W.W.
BONNET CARRE SPILLWAY AND FLOODWAY
ARKANSAS
LOUISIANA
MISSISSIPPI
TEXAS
Location of Work
BATON ROUGE
NEW ORLEANS
GULF OF MEXICO
VICINITY MAP
SCALE OF MILES
5 0 5 10 Miles
ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study
Project Location and Vicinity Map
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

Plate 1

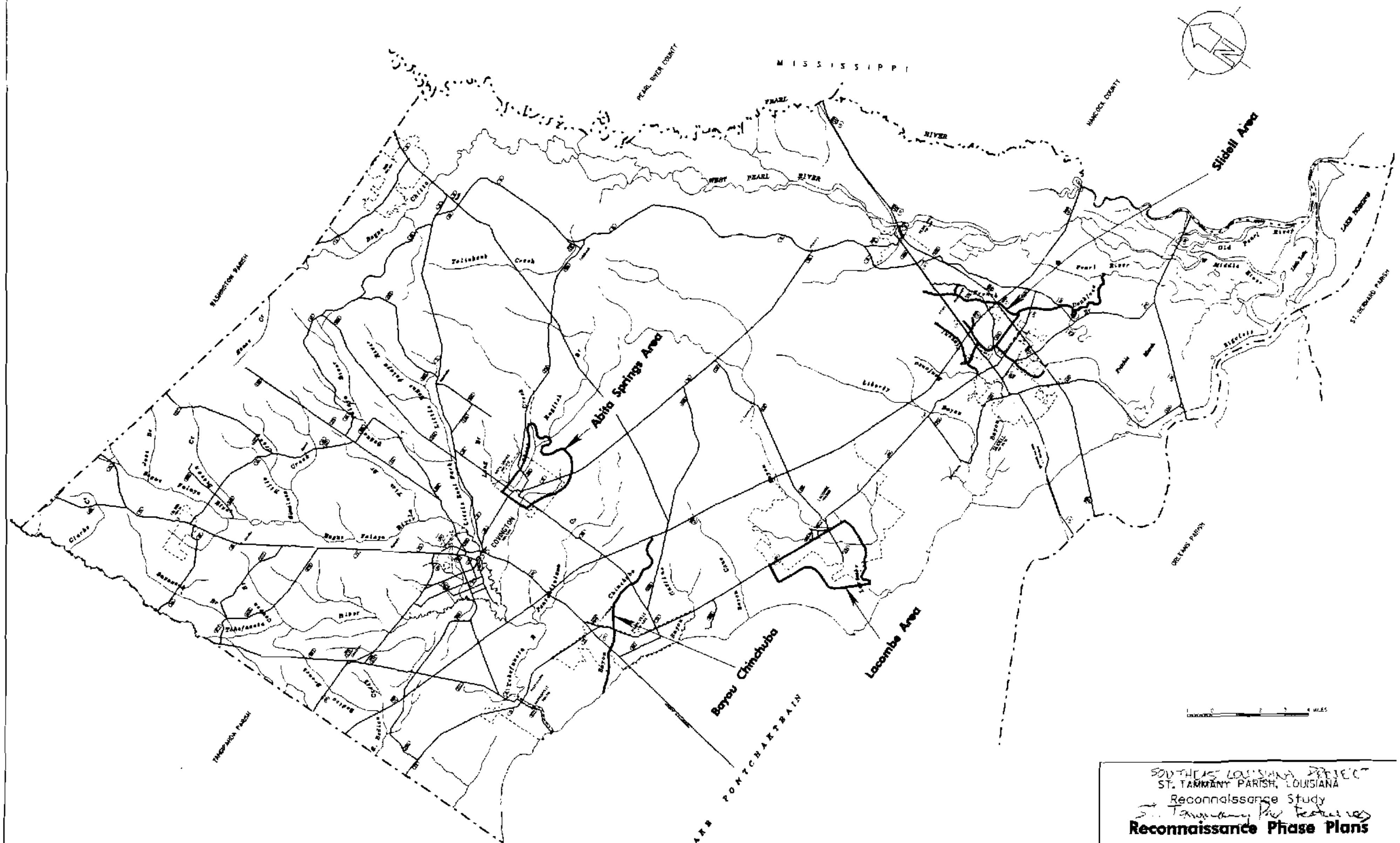


ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study

DRAINAGE BASINS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

Plate 2

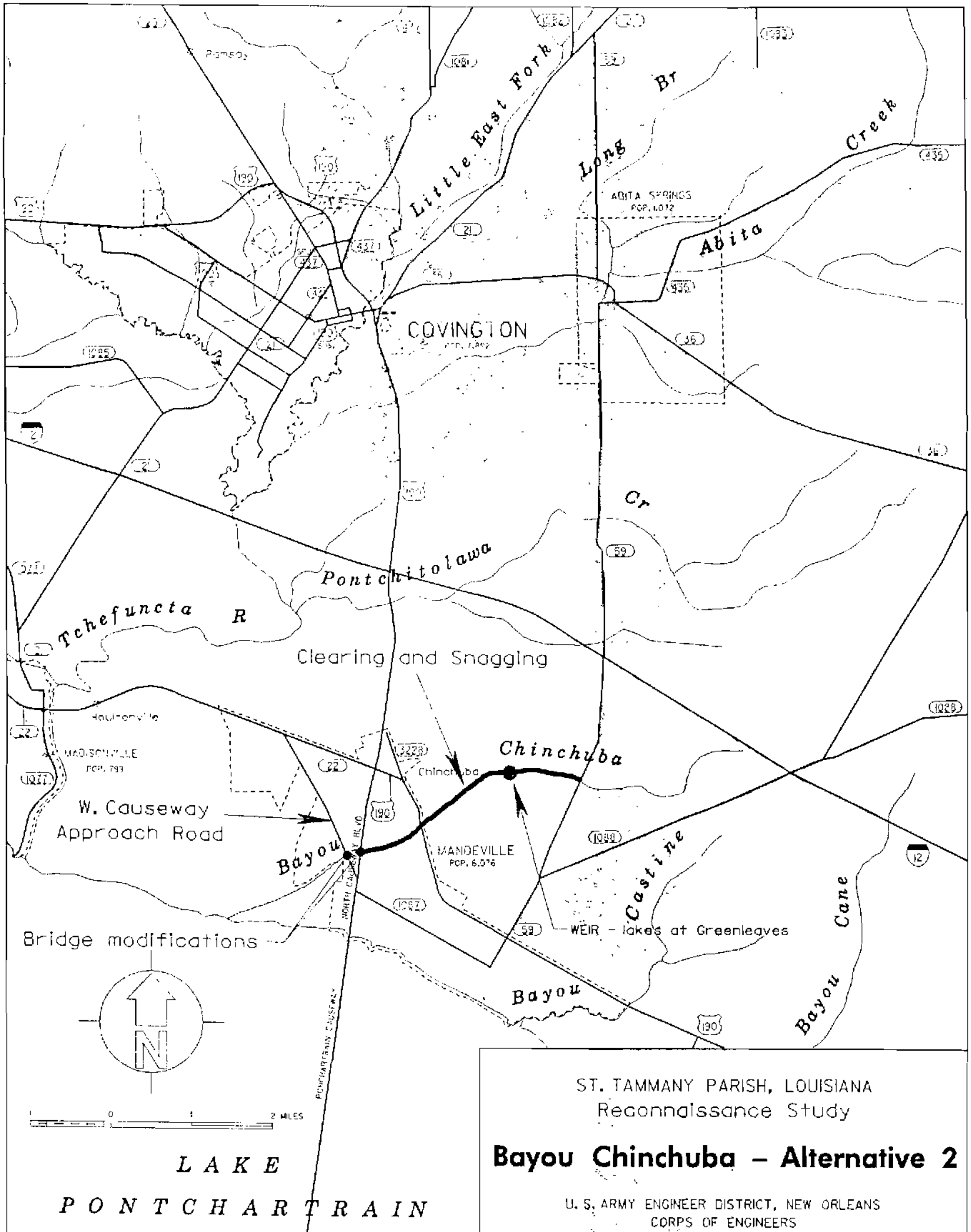


SOUTHEAST LOUISIANA PROJECT
ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study
St. Tammany Par. features
Reconnaissance Phase Plans

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

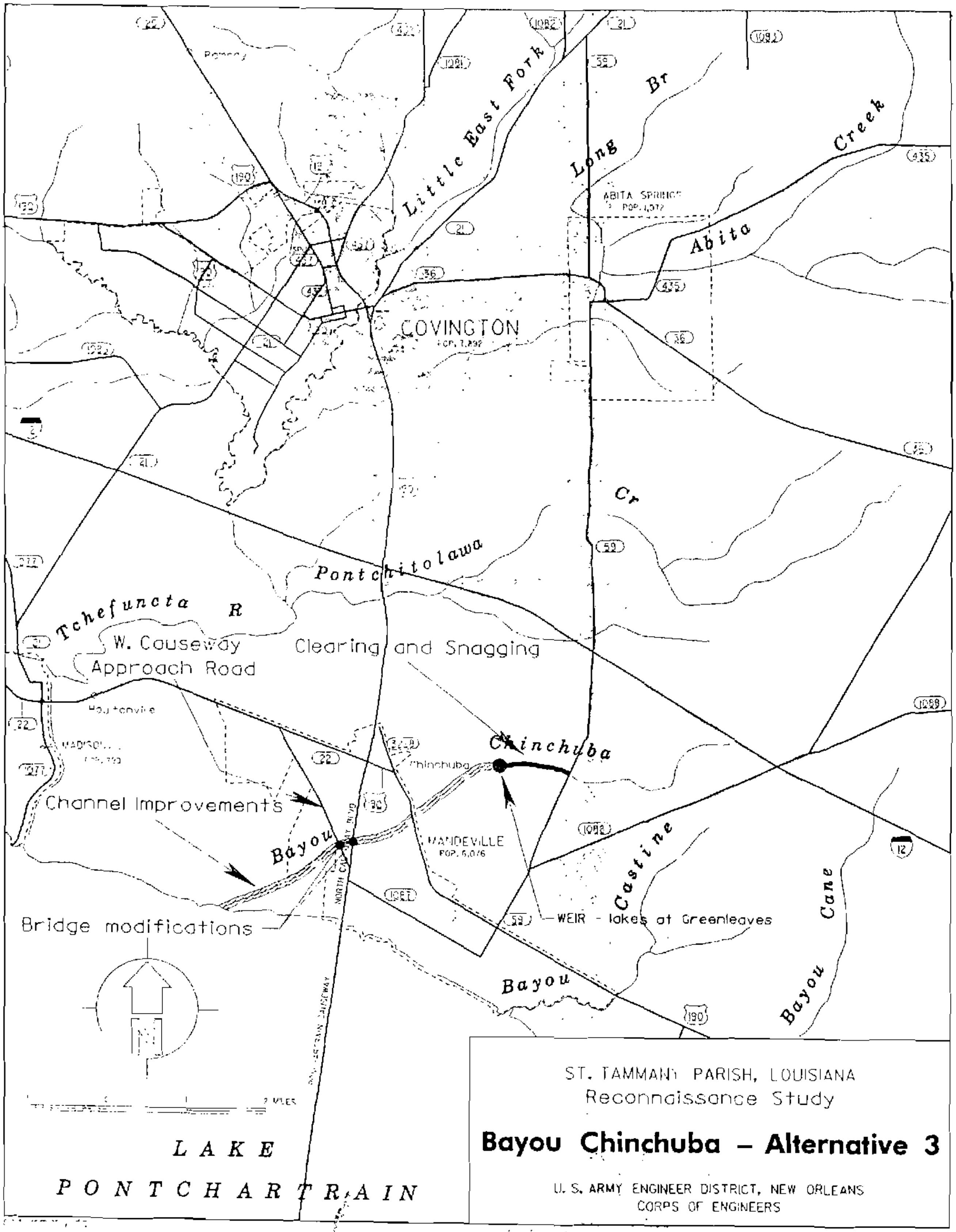
stlammany.dgn

Plate 3



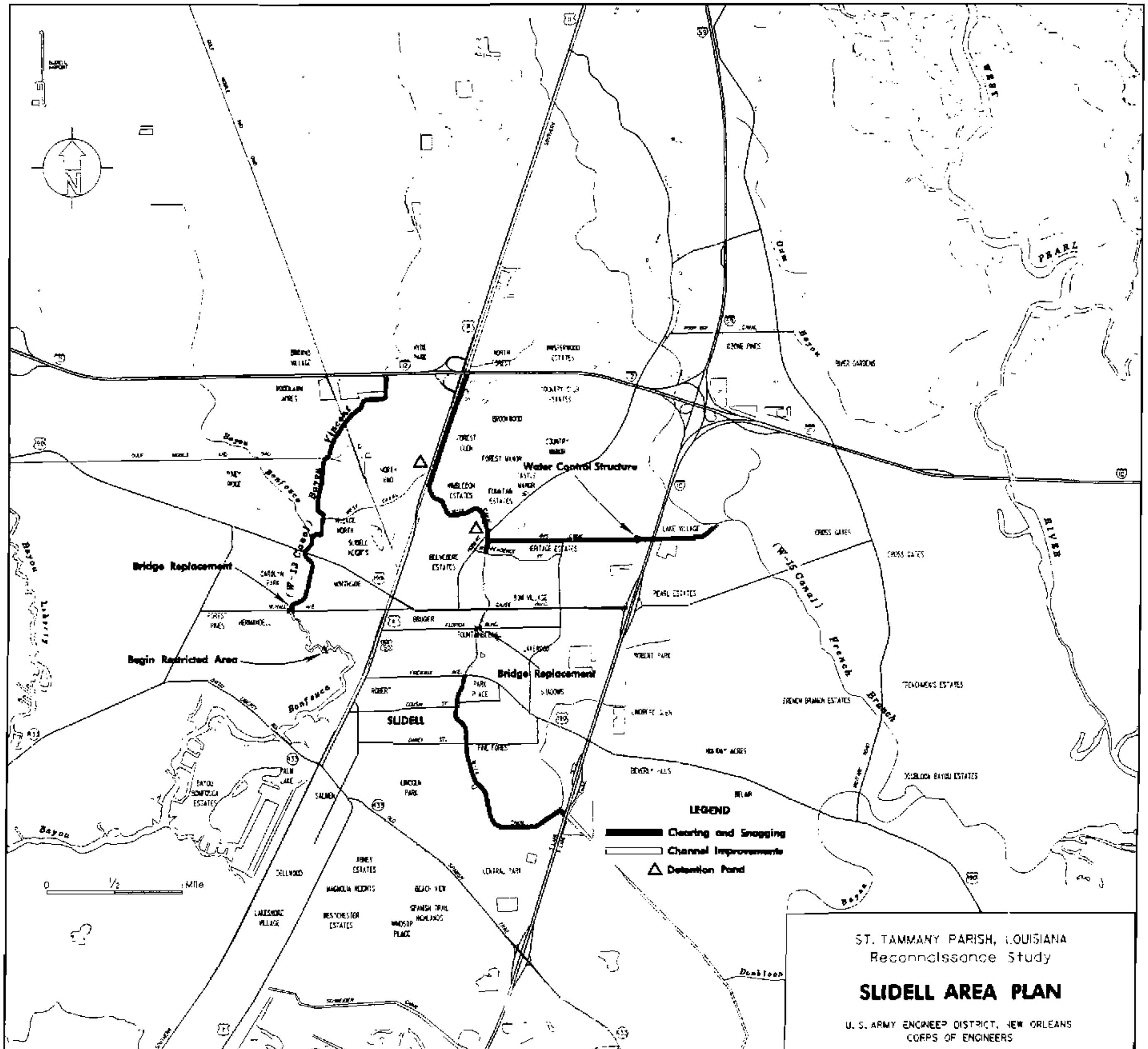
Little East Fork
Long Br
Abita Creek
ABITA SPRINGS
COVINGTON
Cr
Pontchitolawa
Tchefuncta R
Clearing and Snagging
Chinchuba
MADISONVILLE
POP. 793
W. Causeway
Approach Road
Bayou
MANDEVILLE
POP. 6,076
Castine
Bridge modifications
WEIR - lakes at Greenleaves
Cane
Bayou
Bayou
N
0
1
2 MILES
LAKE
PONTCHARTRAIN
ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study
Bayou Chinchuba - Alternative 2
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

Plate 4



Little East Fork
Long Br
Abita Creek
ABITA SPRINGS
COVINGTON
Cr
Pontchitolawa
Tchefuncta R
W. Causeway Approach Road
Clearing and Snagging
Chinchuba
Channel Improvements
Bayou
MANDEVILLE
Castine
WEIR - lakes at Greenleaves
Bayou Cane
Bridge modifications
Bayou
LAKE PONTCHARTRAIN
ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study
Bayou Chinchuba - Alternative 3
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

Plate 5



ST. TAMMANY PARISH, LOUISIANA
Reconnaissance Study

SLIDELL AREA PLAN

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

Plate 6

APPENDIX A

ENGINEERING APPENDIX

ST. TAMMANY PARISH
RECONNAISSANCE STUDY
APPENDIX A
ENGINEERING ANALYSIS
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CLIMATOLOGY

GENERAL

The climate of the area is humid subtropical, but is subject to polar influences during winter, as cold air masses periodically move southward over the area displacing warm moist air. Prevailing southerly winds create a strong maritime character. This movement from the Gulf of Mexico helps to decrease the range between hot and cold temperatures and provides a source of abundant moisture and rainfall.

TEMPERATURE

Records of temperatures are available from "Climatological Data" for Louisiana, published by the National Climatic Center. The study area can be described by using temperature normal data observed at Covington. The annual normal temperature for Covington based on the period 1961-1990 is 66.8 degrees Fahrenheit (°F) with monthly mean temperature normals varying from 50.1°F in January to 81.1°F in July. Table A1 lists the monthly and annual normals for Covington. Since 1951, temperature extremes at Covington have ranged from a record low temperature of 7°F occurring on December 13, 1962, and January 21, 1985, to a record high of 103°F occurring three times, the latest being August 22, 1980.

Table A1
Mean Monthly and Annual Temperature (°F)
30 Year Normals (1961-1990)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
COVINGTON	50.1	53.2	60.2	67.1	73.5	78.9	81.1	80.7	77.0	67.5	59.4	52.9	66.8

Source: National Climatic Center

PRECIPITATION

The average annual precipitation for the study area based on National Climatic Center records at Abita Springs, Covington, and Slidell over the period 1974-1995 is 65.50 inches. Table A2, which lists the stations with their monthly and annual totals, shows that the heaviest rainfall usually occurs during the summer with July being the wettest month with an average of 6.82 inches. October is the driest month, averaging 3.42 inches. Since 1974, the maximum monthly rainfall totals have been 26.20 inches in May 1995, at Abita Springs, 15.09 inches in August 1977, at Covington, and 26.14 inches in May 1995 at Slidell. No precipitation was recorded at any of the stations during the month of October 1978. The maximum day rainfall over the period of record is 13.35 inches in Abita Springs, which fell during May 9, 1995, 6.67 inches in Covington, which was measured December 4, 1982, and 13.42 inches which fell in Slidell on May 10, 1995. Plate A1 gives the location of these stations.

Table A2
Average Monthly Precipitation (inches)
(1974-1995)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
ABITA SPRINGS	6.13	6.11	6.28	5.32	6.68	5.29	6.91	7.58	4.90	3.41	4.87	4.49	67.55
COVINGTON	5.58	5.22	6.34	5.44	6.04	4.96	6.84	5.92	4.21	3.39	4.78	4.79	64.08
SLIDELL	6.73	5.45	5.88	5.08	6.92	4.36	6.72	6.32	5.06	3.47	4.96	4.71	64.87
AVERAGE	6.15	5.59	6.17	5.28	6.55	4.87	6.82	6.61	4.72	3.42	4.87	4.66	65.50

Source: National Climatic Center

WIND

Wind data taken at Baton Rouge and New Orleans Moisant Airport are used to describe the study area. The average velocity of the wind for the two stations over the 1973-1994 period is 7.7 miles per hour (mph). Prevailing wind direction is southerly during much of the year in the upper study area, while southeast winds predominate in the lower part. The summer is often disturbed by tropical storms and hurricanes which produce the highest winds in the area. The maximum wind speeds observed (highest one minute speed) since 1963 are 58 mph at Baton Rouge and 69 mph at New Orleans and were a result of Hurricane Betsy in September 1965.

STREAM GAGING DATA

In the western part of the study area, daily stage and discharge measurements are currently taken by the U.S. Geological Survey (USGS) at Tchefuncte River near Folsom and also on a partial-record basis at Tchefuncte River near Covington and Abita River north of Abita Springs. Daily stage readings are recorded by the Corps of Engineers (COE) at the Lake Pontchartrain at Mandeville gage. Past records of the Bogue Falaya River near Covington gage (USGS), discontinued in 1983, are also available.

For the eastern part of the study area, the COE takes stage measurements at the Rigolets near Lake Pontchartrain gage, and the

USGS has stage records for the 1985-1986 water year at gages on the W-14 Canal (Main Diversion Canal) at Daney Street and Robert Road. Stage and discharge measurements are available at the W-14 Canal Kingspoint gage for the period 1985-1988. Past records of Bayou Bonfouca at Slidell (COE), discontinued in 1992, Bayou Bonfouca at West Hall Road (USGS) and W-15 Canal at Service Road (USGS), discontinued in 1987, are also available.

Pertinent data such as period of record and maximum and minimum stages and available discharges of the above stations are presented in Table A3 and Table A4. The locations of the gages are shown in Plate A1.

Table A3
Stream Gaging Data
Stage

STATION	PERIOD OF RECORD	MAXIMUM STAGE FT (NGVD)	MAXIMUM STAGE DATE	MINIMUM STAGE FT (NGVD)	MINIMUM STAGE DATE
TCHEFUNCTE RIVER NR FOLSOM	1944-95	86.25		66.86c	10/4-6/86
TCHEFUNCTE RIVER NEAR COVINGTON	1951-65, 67 69, 72, 74, 78-85, 94a	N/A	-	N/A	-
ABITA RIVER NORTH OF ABITA SPRINGS	1966-95a	25.37c	4/12/95	N/A	-
BOGUE FALAYA NR COVINGTON	1964-83ab	26.38c	4/8/83	N/A	-
LAKE PONTCHARTRAIN @ MANDEVILLE	1931-96	7.60d	10/28/85	-2.25	1/26/38
W-14 CANAL @ DANEY ST.	1985-86a	4.20d	10/28/85	N/A	-
W-14 CANAL @ ROBERT ROAD	1985-86 1987-88a	8.83d	10/28/85	4.49	4/26/88f
W-14 CANAL @ KINGSPOINT BLVD.	1985-88	3.1	4/2/88	-0.46	1/26/88
W-15 @ SERVICE ROAD	1985-87b	15.94	3/17/87	N/A	-
RIGOLETS NR LAKE PONTCHARTRAIN	1931-95	9.00d	8/18/69	-1.9	1/26/38
BAYOU BONFOUCA AT SLIDELL	1962-92b	6.8d	8/18/69	-0.6	2/15/63
BAYOU BONFOUCA @ WEST HALL RD.	1985-87b	21.02g	3/18/87	16.24	1/27/86

a. Partial record station
b. Discontinued
c. Peak stage at peak discharge below
d. caused by hurricane
e. From incomplete records
f. and other dates
g. Stages affected by tides
N/A (Not available)

Table A4
Stream Gaging Data
Discharge

STATION	PERIOD OF RECORD	MAXIMUM DISCHARGE		MINIMUM DISCHARGE	
		CFS	DATE	CFS	DATE
TCHEFUNCTE RIVER NR FOLSOM	1944-95	29,800	4/5/83	26	9/6/68
ABITA RIVER NORTH OF ABITA SPRINGS	1966-95a	6,000	4/12/95	N/A	-
BOGUE FALAYA NEAR COVINGTON	1964-83a	12,700	4/8/83	N/A	-
W-14 CANAL @ KINGSPOINT ROAD	1985-87b	222c	3/18/87	-32c	9/23/87

a. Partial record station
b. Discontinued
c. From completed record
N/A (not available)

Source: U.S. Geological Survey/U.S.A.C.E

FLOODS OF RECORD

Stream flooding from intense rainfall has occurred in the study area and its surrounding area. Four of the most severe flood events in the western part of the study area occurred in May 1953, April 1983, April 1995, and May 1995. These floods are described below.

May 1953 The flood of May 1953 was caused by unusually heavy rains beginning at the end of April. During the period 22 April through 9 May 1953, heavy rainfall produced generally high stages on most streams in the area and set the stage for additional flooding following a second storm period between 10 May and 21 May 1953. At the Tchefuncte River near Covington, a peak discharge of 14,800 cubic feet per second (cfs) occurred on 3 May with a maximum stage of 29.9 feet NGVD.

April 1983 Heavy rains produced the flood in April 1983. During the period 5 April through 8 April, severe thunderstorms produced more than 10 inches of rain over some parts of the Lake Pontchartrain Basin. Franklinton, north of the study area, received 10.56 inches on 6 April. Covington's storm total for 6 and 7 April was 5.3 inches. Several stage and discharge records were exceeded during this flood. The Tchefuncte River near Folsom gage recorded a peak discharge of 29,800 cfs with a maximum stage of 86.25 feet NGVD on 6 April. The Bogue Falaya near Covington gage had a maximum stage of 28.38 feet NGVD and a peak discharge of 12,700 cfs on 8 April.

April 1995 The rainstorm on 11 April dumped over 7 inches of heavy rain on Abita Springs and broke the maximum stage record at the Abita Springs gage with a 25.37 feet NGVD reading on 12 April. It also set the maximum discharge record of 6,000 cfs on the same day. Flooding was also reported in Covington and Mandeville with Covington receiving 5.85 inches of rain.

May 1995 This flood was caused by intense rainfall over a three day period, 8 May through 10 May. Covington had a storm total of 10.72 inches with 10.62 inches falling on the last two days. The Tchefuncte and Bogue Falaya Rivers rose rapidly above flood stage and caused major damage to a few buildings in the area near their confluence. The Tchefuncte River near Folsom gage recorded a maximum stage of 79.51 feet NGVD on 11 May. At Covington, the Tchefuncte River peaked at 27.2 feet NGVD also on 11 May. A local gage at Lee Road had a high stage of 16.9 feet NGVD for the same day. The Bogue Falaya River and Abita Creek also rose rapidly above flood stage and overtopped their banks causing flood damages.

In the eastern part of the study area, headwater flooding due to intense rainfall in the upper reaches of the streams is relatively frequent. Some of the severe floods for this part are discussed below.

May 1958 One of the worst floods of record in the Slidell area occurred on 18 May 1958, when 13.20 inches of rainfall in a 24 hour period was recorded at the Central Fire Station in Slidell. At Bayou Liberty, 10.85 inches was measured. A high water level of 7.1 feet NGVD was recorded in the center of Slidell.

January 1966 On 3 through 5 January 1966, heavy rain fell in Slidell and caused a high stage of 7.4 feet NGVD on the gage at Bayou Vincent. The gage on Bayou Liberty near Slidell exceeded the 6.0 foot limit of gage. The Central Fire Station in Slidell recorded a storm total of 4.87 inches of rain for the three days.

April 1983 The same storm that flooded the western part of the study area on 7 April 1983, caused wide-spread residential and commercial flooding in the eastern part. The stage on Bayou Bonfouca at Slidell gage rose nearly two feet on 7 April. Slidell recorded 8.70 inches of rainfall over a 10 hour period.

April 1995 The heavy rains which flooded the western part of the study area on 11 April also flooded approximately 100 homes in the Slidell area after 5 to 7 inches of rain fell in this part.

May 1995 This storm on 8 through 10 May 1995, caused more severe flood problems in the eastern part than the western part of the study area. More than 22 inches of torrential rain fell in the area over this short period with nearly all of it falling on 9 and 10 May. The National Weather Service Office in Slidell recorded 15.75 inches overnight. Severe flooding was reported in several communities throughout the area. A high water mark of approximately 8.0 feet NGVD was reported in downtown Slidell near the W-14 canal.

Flooding in the lower reaches of the study area has been the result of high stages in Lake Pontchartrain caused by hurricanes and tropical storms. Several of the maximum stage records in Table 3 have been set by hurricanes. Some of the significant hurricanes affecting the study area are: 1915 hurricane (September-October 1915); Hurricane Flossy (September 1956); Hurricane Hilda (October 1964); Hurricane Betsy (September 1965); Hurricane Camille (August 1969); Hurricane Carmen (September 1974); Hurricane Juan (October 1985); and Hurricane Andrew (August 1992).

TIDES

Tides in Lake Pontchartrain are diurnal with a tidal range of 0.6 feet. The mean high water is approximately 1.6 feet NGVD and the mean low water is approximately 1.0 feet NGVD. These stages are based on the Lake Pontchartrain at Mandeville gage.

HYDRAULICS AND HYDROLOGY

STUDY AREA

The study area includes the drainage basins of several streams and bayous in the Parish of St. Tammany, located in Southeastern Louisiana. Plate A2 shows the study area.

Bayou Chinchuba

Bayou Chinchuba, a bayou located in the southcentral portion of St. Tammany Parish near Mandeville, flows in a westerly and south direction into Lake Pontchartrain. The upper portion of the drainage area is suburban, with several lakes and ponds, including Greenleaves Lake. The lower portion of the basin is undeveloped wetlands. Six roads and highways and an old railroad trestle cross the bayou, including U.S. Highway 190 and North Causeway bridge. The bayou runs through incorporated and unincorporated Mandeville, LA. Elevations in the basin range between 30 feet NGVD and -3 feet NGVD. The Bayou Chinchuba drainage basin measures 11.2 square miles in area. The stream length is 5.5 miles.

Abita River

Directly north of Bayou Chinchuba, in Abita Springs, LA, are the Abita River and the Abita North and South Tributaries. The town of Abita Springs is located in rolling forest and agricultural and ranch country measures four square miles. Approximately 1 square mile is developed. The area consists of high, dry wooded, or cleared land and is suitable for residential or industrial sites. Transportation routes that pass through the area are State Routes 36, 59, and 435. The drainage basin of the three streams is 54 square miles in area, and the stream is 6 miles in length within the project area. Basin elevations vary from 15 feet to 35 feet. The Abita River empties into the Bogue Falaya River.

Bayou Lacombe

Bayou Lacombe originates in central St. Tammany Parish and flows south into Lake Pontchartrain. In the town of Lacombe, LA, Bayou Lacombe drains a 68.9 square mile area and drains into Lake Pontchartrain. Within the study area, the stream is 3.5 miles in length. Elevations in the drainage basin vary from 2 to 30 feet NGVD. Most of the flooding occurs near the U.S. Highway 190 area where Lacombe Bayou and Big Branch Bayou combine and downstream of U.S. Highway 190 where most of the flooding is influenced by tidal effects.

W-13 Canal, W-14 Canal, and W-15

The drainage system of Slidell and vicinity is composed of a complex network of natural and canal systems. They include: Schneider Canal; Bayou Bonfouca/Bayou Vincent(W-13); Main Diversion Channel (W-14); and Doubloon Branch-French Branch(W-15). The drainage basins for these channels are not well defined. The canal systems are partially separated by the embankments of Interstate 10 and the Southern Railway System. Crossflow between the channels can occur through underpasses, several diversion channels, or overland. The diversion channels include the W-14 West Diversion Canal, connecting the W-14 Canal to Bayou Vincent, and the W-15 lateral, connecting the W-14 Canal to W-15 Canal.

The study area has several small industries. Most of the area is urban in nature comprised of shopping centers, small commercial establishments, and numerous residential subdivisions. Based on comparison of aerial photos, development appears to have been extensive and consistent in the W-13 and W-14 basins and relatively average in the W-15 basin.

W-14 canal drains an 8 square mile area and measures 5.8 miles in length. The drainage basin has elevations varying from 2 feet 25 feet NGVD. The canal flows into Lake Pontchartrain. W-13 Canal drains a 12.5 square mile area and measures 6 miles in length. Elevations in the drainage basin vary from 0 to 30 feet

NGVD. W-13 Canal drains into Lake Pontchartrain via Bayou Bonfouca. The drainage basin for W-15 Canal measures 12.1 square miles in area and varies in elevation from 5 to 30 ft NGVD. W-15 Canal measures 7.5 miles in length and drains into Gum Bayou and eventually the Pearl River.

DRAINAGE BOUNDARIES

The boundaries of each basin were defined by previous studies. Sub-basins in Slidell are interconnected; during heavy rains interbasin flow occurs overland or by diversion channels (Plate A3).

FLOODING PROBLEMS & CAUSES

Bayou Chinchuba

Homes on the Bayou Chinchuba basin flood annually in the reach between North Causeway Bridge and U.S. Highway 190 (the basin is relatively flat) and less often in the reach between U.S. Highway 190 and the outlet of Greenleaves Lake. Although detention basins have been required on all new subdivisions since November 1993, it is unclear just how much the rapid residential growth has affected the bayou. In addition, at least four bridges appeared to exert control flows above the 0.1 (10-year) annual probability event. New subdivisions are being built in the uppermost reach of the basin where most of the undeveloped land remains (Figure A1).

The nine square mile basin area upstream of the West Causeway approach floods due to headwater flow from the West Causeway bridge to U.S. Highway 190 and from that point to just downstream of Greenleaves Lake. The 2.1 square mile area downstream of the of the West Causeway bridge floods due to tidal effects. Cursory surveys revealed a problem area just downstream of the West Causeway Bridge along the Mandeville Water Treatment Pond levee and at the Old Logging Road embankment adjacent to the Lewisburg Subdivision. A field trip was made during a storm when water levels in Lake Pontchartrain were comparable to the average annual stage. It was observed that flows in Bayou Chinchuba were moving very slowly and the water levels at North Causeway bridge were close to the low chord of the bridge and had reached the top of the Corin Street bridge in the Golden Glenn Subdivision. It was later determined that the frequency of that event was close to a 0.167 (6-year) annual probability event.

Abita River

The Abita Springs area floods due to the inadequacy of the existing channel system especially in the upper portions of the community. The lower areas near Maple Street and State Routes 36 and 435 have relatively low flat floodplains and are subject to backwater effects and flow across watersheds.

Bayou Lacombe

The area south of U.S. Highway 190 is subject to flooding from tidal inundation. The area is low, with elevations near lake levels and floods frequently from high tides or when a strong wind is present.

W-14 Main Diversion Canal, Bayou Vincent, and French Branch

Because of the City of Slidell's close proximity to Lake Pontchartrain and the relatively flat topography, it is subject to flooding from hurricane surges as well as headwater flooding from the various streams and channels in the area. Flooding from all-season rainfall occurs in the northern half of the W-14 basin above Fremaux Avenue and from above normal high tides with rainfall in the southern half. The right descending bank of the W-14 Canal within the city limit is higher than the floodplain. Flooding occurs because runoff cannot reach the channel. Lack of channel maintenance and limited channel capacity also cause flooding. It is suspected that interbasin flow occurs between its adjacent basins W-13(Bayou Vincent) and W-15(French Branch) during the higher rainfall events.

W-13 Canal floods between West Hall Avenue to just north of Interstate 12, however, the homes do not encroach on the floodplain as badly as in the W-14 Canal basin. The channel has not been cleared and snagged north of West Hall Avenue in at least 25 years and at least two bridges exert control on the flood profile.

The W-15 Canal or, French Branch, drains the area adjacent to the eastern boundary of the City of Slidell known as the unincorporated area of Slidell. Development is less dense than in the W-14 Canal basin; however, this is currently changing. The W-15 basin floods mostly in the French Branch Estates, Doubloon Branch Estates, and Cross Gates Subdivision. Flooding is due to the lack of channel capacity, maintenance and bridge restrictions. During high Pearl River stages, flooding occurs due to a combination of rainfall and backwater.

BAYOU CHINCHUBA

Existing Conditions

Previous Studies.

The following studies were used in this analysis: Flood Insurance Study for Mandeville, LA, published March 1979, and St. Tammany Parish, LA, published April 1992, The Tangipahoa, Tchefuncte, and Tickfaw Rivers , LA, Reconnaissance Report published June 1991, The Bayou Chinchuba Hydraulic Analysis in the Vicinity of Lewisburg Subdivision completed April 1994, the Hydraulic Study of Bayou Chinchuba Flow Under the Causeway North & West Approach Bridges for the Greater New Orleans Expressway Commission December 1995, and a May 1995 Post-flood report published by the Corps of Engineers in 1996.

Hydrologic Analysis.

Discharges for Bayou Chinchuba for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the flood insurance studies for Mandeville, LA, and St. Tammany Parish. The following is a summary of the methodology used in these studies.

Generalized rainfall frequency-depth-duration data were used with synthetic unit hydrographs to develop runoff hydrographs for each pertinent drainage area. The rainfall-runoff relation was determined using the methods outlined in USGS Technical Report 2A. Flood hydrographs for different storm frequencies were developed by synthetic methods utilizing the basin characteristics and the associated 0.1 and 0.01 (10- and 100-year) frequency rainfall. The unit hydrographs were developed using the methods outlined in USGS Technical Report 2B.

Computed unit hydrograph ordinates and incremented runoff amounts for each storm frequency were used to develop runoff hydrographs. The computed discharge hydrographs were assumed to have the same frequencies of occurrence as their associated storms.

From the flood insurance data, discharge frequency curves were plotted for several locations on Bayou Chinchuba using log normal probability paper. These curves were extended to estimate the 0.5 (2-year) annual probability discharges.

Peak discharges for Bayou Chinchuba at select locations for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability events are shown on Table A5.

Table A5
Bayou Chinchuba
Existing Conditions [a]
Peak Discharges, cfs

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Bayou Chinchuba outlet to Lake Pontchartrain	3,050	5,150	7,650
Downstream of West Causeway Bypass (Route 22)	2,500	4,230	6,300
US Highway 190	2,250	3,800	5,730
Greenleaves Lake weir	2,050	3.640	5,420
Illinois Gulf Central RR	1,450	2,380	3,400
State Highway 59	1,300	2,140	3,000

[a]It was assumed that all detention ponds constructed for new developments since the inception of the most recent FIS were designed properly and therefore the discharges were not affected.

Hydraulic Analysis.

The HEC-2 model used in the St. Tammany, LA Flood Insurance Study was imported into HEC-RAS.

The HEC-2 model from the flood insurance study started at the Causeway bridge system. For the reach from the Bayou Chinchuba outlet to the West Causeway Approach, the cross-section information was derived from studies listed above. These cross sections were obtained from field surveys and supplemented by topographic maps. The Corin Street bridge was also coded into the model.

The State of Louisiana plans on improving the U.S. Highway 190 bridge in 1997. The plan is to increase the bridge deck to an 80 foot length. The improved bridge section was incorporated into the HEC-2 model.

Roughness coefficients, (Manning's"n" values) were determined by field inspection. Manning "n" values used were as follows: Bayou Chinchuba 0.035-0.05 channel and 0.07-0.13 overbank.

The mean annual high stage of Lake Pontchartrain (exclusive of hurricane effects) was used as the starting water-surface elevation for all frequency floods; this stage, 3.5 ft NGVD, was computed from the Lake Pontchartrain Mandeville gage records (1940-1995).

Stage frequency information for existing conditions for Bayou Chinchuba is shown on Table A6.

Table A6
Bayou Chinchuba
Existing Conditions
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Causeway W. Approach	7.5	9.7	11.5
North Causeway	7.8	10.7	12.3
Corin Street	8.5	11.2	12.9
US Highway 190	10.2	12.3	14.0
Greenleaves Dam	14.2	15.6	17.2
Greenleaves Bridge	14.5	15.8	17.3
Greenleaves Lakes	14.6	16.0	17.7
Ill Central R/R	18.5	20.0	23.4
State Highway 59	23.0	23.2	23.8

Alternative Analysis

Alternative 1: Raising Structures.

Structures identified as exerting substantial control on flow (i.e. substantial headloss across structures) were modified to reflect potential lowerings therefrom.

Alternative 2: Clearing and Snagging with Bridge Modifications.

Based on field observations, previous studies, discussions with the St. Tammany Parish and City of Mandeville officials and New Orleans District Planning Division, the proposal to clear and snag the channel from the West Causeway bridge to Greenleaves Dam was established. Manning's "n" values in the HEC-RAS existing conditions model were adjusted to 0.030 for the channel and the model was run using existing conditions discharges.

The analysis showed an increase in head loss at the West and North Causeway bridges. Therefore, bridge modifications of increasing the Causeway bridge lengths from 125 feet to 152 feet and improving the base widths of the channel under each bridge to 70 feet were added to the alternative. The Corin Street bridge that services one home and one pool club was also replaced or removed.

The HEC-RAS model was modified to reflect the changes to the Causeway bridge system and the removal of the Corin Street bridge. Stage lowerings on the order of approximately 0.5 ft were computed. The most common area of flooding, Golden Glenn Subdivision, has several homes that flood annually. With this alternative, some of the homes that now flood annually would still flood.

Stage frequency information for this alternative is shown on Table A7.

Table A7
Bayou Chinchuba
Alternative 2
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Causeway West Approach	7.4	9.2	10.9
North Causeway	7.6	9.5	11.5
Corin Street	8.0	10.0	11.9
U.S. Highway 190	9.7	11.3	13.1
Greenleaves Dam	14.0	15.2	16.9
Greenleaves Bridge	14.3	15.6	17.0
Greenleaves Lake	14.4	15.8	17.3
Ill Central R/R	18.5	20.0	23.4
State Highway 59	23.0	23.2	23.8

Alternative 3: Clearing and Snagging, Dredging, Bridge Replacement.

Based on the economic findings, a 3-foot lowering in the 0.1 (10-year) annual probability flood profile provides the greatest benefits to the Golden Glenn Subdivision. In an attempt to achieve these type of lowerings, the channel was enlarged to a 200-foot bottom width from the southside of the Lewisberg logging road embankment to 100 feet south of the West Causeway Approach. From this point to downstream of the U.S. Highway 190 bridge, the channel bottom width is increased to 125 feet and from the U.S. Highway 190 bridge to the Greenleaves Lake Weir the channel bottom is increased to 60 feet. To supplement these improvements, the bayou is cleared and snagged from upstream of Greenleaves Lakes to State Highway 59.

The West and North Causeway bridges are lengthened to 210 feet to accommodate the 125-foot channel bottom width. The bridges are raised so that the low chord of each bridge is at the existing roadway elevation, 10 feet NGVD.

The existing conditions HEC-RAS model was modified to include all the changes described above and run using the existing conditions flows. Stage frequency information for this alternative is shown on Table A8.

Table A8
Bayou Chinchuba
Alternative 3
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Causeway West Approach	5.7	7.2	9.0
North Causeway	6.1	7.6	9.8
Corin Street	6.6	8.2	9.0
US Highway 190	7.3	9.0	11.1
Greenleaves Dam	13.5	14.2	15.3
Greenleaves Bridge	13.8	14.6	15.7
Greenleaves Lake	13.9	14.9	16.2
Ill Central R/R	18.4	20.0	23.0
State Highway 59	23.0	23.2	23.6

ABITA RIVER, LA 36 NORTH AND LA 36 SOUTH TRIBUTARIES

Existing Conditions

Previous Studies.

A Flood Insurance Study for the Town of Abita Springs, LA, was published in May 1988.

Hydrologic Analysis.

Discharges for Abita River and the North and South Tributaries for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the flood insurance studies for Abita Springs. The following is a summary of the methodology used in these studies.

Generalized rainfall frequency-depth-duration data were used with synthetic unit hydrographs to develop runoff hydrographs for each pertinent drainage area. The rainfall-runoff relation was determined using the methods outlined in USGS Technical Report 2A. Flood hydrographs for different storm frequencies were developed by synthetic methods utilizing the basin characteristics and the associated 0.1 and 0.01 (10- and 100-year) frequency rainfall. The unit hydrographs were developed using the methods outlined in USGS Technical Report 2B.

Computed unit hydrograph ordinates and incremented runoff amounts for each storm frequency were used to develop runoff hydrographs. The computed discharge hydrographs were assumed to have the same frequencies of occurrence as their associated storms.

From the flood insurance data, discharge frequency curves were plotted for several locations on Abita River and the tributaries using log normal probability paper. These curves were extended to estimate the 0.5 (2-year) annual probability discharges.

Peak discharges for the three streams at select locations for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability events are shown on Tables A9-A11.

Table A9
Abita River
Peak Discharges, cfs
Existing Conditions

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Downstream corporate limit	8,700	14,250	21,290
LA 36 south tributary	8,500	14,100	21,000
Long Branch	7,250	12,360	18,390

Table A10
LA 36 South Tributary
Peak Discharges, cfs
Existing Conditions

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Confluence w/Abita River	900	1,520	2,290
Confluence w/LA 36 N. Trib	540	880	1,320
Hebert Road	440	730	1,090

Table A11
LA 36 North Tributary
Existing Conditions
Peak Discharges, cfs

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Confluence w/ LA 36 S. Trib	540	880	1,320
Illinois Central Gulf RR	375	650	990
0.6 Mi u/s Gum Street	290	480	715

Hydraulic Analysis.

The HEC-2 model used in the Flood Insurance Study was imported into HEC-RAS. Roughness coefficients, (Manning's "n" values) were verified by field inspection. Manning "n" values used were as follows: Abita River 0.045 channel and 0.070 overbank; LA 36 South Tributary 0.013 - 0.050 channel and 0.070 - 0.080 overbank; and LA 36 North Tributary 0.024 - 0.050 channel and 0.080 overbank.

Starting water surface elevations for the Abita River for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the Flood Insurance Study. The starting water surface elevation for the 0.5 (2-year) annual probability event was developed by extrapolating a stage-discharge rating curve at the downstream corporate limit. Starting water surface elevations for the remaining streams were taken at their confluences. Stage frequency information for existing conditions is shown on Table A12.

Alternative Analysis

Raising Structures.

Existing Conditions flood profiles were used to identify structures in the flood plain that exerted substantial control on the stream flows.

BAYOU LACOMBE

Existing Conditions

Previous Studies.

A Flood Insurance Study for Unincorporated St. Tammany Parish, LA, was published in April 1992.

Table A12
LA 36 North Tributary, Abita River & LA 36 South Tributary
Existing Conditions
Stage Frequency Data

LOCATION	0.5 FT-NGVD	0.1 FT-NGVD	0.01 FT-NGVD
North Tributary:			
Confluence of South Trib. & North Trib.	20.5	21.9	23.5
Hickory Street	23.3	23.7	24.9
Laurel Street	23.8	24.4	25.5
limit of North Tributary	29.5	29.8	29.9
Abita River:			
Downstream Corporate Limit	18.8	20.8	22.5
U/S of State Highway 36	21.5	24.3	26.6
St. Joseph Street	24.0	26.3	28.9
Hickory Street	25.4	27.8	29.9
Talisheek Road	27.8	29.5	31.4
D/S of Corporate Limit	29.3	31.2	33.0
South Tributary:			
Confluence of South Trib. with Abita River	19.6	20.8	22.5
St. Joseph Street	20.5	21.9	23.5
U/S of Illinois Gulf Central Railroad	24.6	25.2	26.3
D/S of Border Street	28.1	28.3	28.7
U/S of Border Street	29.0	29.2	29.5
Hebert Street	30.6	31.0	31.5

Hydrologic Analysis.

Discharges for Bayou Lacombe for the 0.1, 0.02, and 0.01 (10-, 50-, and 100-year) annual probability events were taken from the flood insurance study for Unincorporated St. Tammany Parish, LA. Gaging station records are not available for Bayou Lacombe or its tributaries, therefore, unit hydrographs and base flows were derived using synthetic methods. The techniques described in Unit Hydrographs for Southeastern Louisiana and Southern Mississippi provide a practical means of developing synthetic Unit Hydrographs and baseflow recession from regionalized data. These techniques compare favorably with data generated by the Snyder method. Basin characteristics were determined using USGS topographic maps. and NASA USC Aerial Photos. Peak rates of runoff were developed by modeling the Bayou Lacombe watershed using computer program HEC-1. Appropriate sub-basin parameters were included to derive flows at points of interest within the basin. These parameters are drainage areas, rainfall amounts, loss-rate functions, depth-area relationships, unit hydrographs, base flow recession data, and storage-outflow relationships.

Peak discharges at select locations for the 0.1, 0.02, and 0.01 (10-, 50- and 100-year) annual probability events are shown on Table A13.

Table A13
Bayou Lacombe
Existing Conditions
Peak Discharges, cfs

LOCATION	Return Period, Annual Probability Event 0.1	0.02	0.01
At confluence with Lake Pontchartrain	10,890	15,800	18,830
Immediately upstream of Confluence of Cypress Bayou	10,470	14,970	17,670
Immediately upstream of Big Branch Bayou	10,710	14,840	17,480

Hydraulic Analysis

The Bayou Lacombe area has developed at a relatively slow rate compared to the eastern and western part of St. Tammany Parish. The hydraulic analysis performed in the most recent St. Tammany Parish, LA. Flood Insurance study was adequate and therefore adopted for this analysis.

The area that normally floods in the town of Bayou Lacombe is located mostly south of U.S. Highway 190. The predominant flooding source in this area is from tidal influence, specifically hurricanes. Stages on Bayou Lacombe were derived from the North Shore Hurricane Protection Study (1970) and the Type 5 Flood Insurance Study of the Louisiana Gulf Coast (1970).

Alternative Analysis

Raising Structures.

Existing Condition stage frequency information was used to identify structures in the flood plain.

W-13 CANAL

Existing Conditions

Previous Studies.

During this study, it was found that the Superfund site at Bayou Bonfouca and W-13 Canal junction controlled the type of improvements that would be allowed due to environmental restrictions. The stages used to design the retaining wall at the superfund site were those for existing conditions for a 0.01 (100-year) annual probability event. Even if improvements upstream of the site did not raise stages, any increase in velocities would create problems.

Other studies of W-13 Canal include: Flood Insurance Study for unincorporated portions of St. Tammany Parish, initial study completed in 1971, revised in 1974, 1976, 1984, 1989, and 1991. Flood Insurance Study for Slidell, LA, 1980. New Orleans District study on the Bayou Vincent, LA, project. The original project was completed in 1947.

Hydrologic Analysis.

Discharges for W-13 Canal for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the flood insurance studies for Slidell, LA, and St. Tammany Parish. The following is a summary of the methodology used in these studies.

No flow records exist for W-13 Canal. Flood hydrographs for different storm frequencies were developed by synthetic methods utilizing the basin characteristics and the associated 0.1 and 0.01 (10- and 100-year) annual probability frequency rainfall. The basin characteristics were determined from USGS quadrangle maps at a scale of 1 inch = 2,000 feet, contour interval 5 feet. The synthetic unit hydrographs were created by the procedures developed for small urban and rural drainage basins by the Texas Water Development Board. Generalized rainfall frequency-depth-duration data were used with the synthetic unit hydrographs to develop runoff hydrographs. The resulting peak discharges were verified by other hydrograph techniques. The resultant discharges were assumed to have the same probability of occurrence as their associated storms.

Using data from the 1991 Flood Insurance study, discharge frequency curves were plotted for several locations on W-13 Canal using log normal probability paper. These curves were extended to estimate the 0.5 (2-year) annual probability discharges.

Peak discharges for W-13 Canal at select locations for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-Year) annual probability events are shown on Table A14.

Table A14
W-13 Canal
Existing Conditions
Peak Discharges, cfs

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Junction of Bayou Vincent and Bayou Bonfouca	3,465	5,616	7,830
U.S. Highway 190 (excluding the Western branch upstream)	2,565	4,130	6,130

Hydraulic Analysis.

The HEC-2 model used in the Flood Insurance Study was imported into HEC-RAS. Channel cross sections and bridges were field verified. Starting water surface elevations for the W-13 Canal for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the 1991 Flood Insurance Study. The starting water surface elevation for the 0.5 (2-year) annual probability event was developed by extrapolating a stage-discharge rating curve at the downstream corporate limit.

Stage frequency information for existing conditions for W-13 Canal is shown on Table A15.

Table A15
W-13 Canal
Existing Conditions
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
West Hall Road	7.0	8.7	9.7
U.S. Hwy 190	9.4	10.9	11.5
ICGR West	12.4	13.0	13.6
ICGR NW	13.8	14.5	16.0
Interstate 12	15.9	16.6	17.2

Plan Analysis

Channel improvement of the W-13 Canal was analyzed. The existing conditions HEC-RAS model was used to analyze the impacts of channel improvements on the flood profiles. The design analyzed began just downstream of West Hall Road and continued upstream about 2.8 miles to the downstream side of the eastbound Interstate 12 (see vicinity map on Plate A4). The improved channel consists of a 40-foot bottom width with 1V on 2H side slopes. The channel is deepened in some reaches to provide a more consistent invert slope. The existing West Hall Road bridge (44 feet long, low chord = 9.0 ft NGVD) causes significant head loss and, as such, a replacement bridge (116 feet long, low chord = 10.0 feet NGVD)has been included in this alternative. No other bridges are modified under this alternative. Instead, the existing channels under these bridges are cleared of debris.

In the HEC-RAS model, Manning's 'n' values for the channel in the improved reach were reduced by 0.005 to 0.010 to account for the removal of excessive vegetation and debris from the channel. Stage data for existing and improved conditions were developed for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-Year) annual probability events using the existing conditions flows.

Stage frequency information for the channel improvement is shown in Table A16.

Table A16
W-13 Canal
Channel Improvement
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
West Hall Road	6.5	7.7	8.8
U.S. Hwy. 190	7.7	9.5	10.9
ICGR West	10.3	12.1	13.0
ICGR NW	12.3	13.8	15.3
Interstate 12	14.0	15.5	16.6

W-14 (MAIN DIVERSION CANAL)

Existing Conditions

The W-14 canal drains portions of the City of Slidell, LA, and its surrounding area. Previous studies of this area assumed that the canal drains the W-14 basin independently. The two laterals connected to W-14 Canal have not been previously analyzed.

Previous Studies.

A Reconnaissance Report for Schneider Canal, located near the lower corporate limit of Slidell, LA, was completed in November, 1989. The study identified a hurricane protection plan consisting of a levee and either gravity or forced drainage to handle the interior drainage for Schneider Canal, W-14 Canal, and W-13 Canal. It recommended continuation of the study into the feasibility phase to determine the interior drainage conditions.

Other references used include: the St. Tammany Parish, LA, Master Drainage Plan March 1983; the St. Tammany Parish Master Drainage Plan Task Order No. May 9,1994, with amendment No. 2 from October 1995, prepared by Burke-Kleinpeter, Inc.; The 1980 Flood Insurance Study, City of Slidell; the revised October 17, 1989 Flood Insurance Study, St. Tammany Parish, LA, Unincorporated Areas; and the May 1995 Post Flood Study.

The W-14 Canal was studied as a Section 205 project beginning in 1995. The Section 205 study was suspended when the W-14 Canal became part of the study area for this reconnaissance study. Results from the 205 study have been incorporated into this reconnaissance study.

Hydrologic Analysis.

An HEC-1 model was developed for the W-14 Canal for the Section 205 study. No flow records exist; therefore, storm frequencies were developed using synthetic methods that utilize basin characteristics.

The flood hydrograph package computer program, HEC-1, was used for the hydrologic analysis. The HEC-1 option that generates synthetic storms using rainfall depth-duration data was used. The information for the basin was developed for the 0.5, 0.1, and 0.01 (2-year, 10-year, and 100-year) annual probability storms using U.S. Weather Bureau Technical Memoranda:

"Five-to-60-Minute Precipitation Frequency for the Eastern and Central United States" (NWS HYDRO 35)

"Rainfall Frequency Atlas of the United States" (TP-40)

The storm duration chosen for W-14 Canal was 24 hours. Loss rates were determined by HEC-1 using the SCS method. Curve numbers were estimated based on vegetation and basin development using aerial photographs and information from field observations.

The SCS dimensionless unit hydrograph method was used to transform the rainfall excess to runoff.

For this reconnaissance analysis, a simplified approach was used to determine the effects of the W-14 Canal and the W-15 Canal laterals. The City of Slidell planned to increase the capacity of this lateral then abandoned the idea when it was found during this study that W-13 Canal is also restricted.

It was assumed that the times to peak for the W-14 Canal and W-13 Canal at the W-14 lateral connections occur simultaneously. The difference in stage between the W-14 and W-13 Canals was used in Manning's Equation to calculate the flows leaving the W-14 Canal via the lateral.

The W-15 lateral was approached slightly differently. Review of the stages for the 0.1, 0.02, 0.01, and 0.002 (10-, 50-, 100-, and 500-yr) annual probability events from the Flood Insurance Study showed that the peak stages for the W-14 Canal and W-15 Canal at the location of the W-15 lateral are almost the same. Therefore, it was necessary to compare the runoff hydrographs for the W-14 Canal and the W-15 Canal where the W-15 lateral connects with each canal. A rough HEC-1 model was developed for the W-15 Canal above the W-15 lateral, using the same approach as the HEC-1 model for the W-14 Canal. The peak flow and time to peak for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability runoff hydrographs for each canal were compared. Flow in the W-14 Canal peaks before the W-15 Canal so that water flows from the W-14 to the W-15 Canal at the peak W-14 flow. When the W-15 Canal peaks, flow in the lateral is in the opposite direction, from the W-15 to the W-14 Canal, and may increase the duration of high water in the W-14 Canal and contribute to flooding. This resulted in a decision to include a control structure to prevent flow to occur in the east to west direction.

In the HEC-1 model, the two diversion channels were modeled using outflow rating curves. The W-14 West Diversion Canal maximum outflow was 130 cfs for a 0.1 (10-year) annual probability event. To estimate flows in the W-15 Canal lateral, a rough HEC-2 model was set up. The downstream starting water surface elevation was developed from water levels in the W-15 Canal coincident with runoff conditions on the W-14 Canal. Flows in the HEC-RAS model for the W-14 Canal (described below) downstream of the lateral and in the HEC-2 model for the W-15 lateral were adjusted until the water surface elevations at their confluence matched. For the 0.1 (10-year) annual probability event, a maximum of 250 cfs is diverted from the W-14 Canal to the W-15 Canal. The peak discharges downstream for the W-14 Canal downstream of the W-15 lateral occur when flow is diverted from the W-14 Canal to the W-15 Canal. In the HEC-1 model for the W-14 Canal, the Muskingum-Cunge routing method was used for routing flows.

Peak discharges of the W-14 Canal for existing conditions at select locations as determined from the HEC-1 model for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability events are shown on table A17.

Table A17
W-14 Canal
Existing Conditions
Peak Discharges, cfs

LOCATION	Return Period, Annual Probability Event 0.5	0.1	0.01
Kingspoint Boulevard	1,650	2,920	4,370
Interstate 10	1,570	2,710	4,020
Fremaux Avenue	1,430	2,490	3,740
Gause Boulevard	980	1,670	2,520
Robert Road	810	1,380	2,110
North Boulevard	460	820	1,240
Upstream limit of study	200	360	550

Hydraulic Analysis.

The HEC-2 model from the existing Flood Insurance Study for the City of Slidell, LA, was imported into HEC-RAS. The model was updated to reflect current conditions. From field observations, Manning's 'n' values were adjusted to 0.05 in the channel and 0.07 in the overbanks. The Independence Avenue bridge was added, and the Fremaux Avenue bridge was modified to reflect current conditions. The starting water surface elevation used was the Lake Pontchartrain mean annual high stage (3.5 feet NGVD). Discharges from the HEC-1 existing conditions model were used. Stage frequency information for existing conditions for the W-14 Canal is shown on Table A18.

Table A18
W-14 Canal
Existing Conditions
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Kingspoint Road	4.8	6.5	8.2
Interstate 10	5.7	8.1	10.5
Fremaux Ave	8.4	9.3	11.7
Gause Boulevard	12.4	12.7	13.1
Robert Road	13.8	13.8	14.2
North Boulevard	14.8	15.3	15.8
Upstream Study Limit	15.4	16.1	16.0

Plan Analysis

Existing hydraulic conditions and information provided by the Slidell City engineer indicates that channel improvements are needed from Interstate 10 to Interstate 12. These channel improvements included clearing and snagging, channel modification, and bridge improvements.

The City of Slidell has purchased two potential sites for detention ponds in the W-14 Canal basin. One pond site is located west of U.S. Highway 11 near North Blvd and the other pond site is located upstream of Robert Road (see Plate A4).

The pond west of U.S. Highway 11 covers 13.4 acres of the site purchased by the city. With a storage depth of 5 feet, the pond provides 67 acre-ft of storage with an invert elevation of 7.5 feet NGVD. Larger depths for this pond and the other pond are not feasible because of the likelihood that groundwater would make the larger depths ineffective. The pond perimeter is a minimum of 15.5 feet NGVD or at natural ground, whichever is higher. The pond has an inlet rectangular weir 50 feet long, with side walls 3 feet high, and a crest elevation of 12.5 feet NGVD. An outlet culvert is also included to draw down the detention pond after an event. The outlet culvert consists of a 12-inch diameter concrete culvert with an invert elevation of 6.5 feet NGVD. The culvert is flap- or sluice-gated on the detention pond side to prevent the pond from draining during an event. The outlet culvert is designed for a peak flow of 30 cfs and drains the pond in approximately 60 hours following an event. To convey the flows from the W-14 Canal to the pond, the existing W-14 West Diversion Canal must be enlarged 50 square feet over its current size from the W-14 Canal to the vicinity of the pond with an invert elevation of 7.0 feet NGVD at the W-14 Canal sloping to an invert elevation of 6.0 feet NGVD at the detention pond. Additional culverts under U.S. Highway 11 must be added to the existing culverts (whose dimensions are not currently known). The additional culverts should consist of three 4X4 foot concrete culverts with an invert of 7.0 feet NGVD. The existing bridge opening through the ICG Railroad is assumed to be adequate and, therefore, no additional opening is estimated.

The pond at Robert Road encompasses 25 acres of the site purchased by the city. With a storage depth of 5 feet, the pond provides 125 acre-ft of storage with an invert elevation of 7.5 feet NGVD. The pond perimeter is a minimum of 15.0 feet NGVD or at natural ground, whichever is higher. The pond has an inlet rectangular weir 110 feet long, with side walls 3 feet high, and a crest elevation of 12.5 feet NGVD. An outlet culvert is also included to draw down the detention pond after an event. The outlet culvert consists of a 30-inch diameter concrete culvert with an invert elevation of 5.0 feet NGVD. The culvert is flap-or sluice-gated on the detention pond side to prevent the pond from draining during an event. The outlet culvert is designed for a peak flow of 50 cfs and drains the pond in approximately 60 hours following an event.

The existing conditions HEC-1 and HEC-RAS models were used to analyze the detention ponds. In HEC-1, the detention ponds were modeled as diversions to simulate the filling of the detention pond during the rainfall event.

In addition to the detention ponds, this plan provides for a cleared and snagged channel from Interstate 10 to Interstate 12; channel improvement to a 40 foot base width and 1 horizontal on 2 vertical side slopes from Fremaux Avenue to 1,000 feet north of Gause Boulevard.

The channel cross sections in the HEC-RAS model were recoded to the improved channel condition with channel "n" values of 0.035.

Table A19 shows peak discharges for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability events.

Table A19
W-14 Canal
Slidell Area Plan
Peak Discharges, cfs

LOCATION	0.5	0.1	0.01
Kingspoint Boulevard	1,690	2,610	4,150
Interstate 10	1,600	2,470	3,800
Fremaux Avenue	1,460	2,160	3,480
Gause Boulevard	1,010	1,300	2,240
Robert Road	840	1,135	1,820
North Boulevard	200	360	550
Upstream limit of study	200	360	550

Stage data for this plan are shown on Table A20.

Table A20
W-14 Canal
Slidell Area Plan
Stage Frequency Data

Location	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Interstate-10	5.7	8.1	10.0
Daney Street	6.7	8.9	10.8
Cousin Street	6.9	8.9	10.9
Fremaux Avenue	7.7	8.9	10.8
Florida Avenue	8.7	9.8	11.5
Gause Blvd	9.5	10.6	12.4
Independence Drive	11.7	13.2	13.9
Robert Road	12.9	13.8	14.3
North Blvd	13.7	14.2	14.9

W-15 BASIN (FRENCH BRANCH)

Existing Conditions

Previous Studies.

References used include: St. Tammany Parish, LA, Master Drainage Plan prepared by Burke and Associates, March 1983; Flood Plain Information on Slidell, LA, prepared by the Corps of Engineers in December 1971; Flood Insurance Study, St. Tammany Parish, LA, Unincorporated Areas, revised 17 October 1989; and May 1995 Post Flood Study also prepared by the Corps of Engineers.

Hydrologic Analysis.

Discharges for W-15 Canal downstream of Poor Boy Canal for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the flood insurance studies for St. Tammany Parish. The following is a summary of the methodology used in these studies.

No flow records exist for the W-15 Canal. Flood hydrographs for different storm frequencies were developed by synthetic methods utilizing the basin characteristics and the associated frequency rainfall. The basin characteristics were determined from USGS quadrangle maps at a scale of 1 inch = 2,000 feet, contour interval 5 feet The synthetic unit hydrographs were created by the procedures developed for small urban and rural drainage basins by the Texas Water Development Board. Generalized rainfall frequency-depth-duration data were used with the synthetic unit hydrographs to develop runoff hydrographs. The resulting peak discharges were verified by other hydrograph techniques. The resultant discharges were assumed to have the same probability of occurrence as their associated storms.

From the flood insurance data, discharge frequency curves were plotted for several locations on the W-15 Canal using log normal probability paper. These curves were extended to estimate the 0.5 (2-year) annual probability discharges.

Peak discharges for the W-15 Canal at select locations for the 0.5, 0.1, and 0.01 (2-, 10-, and 100-year) annual probability events are shown on Table A21.

Table A21
W-15 Canal
Existing Conditions
Peak Discharges, cfs

	Return Period, Annual Probability Events		
LOCATION	0.5	0.1	0.01
Gause Boulevard	540	1,180	2,200
Interstate 10	400	900	1,300
Downstream of Poor Boy Canal	300	750	1,100

Hydraulic Analysis.

The HEC-2 model used in the Flood Plain Information Study was imported into HEC-RAS. More recent step backwater models or cross sections were not available. Channel cross sections and bridges in the model were compared to field observations. Significant differences in the physical characteristics of many bridges and culverts were noted between the model and existing conditions. Thalweg elevations were compared to profiles contained in the Burke and Associates report. Roughness coefficients (Manning's "n") used in the hydraulic analysis were 0.040 for the channel and 0.070 for the overbank. Starting water surface elevations for the W-15 Canal for the 0.1 and 0.01 (10- and 100-year) annual probability events were taken from the Flood Insurance Study. The starting water surface elevation for the 0.5 (2-year) annual probability event was developed by extrapolating a stage-discharge rating curve at the downstream corporate limit. Discharges used were from the hydrologic analysis.

Stage frequency information for existing conditions for W-15 is shown on Table A22.

Table A22
W-15 Canal
Existing Conditions
Stage Frequency Data

LOCATION	0.5 ft NGVD	0.1 ft NGVD	0.01 ft NGVD
Old River Rd.	5.2	7.0	8.2
Military Rd.	8.8	10.8	11.7
Gause Blvd.	11.3	13.0	13.4
Pearl Acres Rd.	14.8	16.7	17.0
Interstate 10	14.9	16.7	17.0

Plan Analysis

The Slidell Area Plan will provide for the enlargement of the existing Poor Boy Canal from the W-15 Canal eastward to the Gum Bayou (approx. 1 mile in length). In addition, the entrance to the Poor Boy Canal from the W-15 Canal is realigned to provide a more efficient transition (Plate A4). The enlarged canal diverts all of the W-15 Canal watershed above Poor Boy Canal for events up to the 0.01 (100-year) annual probability event. The existing Poor Boy Canal is estimated to have a 10-foot bottom width, 1V on 2H side slopes and an invert of approximately 9.0 feet NGVD. The proposed enlargement consists of a 25-foot bottom width, 1V on 2H side slopes, and the existing invert. The channel passes under three existing highways shown on the vicinity map (see Plate A4). Sets of two 10 X 10 foot concrete box culverts are required under each highway (2 sets under Interstate 59) to be placed at the existing channel invert (see plate A5).

The plan was analyzed using the following assumptions or conditions. Flow from the W-15 Canal to the W-14 Canal through the W-15 Lateral was assumed to not occur. The gated structure proposed for the W-15 Lateral under the W-14 Canal alternatives was assumed to be in place. While this structure would allow flow from the W-14 Canal to the W-15 Canal (but not in reverse), those flows were analyzed in detail for this plan. The runoff from the W-14 Canal peaks significantly sooner than the runoff from the W-15 Canal and, therefore, W-14's flow contribution to the W-15 Canal would be expected to have passed before the W-15 Canal peaks. Analysis of this plan was done using the HEC-RAS model described above. The current capacity of the Poor Boy Canal was not determined.

Peak discharges at selected locations for the W-15 Canal with this plan in place are shown on table A23.

Table A23
W-15 Canal
Slidell Area Plan
Peak Discharges, cfs

Location	Return Period, Annual Probability Event 0.5	0.1	0.01
Gause Boulevard	390	780	1,650
Interstate 10	250	500	750
Downstream of Poor Boy Canal	150	350	550

Stage frequency information with the diversion at Poor Boy Canal, developed for the 0.5, 0.1, and 0.01 (2-yr, 10-yr, and 100-year) annual probability events, is shown on Table A24.

Table A24
W-15 Canal
Slidell Area Plan
Stage Frequency Data

LOCATION	0.5 ft-NGVD	0.1 ft-NGVD	0.01 ft-NGVD
Old River Rd.	3.9	6.1	7.7
Military Rd.	7.5	9.8	11.2
Gause Blvd.	10.1	11.8	15.8
Pearl Acres Rd.	13.4	15.5	16.5
Interstate 10	13.4	15.5	16.5

ADDITIONAL HYDRAULICS AND HYDROLOGIC STUDIES REQUIRED FOR THE FEASIBILITY PHASE

Analysis of the W-13, W-14, and W-15 watersheds was conducted using available HEC-1 and HEC-2 models from previous studies. The W-14 watershed is connected by lateral canals with both W-13 and W-15 basins. Very little data on the lateral between the W-13 and W-14 basins, and the highway and railroad under which the lateral passes, were available. As such, the reconnaissance level analysis on W-13 Canal was not very detailed and will require a more thorough analysis in the next study phase. Modeling of the lateral between W-14 Canal and W-15 Canal was also limited. Alternatives for both watersheds will require a more thorough analysis of this lateral in the next study phase.

The W-15 watershed also has a connection through Poor Boy Canal with the West Pearl River through Gum Bayou. Data on Poor Boy Canal were limited to field reconnaissance, and no data were collected on Gum Bayou. Previously developed hydrology above the junction of W-15 Canal and Poor Boy Canal was not available. The proposed enlargement of Poor Boy Canal was sized using the flows immediately downstream of the junction. No analysis of the capacity of Gum Bayou was conducted.

The interconnectivity between the W-14 watershed and Schneider Canal watershed was not addressed in this reconnaissance study. The flood control recommendations made in the Southeast Louisiana Project St. Tammany Parish Technical Report for the Schneider Canal basin were not considered in the hydraulic and hydrologic analysis of existing or with project conditions. In the next study phase, the proposed hurricane protection levee and the two pumping stations, one of which is on W-14 Canal, need to be part of the analysis.

Although the watersheds have similar basin characteristics, the hydrology for each watershed was developed differently. Peak flows rather than the entire flow hydrograph were developed. In the next study phase, consideration needs to be given to consistency in methodology.

The existing hydraulic modeling used for this reconnaissance study also does not adequately simulate the interflow between the three watersheds through the laterals. Neither does it adequately address any overland interbasin flow. For this study, assumptions were made to account for the flows between watersheds instead of attempting to more accurately quantify the interflow. For the next phase of study, it will be necessary to develop a more complete hydraulic model for the combined three watersheds, instead of separate simulations. A model such as UNET (unsteady flow) will be required to account for the basin's interflow with each other as well as with the tidal areas and with the West Pearl River.

Many of the cross sections used in the reconnaissance study models are over 10 years old. In the case of the W-15 Canal, many of the bridges have been modified; the model needs to reflect these modifications. For the next study phase, controlled surveys will be required.

A third alternative was discussed to get the greatest stage lowerings for the W-14 Canal. In addition to the features in Alternative 2, this alternative includes:

A U-shaped concrete lined channel from Interstate 12 to Daney Street ranging in bottom width from 40 feet to 50 feet; replacement of at least four bridges, including Independence

Avenue, Robert Road, Daney Street and Cousin Street; and a pump station downstream of Interstate 10 to expedite the evacuation of the flow.

The Schneider Canal Reconnaissance Report discusses improvements to the Schneider Canal area located on the southern portion of the City of Slidell. These improvements include a levee from State Highway 433 north to a point midway between Gause Blvd. and Interstate 12, and a pump station adjacent to the W-14 Canal on the southside of Interstate 10. This pump and levee combination would be beneficial to the W-14 Canal comprehensive plan. A feasible interior drainage plan such as the W-14 Canal comprehensive plan would also be beneficial to the Schneider Canal project since the interior drainage analysis of that study was never completed.

WATER QUALITY

1. General. This section considers the applicable standards and criteria used to gage existing water quality in the area. This section also describes existing water quality and identifies the potential water quality impacts associated with the alternatives proposed in the St. Tammany Parish Reconnaissance Study.

2. Water Quality Standards and Criteria. Both the Louisiana Department of Environmental Quality (LDEQ) and the U.S. Environmental Protection Agency (EPA) have established ambient water quality criteria applicable to surface waters in the State of Louisiana. These criteria are discussed in the following paragraphs.

a. Applicable State of Louisiana standards. The LDEQ has established general written water quality criteria which are applicable to all waters of the State of Louisiana. The general written standards relate to the condition of the water as affected by waste discharges or human activity as opposed to purely natural phenomena, and are as follows. The criteria were last revised in 1994.

(1) Descriptive water quality standards.

(a) Aesthetics. The waters of the state shall be maintained in an aesthetically attractive condition and shall meet the generally accepted aesthetic qualifications. All waters shall be free from such concentrations of substances attributable to wastewater or other discharges sufficient to:

1. settle to form objectionable deposits;

2. float as debris, scum, oil, or other matter to form nuisances or to negatively impact the aesthetics;

3. result in objectionable color, odor, taste, or turbidity;

4. injure, be toxic, or produce demonstrated adverse physiological or behavioral responses in humans, animals, fish, shellfish, wildlife, or plants; or

5. produce undesirable or nuisance aquatic life.

(b) Color. Water color shall not be increased to the extent that it will interfere with present usage or projected future use of the state's water bodies.

1. Waters shall be free from significant increases over natural background color levels.

2. The source of drinking water supply should not exceed 75 color units on the platinum-cobalt scale.

3. No increases in true or apparent color shall reduce the level of light penetration below that required by desirable indigenous species of aquatic life.

(c) Floating, suspended, and settle able solids. There shall be no substances present in concentrations sufficient to produce distinctly visible solids or scum, nor shall there be any formation of long-term bottom deposits of slimes or sludge banks attributable to waste discharges from municipal, industrial, or other sources including agricultural practices, mining, dredging, and the exploration for and production of oil and natural gas. The administrative authority may exempt certain short-term activities permitted under Sections 402 or 404 and certified under Section 401 of the Clean Water Act, such as maintenance dredging of navigable waterways or other short-term activities determined by the state as necessary to accommodate legitimate uses or emergencies or to protect the public health and welfare.

(d) Taste and odor. Taste- and odor- producing substances in the waters of the state shall be limited to concentrations that will not interfere with the production of potable water by conventional water treatment methods or impart unpalatable flavor to food fish, shellfish, and wildlife, or result in offensive odors arising from the waters, or otherwise interfere with the designated water uses.

(e) Toxic substances. No substances shall be present in the waters of the state or the sediments underlying said waters in quantities that alone or in combination will be toxic to human, plant, or animal life or significantly increase health risks due to exposure to the substances or consumption of contaminated sift or other aquatic life. The numerical criteria specify allowable concentrations in water for several individual toxic substances to provide protection from the toxic-effects of these substances. Requirements for the protection from the toxic effects of other toxic substances not included in the numerical criteria and required under the general criteria are described in LAC 33:IX.1121.

(f) Oil and grease. Free or floating oil or grease shall not be present in quantities large enough to interfere with the designated water uses, nor shall emulsified oils be present in quantities large enough to interfere with the designated uses.

(g) Foaming or frothing materials. Foaming and frothing materials of a persistent nature are not permitted.

(h) Nutrients. The naturally occurring range of nitrogen-phosphorous ratios shall be maintained. This range shall not apply to designated intermittent streams. To establish the appropriate range of ratios and compensate for natural seasonal fluctuations, the administrative authority will use site-specific studies to establish limits for nutrients. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters.

(i) Turbidity. Turbidity other than that of natural origin shall not cause substantial visual contrast with the natural appearance of the waters of the state or impair any designated water use. Turbidity shall not significantly exceed background; background is defined as the natural condition of the water. Determination of background will be on a case-by-case basis.

As a guideline, maximum turbidity levels, expressed as nephelometric turbidity units (NTU), are established and shall apply for the following named water bodies and major aquatic habitat types of the state:

1. Red, Mermentau, Atchafalaya, Mississippi, and Vermilion Rivers and Bayou Teche -- 150 NTU;

2. estuarine lakes, bays, bayous, and canals -- 50 NTU;

3. Amite, Pearl, Ouachita, Sabine, Calcasieu, Tangipahoa, Tickfaw, and Tchefuncte Rivers -- 50 NTU;

4. freshwater lakes, reservoirs, and oxbows -- 25 NTU;

5. designated scenic streams and outstanding natural resource waters not specifically listed above -- 25 NTU; and

6. for other state waters not included above and in water body segments where natural background turbidity exceeds the values specified above, the turbidity in NTU caused by any discharges shall be restricted to the appropriate background value plus 10 percent. This shall not apply to designated intermittent streams.

The administrative authority may exempt for short periods certain activities permitted under Sections 402 or 404 and certified under Section 401 of the Clean Water Act, such as maintenance dredging of navigable waterways or other short-term activities that the state determines are necessary to accommodate legitimate uses or emergencies or to protect the public health and welfare.

(j) Flow. The natural flow of state waters shall not be altered to such an extent that the basic character and water quality of the ecosystem are adversely affected except in situations where alterations are necessary to protect human life or property. If alterations to the natural flow are deemed necessary, all reasonable steps shall be taken to minimize the adverse impacts of such alterations. Additionally, all reasonable steps shall be taken to mitigate the adverse impacts of unavoidable alterations.

(k) Radioactive materials. Radioactive materials in the surface waters of the state designated for drinking water supply use shall not exceed levels established pursuant to the Federal Safe Drinking Water Act (P.L. 93-523 et Seq.).

(l) Biological and Aquatic Community Integrity. The biological and community structure and function in state waters shall be maintained, protected, and restored except where not attainable and feasible as defined in LAC 33:IX.1109.B.3. This is the ideal condition of the aquatic community inhabiting the impaired water bodies of a specified habitat and region as measured by community structure and function. The biological integrity will be guided by the fish and wildlife propagation use designated for that particular water body. Fish and wildlife propagation uses are defined in LAC 33.IX.111.C. The condition of these aquatic communities shall be determined from the measures of physical, chemical, and biological characteristics of each surface water body type, according to its designated use. Reference site conditions will represent naturally attainable conditions. These sites should be the least impacted and most representative of water body types. Such reference sites or segments of water bodies shall be those observed to support the greatest variety and abundance of aquatic life in the region as is expected to be or has been recorded during past surveys in natural settings essentially undisturbed by human impacts, development, or discharges. This condition shall be determined by consistent sampling and reliable measures of selected, indicative communities of animals and/or invertebrates as established by the office and may be used in conjunction with acceptable chemical, physical, and microbial water quality measurements and records as deemed for this purpose.

(m) Other substances and Characteristics. General criteria on other substances and characteristics not specified in this section will be developed as needed.

(2) Numerical water quality standards. Numerical criteria identified in Table A25 apply to specified water bodies, and to their tributaries, distributaries, and interconnected streams and water bodies contained in the water management subsegment if they are not specifically named therein, unless unique chemical, physical, and/or biological conditions preclude the attainment of the criteria. In those cases, natural background levels of these conditions may be used to establish site-specific water quality criteria. Those water bodies officially approved and designated by the state and EPA as intermittent streams, man-made water bodies, or naturally dystrophic waters may be excluded from some or all numerical criteria as stated in LAC 33:IX.1109. Although naturally occurring variations in water quality may exceed criteria, water quality conditions attributed to human activities must not exceed criteria when flows are greater than or at critical conditions.

A list of surface waters in the study area for which numerical criteria are included in the published tables is shown in Table A25. This table also includes designated use categories for the surface waters listed. Designated water uses for each stream are represented as follows:

A = Primary Contact Recreation
B = Secondary Contact Recreation
C = Propagation of Fish and Wildlife
D = Drinking Water Supply
E = Oyster Propagation
F = Agriculture
G = Outstanding Natural Resource Waters

(a) pH. The pH shall fall within the range of 6.0 to 9.0 standard units (su) unless natural conditions exceed this range or where otherwise specified in the tables. No discharge of wastes shall cause the pH of the water body to vary by more than one pH unit within the specified pH range for that subsegment where the discharge occurs.

(b) Chlorides, sulfates, and dissolved solids. Numerical criteria for these parameters generally represent the arithmetic mean of existing data from the nearest sampling location plus three standard deviations. For estuarine and coastal marine waters subsegments that have no listed criteria (i.e. designated N/A), criteria will be established on a case-by-case basis using field determination of ambient conditions and the designated uses. For water bodies not specifically listed in the Numerical Criteria and Designated Table, increases over background levels of chlorides, sulfates, and total dissolved solids may be permitted. Such increases will be permitted at the discretion of the office on a case-by-case basis and shall not cause in-stream concentrations to exceed 250, 250, and 500 mg/L for chlorides, sulfates, and total dissolved solids, respectively, except where a use attainability analysis indicates that higher levels will not affect the designated uses. In permitting such increases, the office shall consider their potential effects of resident biota and downstream water bodies in addition to the background conditions. Under no circumstances shall an allowed increase over background conditions cause any numerical criteria to be exceeded in any listed water body or any other general or numerical criteria to be exceeded in either listed or unlisted water bodies.

(c) Dissolved oxygen. The following dissolved oxygen (DO) values represent minimum values for the type of water specified. Naturally occurring variations below the criterion specified may occur for short periods. These variations reflect such natural phenomena as the reduction in photosynthesis activity and oxygen production by plants during hours of darkness. However, no waste discharge or human activity shall lower the DO concentration below the specified minimum. These DO criteria shall apply except in those water bodies which qualify for an excepted water use as specified in LAC 33.IX.1109.C or where exempted or excluded elsewhere in these standards. DO criteria for specific state water bodies are contained in LAC 33.IX.1123.

1. Freshwater. For a diversified population of warm water biota including sport fish, the DO concentration shall be at or above 5 mg/L.

2. Estuarine water. DO concentrations in estuarine waters shall not be less than 4 mg/L at any time.

3. Coastal marine water (Including Near shore Gulf of Mexico). DO concentrations in coastal waters shall not be less than 5 mg/L, except when the upwellings and other natural phenomena cause this value to be lower.

(d) Temperature. The temperature criteria enumerated in Table A25, in most cases, represent maximum values obtained from existing data. In a few cases, however, a limited number of unusually high temperatures in the range of 35 degrees to 36 degrees (95-97 degrees F) have been deleted because these values are believed to have been recorded during conditions of unseasonably high temperatures and/or unusually low flows or water levels and therefore, do not represent normal maximum temperatures.

The criterion consists of two parts, a temperature differential and a maximum temperature. The temperature differential represents the maximum permissible increase above ambient conditions after mixing. No additional process heat shall be added once the ambient temperature reaches the maximum temperature specified in the standards, except under natural conditions such as unusually hot, dry weather, as provided for in the following sections.

1. Freshwater. The following temperature standards apply to freshwater:

a. Maximum of 5°F [2.8° Centigrade (C)] rise above ambient for streams and rivers.

b. Maximum of 3°F (1.7°C) rise above ambient for lakes and reservoirs.

c. Maximum temperature of 32.2°C (90°F), except where otherwise listed in the tables. Maximum temperature may be varied on a case-by-case basis to allow for the effects of natural conditions such as unusually hot and/or dry weather.

3. Estuarine and Coastal. The following temperature standards apply to estuarine and coastal waters:

a. Maximum of 4°F (2.2°C) rise above ambient from October through May.

b. Maximum 2°F (1.1°C) rise above ambient from June through September; and

c. maximum temperature of 95°F (35°C), except when natural conditions elevate temperature above this level.

These temperature criteria shall not apply to privately-owned reservoirs or reservoirs constructed solely for industrial cooling purposes.

(e) Bacteria. The applicability of bacterial criteria to a particular stream segment depends upon the use designation of that individual stream segment. Limitations are placed on either the most probable number (MPN) fecal or total coliform concentration, or on a combination of both in order to achieve the stream sanitary quality required for the most restrictive designated use classification.

Table A25 lists the applicable criteria for each individual Louisiana stream segment and designates one of the following four criteria as applicable according to present and/or anticipated water usage of the segment:

1. PRIMARY CONTACT RECREATION. Based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 200/100 mL nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 400/100 mL.

2. SECONDARY CONTACT RECREATION. Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100 mL nor shall more than 10 percent of the total samples during any 30-day period or 25 percent of the total samples collected annually exceed 2,000/100 mL.

3. DRINKING WATER SUPPLY. The monthly arithmetic mean of total coliform most probable number (MPN) shall not exceed 10,000/100 mL, nor shall the monthly arithmetic mean of fecal coliform exceed 2,000/100 mL.

4. OYSTER PROPAGATION. The fecal coliform median MPN shall not exceed 14 fecal coliform per 100 mL, and not more than 10 percent of the samples shall exceed an MPN of 43/100 mL for a 5-tube decimal dilution test in those portions of the area most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions.

(f) Toxic substances. Numerical criteria for specific toxic substances are mostly derived from the following publications of the Environmental Protection Agency: Water Quality Criteria, 1972 (commonly referred to as the "Blue Book"); Quality Criteria for Water, 1976 (commonly referred to as the "Red Book"); Ambient Water Quality Criteria, 1980 (EPA 440/5-80); Ambient Water Quality Criteria, 1984 (EPA 440/5-84-85); and Quality Criteria for Water, 1986 - with updates (commonly referred to as the "Gold Book"). Natural background conditions, however, are also considered. These toxic substances are selected for criteria development because of their known or suspected occurrence in Louisiana waters and potential threat to attainment of designated water uses.

TABLE A25

1994 LDEQ NUMERICAL STANDARDS APPLICABLE TO SURFACE WATERS IN THE STUDY AREA

Stream Description	Water Uses A	B	C	D	E	F	G	CL mg/L	SO_4 mg/L	DO mg/L	pH Range su	Bacterial Standard BAC	Temperature °C	TDS mg/L
Lower Tchefuncte River- From La. Hwy. 22 to Lake Pontchartrain (Estuarine)	X	X	X					850	135	4.0	6.0-8.5	1	30	1850
Bayou Bonfouca - headwaters to LA Highway 433	X	X	X					250	100	5.0	6.0-8.5	1	32	500
W-14 Main Diversion Canal- 32 N/A from its origin in the north end of the City of Slidell to its junction with Salt Bayou	X	X	X					N/A[1]	N/A	Seas[2]		6.0-8.5	1	
West Pearl River - from confluence with Holmes Bayou to the Rigolets (includes east and west mouths) (Scenic)	X	X	X				X	90	20	5.0	6.0-8.5	1	32	235
Bayou Lacombe - U.S. 190 to Lake Pontchartrain (Scenic) (Estuarine)	X	X	X				X	835	135	4.0	6.0-8.5	1	32	1850
Bogue Falaya River - headwaters to Tchefuncte River (Scenic)	X	X	X				X[3]	20	10	5.0	6.0-8.5	1	30	110
Lake Pontchartrain - West of Highway 11 Bridge (Estuarine)	X	X	X					N/A	N/A	4.0	6.5-9.0	1	32	N/A
Lake Pontchartrain - East of Highway 11 Bridge (Estuarine)	X	X	X		X			N/A	N/A	4.0	6.5-9.0	4	32	N/A

1 N/A - not applicable at present
2 Designated Man-made waterbody; Seasonal DO Criteria: 4.0 mg/L November - March, 2.5 mg/L April - October, Subcategory Fish and Wildlife Use, Blue Crab Use.
3 Scenic River Segment limited to: Confluence of East and West Prong to LA Highway 437, north of Covington.

The criteria for protection of aquatic life are based on acute and chronic concentrations in fresh and marine waters as specified in the EPA criteria documents and are developed primarily for attainment of the fish and wildlife propagation use. Where a specific numerical criterion is not derived in EPA criteria documents, a criterion is developed by applying an appropriate application factor for acute and chronic effects to the lowest LC50 value for a representative Louisiana species.

Criteria for human health are derived using EPA guidelines, procedures, and equations for water bodies used as drinking water supplies and those not used as drinking water supplies. Criteria applied to water bodies designated as drinking water supplies are developed to protect that water supply for human consumption, including protection against taste and odor effects, to protect it for primary and secondary contact recreation, and to prevent contamination of fish and aquatic life consumed by humans. Criteria for water bodies not designated as drinking water supplies are developed to protect them for primary and secondary contact recreation and to prevent contamination of fish and aquatic life consumed by humans. In some cases, the maximum contaminant levels (MCLs) from the National Drinking Water Regulations, when more restrictive, are used as the criteria. For those toxic substances that are suspected or proven carcinogens, an incremental cancer risk level of 10^{-6} (1 in 1,000,000) is used in deriving criteria, with the exception of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and hexachlorocyclohexane (lindane, gamma BHC), in which case 10^{-5} (1 in 100,000) is used to derive the criteria.

Metals criteria are based on dissolved metal concentrations in ambient waters. Hardness values are averaged from two-year data compilations contained in the latest Louisiana Water Quality Data Summary or other comparable data compilations or reports.

For purposes of criteria assessment, the most stringent criteria for each toxic substance will apply. For determination of criteria attainment in ambient water where the criteria are below the detection limit, then no detectable concentrations will be allowed. However, for dilution calculations or water quality modeling used to develop total maximum daily load and wasteload allocations, the assigned criteria, even if below the detection limit, will be used.

Table A26 is a listing of these substances and their criteria.

TABLE A26

1994 LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY NUMERICAL CRITERIA FOR SPECIFIC TOXIC SUBSTANCES

(In micrograms per liter (ug/L) or parts per billion (ppb) unless otherwise stated)

	Aquatic Life Protection				Human Health	
Toxic Substance	Freshwater Acute	Freshwater Chronic	Marine Acute	Marine Chronic	Drinking Supply[1]	Non Drinking Supply[2]
Pesticides and PCBs						
Aldrin	3.00	-	1.300	-	0.04 ng/L	0.04 ng/L[3]
Chlordane	2.40	0.0043	0.090	0.0040	0.19 ng/L	0.19 ng/L
DDT	1.10	0.0010	0.130	0.0010	0.19 ng/L	0.19 ng/L
TDE (DDD)	0.03	0.0060	1.250	0.2500	0.27 ng/L	0.27 ng/L
DDE	52.5	10.5000	0.700	0.1400	0.19 ng/L	0.19 ng/L
Dieldrin	2.50	0.0019	0.710	0.0019	0.05 ng/L	0.05 ng/L
Endosulfan	0.22	0.0560	0.034	0.0087	0.47	0.64
Endrin	0.18	0.0023	0.037	0.0023	0.26	0.26
Heptachlor	0.52	0.0038	0.053	0.0036	0.07 ng/L	0.07 ng/L
Hexachlorocyclohexane (gamma BHC, Lindane)	5.30	0.21	0.160	-	0.11	0.20
Polychlorinated Biphenols, Total (PCBs)	2.00	0.0140	10.000	0.0300	0.01 ng/L	0.01 ng/L
Toxaphene	0.73	0.0002	0.210	0.0002	0.24 ng/L	0.24 ng/L
2,4-Dichlorophenoxyacetic acid (2,4-D)	-	-	-	-	100.00	-
2-(2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP, Silvex)	-	-	-	-	10.00	-
Volatile Organic Chemicals						
Benzene	2249	1125	2700	1350	1.1	12.5
Carbon Tetrachloride (Tetrachloromethane)	2730	1365	15000	7500	0.22	1.2
Chloroform (Trichloromethane)	2890	1445	8150	4075	5.3	70
Ethylbenzene	3200	1600	8760	4380	2.39 mg/L	8.1 mg/L[4]
1, 2-Dichloroethane (EDC)	11800	5900	11300	5650	0.36	6.8
1,1,1-Trichloroethane	5280	2640	3120	1560	200.0	
1,1,2-Trichloroethane	1800	900	-	-	0.56	6.9
1,1,2,2-Tetrachloroethane	932	466	902	451	0.16	1.8
1,1-Dichloroethylene	1160	580	22400	11200	0.05	0.58
Trichloroethylene	3900	1950	200	100	2.8	21
Tetrachloroethylene	12900	645	1020	510	0.65	2.5
Toluene	1270	635	950	475	6.1 mg/L	46.2 mg/L
Vinyl Chloride (Chloroethylene)	-	-	-	-	1.9	35.8
Bromoform (Tribromomethane)	2930	1465	1790	895	3.9	34.7
Bromodichloromethane	-	-	-	-	0.2	3.3
Methylene chloride (Dichloromethane)	19300	9650	25600	12800	4.4	87
Methyl chloride (Chloromethane)	55000	27500	27000	13500	-	-
Dibromochloromethane	-	-	-	-	0.39	5.08
1-3 Dichloropropene	606	303	79	39.5	9.86	162.79

TABLE A26(cont.)

1994 LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
NUMERICAL CRITERIA FOR SPECIFIC TOXIC SUBSTANCES

(In micrograms per liter (ug/L) or parts per billion (ppb) unless otherwise stated)

	Aquatic Life Protection				Human Health	
Toxic Substance	Freshwater Acute	Freshwater Chronic	Marine Acute	Marine Chronic	Drinking Supply[1]	Non Drinking Supply[2]
Acid - Extractable Organic Chemicals						
2-Chlorophenol	258	129	-	-	0.10	126.4
3-Chlorophenol	-	-	-	-	0.10	-
4-Chlorophenol	383	192	535	268	0.10	-
2,3-Dichlorophenol	-	-	-	-	0.04	-
2,4-Dichlorophenol	202	101	-	-	0.30	232.6
2,5-Dichlorophenol	-	-	-	-	0.50	-
2,6-Dichlorophenol	-	-	-	-	0.20	-
3,4-Dichlorophenol	-	-	-	-	0.30	-
Phenol (Total)[5]	700	350	580	290	5.00	50.0
Base/Neutral Extractable Organic Chemicals						
Benzidine	250	125	-	-	0.08 ng/L	0.17 ng/L
Hexachlorobenzene	-	-	-	-	0.25 ng/L	0.25 ng/L
Hexachlorobutadiene[6]	5.1	1.02	1.6	0.32	0.09	0.11
Other Organics						
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)[9]	-	-	-	-	0.71 ppq[8]	0.72 ppq
Metals						
Arsenic	360	190	69.00	36.00	50.0	-
Chromium III (Tri)[7]	(980,1700,3100)	(120,210,370)	515.00	103.00	50.0	-
Chromium VI (Hex)	16	11	1.10 mg/L	50.00	50.0	-
Zinc[7]	(65,120,210)	(59,110,190)	95.00	86.00	5.0mg/L	-
Cadmium[7]	(15.4,33.7,73.6)	(0.66,1.13,2.0)	45.62	10.00	10.0	-
Copper[7]	(9.9,19.2,36.9)	(7.1,12.8,23.1)	4.37	4.37	1.0mg/L	-
Lead[7]	(34,82,200)	(1.3,3.2,7.7)	220.00	8.50	50.0	-
Mercury	2.4	0.012[10]	2.10	0.025[10]	2.0	-
Nickel[7]	(790,1400,2500)	(88,160,280)	75.00	8.30	-	-
Cyanide	45.9	5.4	1.0	-	663.8	12844

1 Applies to surface waterbodies designated as a Drinking Water Supply and also protects for primary and secondary contact recreation and fish consumption.
2 Applies to surface waterbodies not designated as a Drinking Water Supply and protects for primary and secondary contact recreation and fish consumption.
3 ng/L = nanograms per liter, parts per trillion
4 mg/L = milligrams per liter, parts per million
5 Total phenol as measured by the 4 - aminoantipyrine (4AAP) method
6 Includes Hexachloro-1,3-butadiene
7 Hardness-dependent criteria for fresh water based on natural logarithm formulas for acute and chronic protection (numbers in parentheses represent criteria in ug/L at hardness values of 50, 100, and 200 mg/L $CaCO_3$)
8 ppq = parts per quadrillion
9 Advances in scientific knowledge concerning the toxicity, cancer potency, metabolism, or exposure pathways of toxic pollutants that affect the assumptions on which existing criteria are based may necessitate a revision of dioxin numerical criteria at any time. Such revisions, however, will be accomplished only after proper consideration of designated water uses. Any proposed revision will be consistent with state and federal regulations.
10 If the four-day average concentration for total mercury exceeds 0.012 ug/L in freshwater or 0.025 ug/L in saltwater more than once in a three-year period, the edible portion of aquatic species of concern must be analyzed to determine whether the concentration of methyl mercury exceeds the FDA action level (1.0 mg/kg). If the FDA action level is exceeded, the state must notify the appropriate EPA Regional Administrator, initiate a revision of its mercury criterion in its water quality standards so as to protect designated uses, and take other appropriate action such as issuance of a fish consumption advisory for the affected area.

b. <u>EPA water quality criteria</u>. The EPA has established ambient water quality criteria applicable to surface waters in the study area. These criteria are shown in Tables A27, A28, and A29. The numerical criteria listed in these tables have been developed for various physical parameters, nutrients, metals, PCB's, and organic pesticides for uses of freshwater aquatic life, marine and estuarine aquatic life, and public water supply, respectively.

(1) EPA water quality tables follow.

TABLE A27

1986 EPA FRESHWATER AQUATIC LIFE CRITERIA

(All values in ug/L except where noted)

Parameter	Chronic (24-Hour Average)	Acute (Maximum at Any Time)	Chronic[1] (4-Day Average)	Acute[2] (1-Hour Average)
Aesthetic Qualities	(Narrative statement - SEE CRITERIA DOCUMENT)			
Aldrin[P]	-	3.0	-	-
Alkalinity	(20 mg/L MINIMUM)			
Ammonia	(Criteria are pH and temperature dependent-SEE CRITERIA DOCUMENT)			
Arsenic(III)[P]	-	-	190	360
Boron	(750 ug/L for long-term irrigation on sensitive crops)			
Cadmium[4,P]	-	-	1.1/1.6/2	3.9/6.2/8.6
Chlordane[P]	0.0043	2.4	-	-
Chlorine	-	-	11	19
Chlorpyrifos	-	-	0.041	0.083
Chromium (VI)[P]	-	-	11	16
Chromium(III)[4]	-	-	210/289/370	1700/2420/3100
Color	(Narrative statement - SEE CRITERIA DOCUMENT)			
Copper[4,P]	-	-	12/17/21	18/22/34
Cyanide[P]	-	-	5.2	22
DDT[P]	0.0010	1.1	-	-
Demeton[P]	0.1	-	-	-
Dieldrin[P]	0.0019	2.5	-	-
Endosulfan[P]	0.056	0.22	-	-
Endrin[P]	0.0023	0.18	-	-
Gases, Total Dissolved	(Narrative statement - SEE CRITERIA DOCUMENT)			
Guthion	0.01	-	-	-
Heptachlor[P]	0.0038	0.52	-	-
Hexachlorocyclohexane (Lindane)[P]	0.080	2.0	-	-
Iron	1000	-	-	-
Lead[4,P]	-	-	3.2/5.3/7.7	82/137/200
Malathion	0.1	-	-	-
Mercury[P]	-	-	0.012	2.4
Methoxychlor	0.03	-	-	-
Mirex	0.001	-	-	-
Nickel[4,P]	-	-	160/222/280	1400/1999/2500
Oil and Grease	(Narrative statement - SEE CRITERIA DOCUMENT)			
Oxygen, Dissolved	(Warmwater and Coldwater Matrix - SEE CRITERIA DOCUMENT)			
Parathion	-	-	0.013	0.065
Polychlorinated Biphenyls (PCB's)[P]	0.014	2.0	-	-
Pentachlorophenol (PCP)[3,P]	-	-	3.5/13/43	5.5/20/68
pH	(6.5 - 9.0 su)	-	-	-
Selenite (inorganic)[P]	35	260	-	-
Silver[4,P]	-	4.1/8.2/13	-	-
Solids (Suspended) and Turbidity	(Narrative statement - SEE CRITERIA DOCUMENT)			
Sulfide-Hydrogen Sulfide	2.0	-	-	-
Temperature	(Species dependent criteria - SEE CRITERIA DOCUMENT)			
Toxaphene[P]	-	-	0.0002	0.73
Zinc[4,P]	-	-	110/149/190	120/165/210

1 4-day average concentration not to be exceeded more than once every 3 years on the average.
2 1-hour average concentration not to be exceeded more than once every 3 years on the average.
3 pH dependent criteria. Values presented are for 6.5/7.8/9.0 standard pH units.
4 Hardness dependent criteria. Values presented are for 100/150/200 mg/L as $CaCO_3$.
P Priority Pollutant

TABLE A28

1986 EPA SALTWATER AQUATIC LIFE CRITERIA

(All values in ug/L except where noted)

Parameter	Chronic (24-Hour Average)	Acute (Maximum at Any Time)	Chronic[1] (4-Day Average)	Acute[2] (1-Hour Average)
Aesthetic Qualities	(Narrative statement - SEE CRITERIA DOCUMENT)			
Aldrin[P]	-	1.3	-	-
Arsenic(III)[P]	-	-	36	69
CadIum[4,P]	-	-	9.3	43
Chlordane[P]	0.004	0.09	-	-
Chlorine	-	-	7.5	13
Chlorpyrifos	-	-	0.0056	0.011
Chromium (VI)[P]	-	-	50	1100
Color	(Narrative statement - SEE CRITERIA DOCUMENT)			
Copper[4,P]	-	-	-	2.9
Cyanide[P]	-	-	-	1.0
DDT[P]	0.0010	0.13	-	-
Demeton[P]	0.1	-	-	-
Dieldrin[P]	0.0019	0.71	-	-
Endosulfan[P]	0.0087	0.034	-	-
Endrin[P]	0.0023	0.037	-	-
Gases, Total Dissolved	(Narrative statement - SEE CRITERIA DOCUMENT)			
Guthion	0.01	-	-	-
Heptachlor[P]	0.0036	0.053	-	-
Hexachlorocyclohexane (Lindane)[P]	-	0.16	-	-
Lead[4,P]	-	-	5.6	140
Malathion	0.1	-	-	-
Mercury[P]	-	-	0.025	2.1
Methoxychlor	0.03	-	-	-
Mirex	0.001	-	-	-
Nickel[4,P]	-	-	8.3	75
Oil and Grease	(Narrative statement - SEE CRITERIA DOCUMENT)			
Polychlorinated Biphenyls (PCB's)[P]	0.030	10	-	-
Pentachlorophenol (PCP)[3,P]	-	-	7.9	13
pH	(6.5 - 8.5 su)	-	-	-
Phosphorus (Elemental)	0.10	-	-	-
Selenite (inorganic)[P]	54	410	-	-
Silver[4,P]	-	2.3	-	-
Sulfide-Hydrogen Sulfide	2.0	-	-	-
Temperature	(Species dependent criteria - SEE CRITERIA DOCUMENT)			
Toxaphene[P]	-	-	0.0002	0.21
Zinc[4,P]	-	-	86	95

1 4-day average concentration not to be exceeded more than once every 3 years on the average.
2 1-hour average concentration not to be exceeded more than once every 3 years on the average.
P Priority Pollutant

TABLE A29
1986 EPA HUMAN HEALTH CRITERIA
(Units per liter)

Parameter	Fish and Water Ingestion	Fish Consumption Only	Drinking Water M.C.L.[1]	Organo-leptic Criteria[2]
Acenapthene[P]	-	-	-	0.02 mg
Acrolein[P]	320 ug	780 ug	-	-
Acrylonitrile[P,C]	0.58/0.058/0.006 ug	6.5/0.65/0.065 ug	-	-
Aesthetic Qualities	(Narrative Statement - SEE CRITERIA DOCUMENT)			
-	-			
Aldrin[P,C]	0.74/0.074/0.0074 ng	0.79/0.079/0.0079 ng	-	-
Antimony[P]	146 ug	45,000 ug	-	-
Arsenic[P,C]	22/2.2/0.22 ng	175/17.5/1.75 ng	0.05 mg	-
Asbestos[P,C]	300,000/30,000/3,000 Fibers/L	-	-	-
Bacteria	(For Primary Recreation And Shellfish Uses - SEE CRITERIA DOCUMENT)			
Barium	1.0 mg	-	1.0 mg	-
Benzene[P,C]	6.6/0.66/0.066 ug	400/40/4 ug	-	-
Benzidine[P,C]	1.2/0.12/0.01 ng	5.3/0.53/0.05 ng	-	-
Beryllium[P,C]	68/6.8/0.68 ng	1170/117/11.71 ng	-	-
Cadmium[P]	10 ug	-	0.010 mg	-
Carbon Tetrachloride[P,C]	4/0.4/0.04 ug	69.4/6.94/0.69 ug	-	-
Chlordane[P,C]	4.6/0.46/0.046 ng	4.8/0.48/0.048 ng	-	-
Chloroethyl Ether(BIS-2)[P,C]	0.3/0.03/0.003 ug	13.6/1.36/0.136 ug		-
Chloroform[P,C]	1.9/0.19/0.019 ug	157/15.7/1.57 ug	-	-
Chloroisopropyl Ether (BIS-2)[P]	34.7 ug	4.36 mg	-	-
Chloromethyl Ether (BIS)[C]	[37.6/3.76/0.376]X10^{-6} ug	[18.4/1.84/.184]x10^{-3} ug		
-	-			
2-Chlorophenol[P]	-	-	-	.1 ug
4 Chlorophenol	-	-	-	.1 ug
Chlorophenoxy Herbicides(2,4,5,-TP)(Silvex)	10 ug	-	10 ug	-
Chlorophenoxy Herbicides(2,4-D)	100 ug	-	100 ug	-
Chloro-4 Methyl-3 Phenol	-	-	-	3000 ug
Chromium (VI)[P]	50 ug	-	0.05 mg	-
Chromium(III)	170 mg	3,433 mg	-	-
Color	(Narrative statement - SEE CRITERIA DOCUMENT)			
-	-			
Copper[P]	-	-	-	1 mg
Cyanide[P]	200 ug	-	200 ug	-
DDT[P,C]	0.24/0.024/0.0024 ng	0.24/0.024/0.0024 ng	-	-
Dibutyl Phthalate[P]	34 mg	154 mg	-	-
Dichlorobenzenes[P]	400 ug	2.6 mg	-	-
Dichlorobenzidine[P,C]	0.103/0.01/0.001 ug	0.204/0.20/0.002 ug		
-	-			
1,2 Dichloroethane[P,C]	9.4/0.94/0.094 ug	2,430/243/24.3 ug	-	-
Dichloroethylenes[P,C]	0.33/0.033/0.003 ug	18.5/1.85/0.185 ug	-	-
2,4-Dichlorophenol	3.09 mg	-	-	0.3 ug
Dichloropropene[P]	87 ug	14.1 mg	-	-
Dieldrin[P,C]	0.71/0.071/0.0071 ng	0.76/0.076/0.0076 ng	-	-
Diethyl Phthalate[P]	350 mg	1.8 g	-	-
2,4-Dimethylphenol[P]	-	-	-	400 ug
Dimethyl Phthalate[P]	313 mg	2.9 g	-	-
2,4 Dinitrotoluene[C]	1.1/0.11/0.011 ug	91/9.1/0.91 ug	-	-
2,4 Dinitro-o-Cresol[P]	13.4 ug	765 ug	-	-
2,3,7,8-TCDD (Dioxin)[P,C]	[0.13/0.013/0.0013]X10^{-6} ug	[0.14/0.014/.0014]x10^{-6} ug		
-	-			
Diphenylhdrazine[P]	422/42/4 ng	5.6/0.56/0.056 ug	-	-
Di-2-EthylHexyl Phthalate[P]	15 mg	50 mg	-	-
Endosulfan[P]	74 ug	159 ug	-	-
Endrin[P]	1 ug	-	0.0002 mg	-
Ethylbenzene[P]	1.4 mg	3.28 mg	-	-
Fluoranthene[P]	42 ug	54 ug	-	-
Halomethanes[P,C]	1.9/0.19/0.019 ug	157/15.7/1.57 ug	-	-
Heptachlor[P,C]	2.78/0.28/0.028 ng	2.85/0.29/0.029 ng	-	-
Hexachloroethane[C]	19/1.9/0.19 ug	87.4/8.74/0.87 ug	-	-
Hexachlorobenzene[P,C]	7.2/0.72/0.072 ng	7.4/0.74/0.074 ng	-	-
Hexachlorobutadiene[P,C]	4.47/0.45/0.045 ug	500/50/5 ug	-	-
Hexachlorocycohexane-Alpha[P,C]	92/9.2/0.92 ng	310/31/3.1 ng	-	-
Hexachlorocyclohexane-Beta[P,C]	163/16.3/1.63 ng	547/54.7/5.47 ng	-	-
Hexachlorocyclohexane-Gama[P,C]	186/18.6/1.86 ng	625/62.5/6.25 ng	-	-
Hexachlorocyclohexane-Technical[P,C]	123/12.3/1.23 ng	414/41.4/4.14 ng	-	-

TABLE A29 (cont.)
1986 EPA HUMAN HEALTH CRITERIA
(Units per liter)

Parameter	Fish and Water Ingestion	Fish Consumption Only	Drinking Water M.C.L.[1]	Organo-leptic Criteria[2]
Hexachlorocyclopentadiene[P]	206 ug	–	–	1 ug
Iron	0.3 mg	–	.3 mg	–
Isophorone[P]	5.2 mg	520 mg	–	–
Lead[P]	50 ug	–	0.05 mg	–
Manganese	50 ug	100 ug	50 ug	–
Mercury[P]	144 ng	146 ng	0.002 mg	–
Methoxychlor	100 ug	–	0.1 mg	–
Monochlorobenzene[P]	488 ug	–	–	20 ug
Nickel[P]	13.4 ug	100 ug	–	–
Nitrates	10 mg	–	10 mg	–
Nitrobenzene[P]	19.8 mg	–	–	30 ug
Nitrosodibutylamine N[P,C]	64/6.4/0.64 ng	5,868/587/58.7 ng	–	–
Nitrosodiethylamine N[P,C]	8/0.8/0.08 ng	12400/1,240/124 ng	–	–
Nitrosodimethylamine N[P,C]	14/1.4/0.14 ng	160000/16,000/1600 ng	–	–
Nitrosodiphenylamine N[P,C]	49000/4,900/490 ng	161000/16,100/1610 ng	–	–
Nitrosopyrrolidine N[P,C]	160/16/1.6 ng	919000/91,900/9190 ng	–	–
Oil And Grease	(Narrative Statement – SEE CRITERIA DOCUMENT)		–	–
PCBs[P,C]	0.79/0.079/0.0079 ng	0.79/0.079/0.0079 ng	–	–
Pentachlorobenzene	74 ug	85 ug	–	–
Pentachlorophenol[P]	1.01 mg	–	–	–
Phenol[P]	3.5 mg	–	–	0.3 mg
Polynuclear Aromatic Hydrocarbons[P,C]	28/2.8/0.28 ng	311/31.1/3.11 ng	–	–
Selenium[P]	10 ug	–	0.01 mg	–
Silver[P]	50 ug	–	0.05 mg	–
Solids(Dissolved)And Salinity	–	–	250 mg	–
Tainting Substances	(Narrative Statement – SEE CRITERIA DOCUMENT)			
– –				
1,2,4,5 Tetrachlorobenzene[P]	38 ug	48 ug	–	–
1,1,2,2-tetrachloroethane[P,C]	1.7/0.17/0.017 ug	107/10.7/1.07 ug	–	–
Tetrachloroethylene[P,C]	8/0.8/0.08 ug	88.5/8.85/0.88 ug	–	–
Thalium[P]	13 ug	48 ug	–	–
Toluene[P]	14.3 mg	424 mg	–	–
Toxaphene[P,C]	7.1/0.71/0.07 ng	7.3/0.73/0.07 ng	0.005 mg	–
1,1,1-trichloroethane[P]	18.4 mg	1.03 g	–	–
1,1,2-trichloroethane[P,C]	6/0.6/0.06 ug	418/41.8/4.18 ug	–	–
Trichloroethylene[P,C]	27/2.7/0.27 ug	807/80.7/8.07 ug	–	–
2,4,5-trichlorophenol	2,600 ug	–	–	1 ug
2,4,6-trichlorophenol[P,C]	12/1.2/0.12 ug	36/3.6/0.36 ug	–	2 ug
Vinyl Chloride[P,C]	20/2/0.2 ug	5246/525/52.5 ug	–	–

1 M.C.L. is maximum contaminant level

2 To control undesirable taste and order quality of ambient water. It should be recognized that organoleptic data have limitations as a basis for establishing water quality criteria, and have no demonstrated relationship to potential adverse human health effects.

P Priority Pollutant

C Carcinogenic pollutant. For the maximum protection of human health from the potential carcin-genic effects resulting from exposure to these pollutants, the ambient water concentrations should be zero. The levels presented are for $10^{-5}/10^{-6}/10^{-7}$ incremental increase of cancer risk over the lifetime.

(2) Additional EPA water quality criteria are as follows:

(a) Aesthetic qualities. All waters free from substances attributable to wastewater or other discharges that:

1. settle to form objectionable deposits;

2. float as debris, scum, oil, or other matter to form nuisances;

3. produce objectionable color, odor, taste, or turbidity;

4. injure or are toxic or produce adverse physiological responses in humans, animals or plants; and

5. produce undesirable or nuisance aquatic life.

(b) Color. Waters shall be virtually free from substances producing objectionable color for aesthetic purposes; the source of supply should not exceed 75 color units on the platinum-cobalt scale for domestic water supplies, and increased color (in combination with turbidity) should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.

(c) Dissolved oxygen. Water should contain sufficient DO to maintain aerobic conditions in the water column and, except as affected by natural phenomena, at the sediment-water interface. Numerical criteria are available for varying aquatic life stages for coldwater and warmwater species.

(d) Fecal coliform bacteria.

1. Bathing waters. Based on a minimum of five samples equally spaced over a 30-day period, the geometric mean of the E. coli density should not exceed 126 per 100 mL for freshwater bathing. For the above sampling period, the geometric means of the enterococci density should not exceed 33 and 35 per 100 mL for freshwater and marine bathing, respectively.

2. Shellfish harvesting waters. The median fecal coliform bacterial concentration should not exceed 14 MPN/100 mL for the taking of shellfish, with not more than 10 percent of samples exceeding 43 MPN/100 mL.

(e) Oil and grease. For domestic water supply: virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products. For aquatic life: (1)

levels of individual petrochemicals in the water column should not exceed 0.01 times the lowest continuous flow 96-hour LC_{50} to several important freshwater or marine species, each having a demonstrated high susceptibility to oils and petrochemicals; (2) levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota should not be allowed; and (3) surface waters shall be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum derived oils.

(f) Settleable and suspended solids. Freshwater fish and aquatic life: settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.

(g) Tainting substances. Materials should not be present in concentrations that individually or in combination produce undesirable flavors which are detectable by organoleptic tests performed on the edible portions of aquatic organisms.

The LDEQ general criteria state that "all waters of the state shall be capable of supporting desirable diversified species of fish, shellfish and wildlife." Therefore, EPA criteria for freshwater or marine aquatic life, Tables A27 and A28, respectively, are held to apply to all surface waters. Also, EPA criteria for the protection of human health apply to all surface waters.

3. Existing Water Quality. An analysis of existing water quality was conducted to determine existing water resource problems and to develop a background for water quality projections. Background water quality is used to verify projection methodologies and to identify water quality problems that merit particular attention. The report will mainly focus attention on existing water quality evaluations previously conducted for the waters of the project area.

The LDEQ publication "Water Quality Management Plan - Water Quality Inventory 1994" is the main basis for the existing water quality provided in this report. Data and information on waterbodies are assessed at two levels by LDEQ. The first level uses ambient monitoring data to assess designated uses and the second level uses other information, such as complaint investigations and spill records to assess use support of the waterbody. The two levels are "monitored" and "evaluated". "Monitored" waters are those for which the assessment is based on site-specific data, i.e., where there are existing water quality stations. The "evaluated" waterbodies are those for which the assessment is based on land use, location of point and nonpoint sources, citizen complaints, short term fisheries surveys, intensive surveys, and general observations of the waterbody.

Monitored waterbodies were assessed by using a Use Impairment Index. For the 1994 monitored assessment, the Use Impairment Index used 5 years of monthly water quality data. Metals and toxics data were not taken into consideration in the index. The Use Impairment Index was calculated based upon the frequency of exceedance of water quality criteria for the specified parameters. Evaluated waterbodies were assessed through questionnaires sent to LDEQ regional personnel. Questions included use support, water quality conditions, causes of problems, and pollutant sources in the waterbody. The Louisiana Water Quality Standards define seven designated uses for surface water: primary contact recreation, secondary contact recreation, fish and wildlife propagation, drinking water supply, oyster propagation, agriculture, and outstanding natural resource waters. In general, the main criteria considered for monitored waterbodies in determination of use attainment are listed below:

Primary Contact Recreation-	Fecal Coliform Bacteria:	400 colonies/100mL (max)
Secondary Contact Recreation-	Fecal Coliform Bacteria:	2,000 colonies/100mL (max)
Fish and Wildlife Propagation-	Dissolved Oxygen:	5 mg/L (freshwater) (min)
		4 mg/L (estuaries) (min)
Drinking Water Supply-	Total Coliform Bacteria:	10,000 colonies/100mL (max)
	Fecal Coliform Bacteria:	2,000 colonies/100mL (max)

Use impairment is based on values obtained at these stations for nine separate parameters. These values are then compared with established criteria for each waterbody to determine support of designated uses. Primary and secondary determinant parameters within each designated use category were established in order to maximize effectiveness of use support classification procedures. The primary and secondary determinant parameters are listed in Table A30. The criteria for parametric support classification per designated use is shown in Table A31.

TABLE A30
PRIMARY AND SECONDARY PARAMETERS FOR DETERMINING LDEQ USE SUPPORT CLASSIFICATIONS

Use	Primary Parameter	Secondary Parameter
Primary Contact Recreation	Fecal Coliform	Temperature
Secondary Contact Recreation	Fecal Coliform	None
Fish and Wildlife Propagation	Dissolved Oxygen	Temperature, pH, Chlorides, Sulfates Total Dissolved Solids
Drinking Water Supply	None	Color, Total Coliform, Fecal Coliform
Outstanding Natural Resource	Turbidity	None

TABLE A31
LDEQ CRITERIA FOR PARAMETRIC SUPPORT CLASSIFICATIONS

Degree of Support	Primary Determinant Determinant Parameters	Secondary Determinant Parameters
Fully criteria	If the parameter criteria are exceeded in <10% of the samples analyzed.	If the parameter are exceeded in <30% of the samples analyzed.
Partially criteria	If the parameter criteria are exceeded in 11% to 25% of the samples analyzed.	If the parameter are exceeded in 31% to 75% of the samples analyzed.
Not	If the parameter criteria are exceeded in >25% of the samples analyzed.	If the parameter criteria are exceeded in >75% of the samples analyzed.

The existing water quality conditions are described for the six project alternatives as follows:

a. Bayou Chinchuba. There is no existing water quality or sediment data for Bayou Chinchuba. However, due to the surrounding land use it is unlikely that the stream segment is highly polluted with pesticides or heavy trace metals. Existing water quality problems are more likely related to low dissolved oxygen concentrations and high fecal coliform levels. According to "Louisiana's Natural Scenic Streams Survey" the water quality of Bayou Chinchuba is poor due to sewerage discharges and urban runoff.

Bayou Chinchuba is designated by Louisiana Department of Wildlife and Fisheries as a natural and scenic river. A natural and scenic river is defined by law as a river, stream or bayou that is in a free-flowing condition and has not been channelized, cleared or snagged within the past 25 years, realigned, inundated, or otherwise altered, has a shoreline covered by native vegetation and has no or few man-made structures along the banks. The Louisiana Natural and Scenic Rivers System is administered by the Louisiana Department of Wildlife and Fisheries (LDWF) for purposes of preserving, developing, reclaiming, and enhancing the wilderness quantities, scenic beauties, and ecological regime of designated free-flowing waterbodies.

Bayou Chinchuba's has an outfall to Lake Pontchartrain and an unnamed canal that empties into the Tchefuncte River. The Lower Tchefuncte River overall does not support it's designated water uses of primary contact recreation, secondary contact recreation, and fish and wildlife propagation. Specifically, primary contact recreation is not supported, secondary contact recreation is not supported, and fish and wildlife propagation is partially supported. Identified sources are: municipal point sources, inflow and infiltration, urban runoff/storm sewers, septic tanks and upstream sources. The cause is primarily pathogen indicators. This assessment was based on evaluated information rather than site specific ambient water quality data. A swimming advisory has been in effect on the Tchefuncte River since February 1991 and septic tanks are cited as the source of pollution. The recommendation is to avoid swimming or other primary contact sports. There are two monitored stations along the upper end of the Tchefuncte River but there are none in the project vicinity.

b. Abita River, North and South Tributaries. There are no existing water quality or sediment data for the Abita River. Abita River flows southward to the Bogue Falaya River which is an evaluated stream by LDEQ. The evaluated assessment was based on information other than current site-specific ambient water quality data. The overall water quality for the Bogue Falaya

River is partially supporting its designated water uses. Primary and secondary contact recreation are considered not supporting, while fish and wildlife propagation is considered fully supporting. Inflow and infiltration, pastureland and septic tanks are cited as contributing factors to moderate problems with pathogen indicators. There is also a swimming advisory in effect since February 1991 due to fecal coliform contamination with possible sources of septic tanks and animal discharges. The advisory recommends avoiding swimming or other primary contact sports.

c. Big Branch (west of Bayou Lacombe) and Bayou Lacombe. There is no existing water quality or sediment data for Big Branch Bayou. However, due to surrounding land use it is unlikely that the stream is highly polluted with pesticides or trace metals. Existing water quality problems are more likely related to low dissolved oxygen concentrations and high fecal coliform levels.

Bayou Lacombe is designated as an outstanding natural resource water from U.S. Highway 190 to Lake Pontchartrain. Currently there are no active water quality stations on Bayou Lacombe. However, water quality and sediment samples were collected in June 1969 and March 1974. These samples do not suggest any contraventions of the state or EPA criteria for physical parameters, pesticides, or PCBs. However, cadmium exceeded the EPA acute aquatic life criteria, while lead and mercury exceeded the EPA chronic aquatic life criteria. Since these parameters were sampled only once and the criteria specify minimum sampling durations, these contraventions should be regarded only as "possible exceedances." Also, in 1994 the LDEQ assessed Bayou Lacombe, from U.S. Highway 190 to Lake Pontchartrain as fully supporting its designated water uses. Primary and secondary contact recreation are partially supported and fish and wildlife propagation is fully supported. A second stream segment of Bayou Lacombe from its headwaters to U.S. Highway 190 overall fully supports its designated water uses; with primary and secondary contact recreation threatened, and fish and wildlife propagation fully supporting. The suspected source for both segments is septic tanks, while the suspected cause for both segments is pathogen indicators. The evaluated assessment was based on information other than current site-specific ambient water quality data.

d. W-13 Canal. There is no existing water quality or sediment data for Bayou Vincent. A clarification first must be made to a discrepancy on exactly where W-13 Canal begins and Bayou Bonfouca ends. For the purpose of this project, W-13 Canal is stated to begin approximately 0.8 miles upstream of Bayou Bonfouca's intersection with LA Highway 433. Because of this, the water segment which is described by LDEQ as Bayou Bonfouca from its headwaters to LA Highway 433, also contains a segment of waterway which for the purposes of the project is labeled W-13 Canal.

Work on W-13 Canal is proposed to begin at the American Creosote NPL site and continue upstream to W-13's intersection with Browns Village Road.

Along this stream segment of Bayou Bonfouca between LA Highway 433 and US Highway 190 lies the American Creosote Superfund Site. The site was placed on the National Priorities List (NPL) due to contamination by creosote as a result of a 1970 fire and tank explosion in which several thousand cubic yards of the compound spilled into Bayou Bonfouca and onto an adjacent land area. Creosote is a phenolic compound commonly used as a wood preservative. Contamination to the area also occurred through a legacy of poor plant operating procedures. The plant had been operating for almost 100 years prior to its closure after the fire. Remediation of the adjacent bayou involved dredging 165,000 cubic yards of contaminated sediments from Bayou Bonfouca, and remediation of the land involved incineration of surface material on site. The bayou has been remediated to an appropriate risk level in accordance with EPA and LDEQ. The most heavily contaminated channel sediments were removed and the channel was backfilled. An approximate 2000 linear foot sheetpile bulkhead was added along both sides of Bayou Bonfouca. Deed restrictions and no dredging regulations by EPA and LDEQ have assured that the sheetpiles and backfill will not be disturbed in the future. Bayou Bonfouca remains under a navigational closure through 1999 from the entrance of Chamela Cove Marina northward.

The Bayou Bonfouca stream segment from its headwaters to LA Highway 433 is listed as not supporting primary and secondary contact recreation as well as fish and wildlife. Therefore, overall Bayou Bonfouca does not support its designated water uses. Sources are sewer/stormwater overflow, urban runoff/storm sewers, septic tanks, contaminated sediments, and inactive/abandoned hazardous waste site. The listed causes are priority organics, pathogen indicators, and oil and grease. A swimming and fish consumption advisory has been issued for Bayou Bonfouca since November 1987 extending 0.25 mile upstream of the American Creosote site to 1 mile south of LA 433 due to surface runoff from the abandoned facility. In addition, the average mercury fish tissue concentration in the Bayou Bonfouca area is notably high. Since 1986, fish samples have been collected for mercury tissue analysis at 37 areas in Louisiana. A total of 268 tissue samples are on record, the average concentration for all samples was 0.32 ppm, with the level in Bayou Bonfouca at 0.52 ppm, among the highest concentrations of mercury in fish tissue from the samples taken. However, mercury has not been detected in the water column at significant levels at any of the sites which have been investigated.

e. W-14 Canal. There is no existing water quality or sediment data for the W-14. However, it is an evaluated LDEQ stream segment from its origin to its junction with Salt Bayou. According to LDEQ W-14 does not support it's designated water uses of primary contact recreation, secondary contact recreation, and fish and wildlife propagation. Therefore, W-14 overall currently does not support it's existing water uses. Suspected sources are listed as inflow and infiltration, urban runoff/storm sewers, and septic tanks. Suspected causes are organic enrichment/low dissolved oxygen, pathogen indicators, and oil and grease. This assessment is based on evaluated information rather than site-specific ambient water quality data.

f. W-15 Canal. There is no existing water quality or sediment data for French Branch. French Branch is a tributary of the West Pearl River. The West Pearl River is a monitored waterbody by LDEQ, the overall degree of support for the lower reach of the West Pearl River is fully supportive of it's designated water uses. Separately, primary contact recreation is partially supportive due to the presence of pathogen indicators, secondary contact recreation is threatened, while fish and wildlife propagation is fully supportive. A possible source of the problem is septic tanks. The West Pearl River is also designated an outstanding natural resource by LDWF, a designated use which it fully supports. There is an existing water quality station on the Pearl River (west) southeast of Slidell for which the above assessment is based.

4. Projected Water Quality.

a. Bayou Chinchuba. This plan calls for clearing, snagging, and dredging from State Highway 59 to its outlet into the unnamed canal near Lake Pontchartrain. The unnamed canal at the mouth of Bayou Chinchuba flows westward, paralleling Lake Pontchartrain to the Tchefuncte River where it empties into Lake Pontchartrain.

Channel improvements are often used to increase stream capacity for flood control. The major types of channel improvements for flood control are channel enlargement, clearing and snagging, and channel realignment. Channel improvements have resulted in many positive benefits besides the primary benefit of flood protection of urban areas. However, channel improvements have also had adverse impacts on the environment and water quality in the project area.

The initial clearing of the land for site preparation and developing access routes leads to an immediate increase in runoff and erosion. Thus the problems associated with turbidity will appear almost at the time construction commences. Reduced stream bank cover due to clearing and snagging helps to further elevate the increased runoff and erosion problem. In addition to the effects on Bayou Chinchuba, short term turbidity increases are also expected in the immediate downstream reach of the Tchefuncte River. The effects of increased turbidity on a stream can affect the water quality in several ways. The shading effect of suspended sedimentary particles decreases the light penetration and interferes with the photosynthetic production of oxygen. At the same time these particles absorb solar energy from the sunlight and transform this energy into heat, thus elevating the temperature of the bayou. Thus oxygen levels could be temporarily decreased. Environmental protection practices normally implemented at construction sites can be effective in reducing the gross erosion and soil loss that can cause shoaling and elevated levels of suspended solids at some relatively short distance downstream of the project site.

Clearing, snagging, as well as dredging disturbs the bottom sediment of a stream. The primary results due to dredging are the creation of deep holes or linear channels and the temporary suspension of large clouds of sedimentary particles. The nature of pollution caused by disturbing the bottom sediment is in a large measure dependent on the material being disturbed. If there is a large amount of organic matter (trees, roots, shrubs, etc.) in the channel or on its banks, then decomposition products of this matter may be present. Also, most of the sediments removed or disturbed are from the deep unoxidized layer of soil and are thus in a chemically reduced state. Such materials have very high chemical and biological oxygen demands.

While these adverse impacts are temporary in nature and will diminish soon after the completion of the project, the permanent loss of stream bank cover due the clearing and snagging will likely result in a long-term increase in stream temperature. These higher water temperatures could result in lower dissolved oxygen levels during low flow conditions. No significant differences in nutrient and contaminant fecal levels are expected since these levels are mainly related to types of land use and their distribution within the drainage basin. However, in those projects where reduced flooding encourages urban development or widespread clearing of land and expansion of crop production, concomitant increases in nutrient and contaminant fecal levels can be expected. By and large, especially at times of moderate to high flows, channel improvements facilitate water flow and flushing. As a result of the increased assimilative capacity of the stream, the water quality with respect to many parameters, and particularly dissolved oxygen content, may increase after the channel improvements.

In closing, there are several construction techniques which will greatly reduce these adverse environmental effects with little loss in flood control. The most promising of these techniques is the single-bank modification approach. This technique applies to both bank clearing and channel enlargement. Some key aspects are: (1) that the existing channel alignment is followed; (2) clearing and widening should generally be restricted to the northerly or easterly bank so that the channel remains shaded as much as possible, and (3) existing vegetation on the opposing bank is disturbed as little as possible, although snags that would interfere with flow or trees that might fall into the channel may be removed. Other protective measures are the revegetation of disturbed or disposal areas and the wise use of existing access routes within the project area. Also buffer strips of vegetated land as wide or wider than the channel should be established on both sides of the channel.

b. Abita River, North and South Tributaries. The work on this segment consists of raising existing structures (homes). Since there will be no work done in an actual waterway, no associated adverse water quality effects are expected as a result of project implementation.

c. Big Branch Bayou (west of Bayou Lacombe) and Bayou Lacombe. The work on this segment consists of raising existing structures (homes). Since there will be no work done in an actual waterway, no associated adverse water quality effects are expected as a result of project implementation.

d. Bayou Vincent (W-13 Canal). This alternative calls for clearing and snagging as well as straightening of the channel to improve flow. The limits are from the Bayou Bonfouca Superfund site to Browns Village Road just north of Interstate 12.

There are no expected water quality impacts due to the American Creosote NPL site just downstream of the project location. The bayou itself has been remediated to an appropriate risk level and all contaminated material on the NPL site has been remediated, therefore, no adverse water quality effects are expected as a result of the NPL site. As this plan calls for clearing and snagging as well as straightening of W-13 Canal, the impacts would be similar to those discussed in previous paragraphs under Bayou Chinchuba. In summary the effects on the water quality of W-13 Canal are expected to be short-term and localized. Effects expected are increased turbidity, increased stream temperature, and decreased dissolved oxygen.

The main water quality concern involved with straightening of the channel is due to actual construction work in the channel. Again, the initial clearing of the land for site preparation will result in an immediate increase in runoff and erosion. Channel realignment may remove stream bank cover which decreases the amount of shade on the stream, thus elevating the temperature of the stream and decreasing dissolved oxygen levels. This reduced stream bank cover helps to further elevate the increased runoff and erosion problem. As with clearing and snagging, short-term turbidity increases are also expected and effects of such are expected to be similar to those described for Bayou Chinchuba in previous paragraphs. Increased turbidity, decreased dissolved oxygen, and elevated stream temperature are expected. A positive effect of channel straightening is due to increased water flow and flushing. As a result of the increased assimilative capacity of the stream, the water quality with respect to many parameters, and particularly dissolved oxygen content, may increase after the channel straightening is completed. The construction techniques described in earlier paragraphs, such as the single-bank modification approach, would help minimize adverse water quality effects.

e. W-14 Canal. This alternative calls for clearing and snagging from Interstate 10 to Interstate 12, with dredging of the channel from Fremaux Avenue to Gause Blvd (U.S. Highway 190).

As this plan calls for clearing and snagging as well as dredging of W-14 , the impacts would be similar to those discussed in previous paragraphs under Bayou Chinchuba. In summary the effects on the water quality of W-14 are expected to be short-term and localized. Effects expected are increased turbidity, increased stream temperature, and decreased dissolved oxygen.

f. W-15 Canal. This alternative consists of clearing and snagging of entire channel and channel improvement of the Poor Boy Diversion.

Clearing and snagging of French Branch would be expected to produce impacts similar to those discussed in previous paragraphs under Bayou Chinchuba. In summary the effects on the water quality of French Branch are expected to be short-term and localized. Effects expected are increased turbidity, increased stream temperature, and decreased dissolved oxygen.

The effects of channel improvement of the Poor Boy Diversion are expected to be similar to effects associated with straightening of the W-13 Canal alternative. Again, decreased dissolved oxygen, increased turbidity, and increased stream temperature are expected, although short-term in nature. The positive effect of increased stream capacity due to channel improvement may actually improve the assimilative capacity of the stream and result in a higher dissolved oxygen content after project implementation.

As a summary of the overall effects resulting from project implementation of the six above listed alternatives is given here. All the proposed alternatives, with the exception of Big Branch Bayou and Abita River, will result in short-term deviations of some water quality parameters as a result of project implementation. However, disturbances or displacement of soil and vegetative cover generally cause only temporary and localized increases in the potential for erosion or production of other pollutants. Water quality conditions are expected to return to pre-project conditions or in some cases improved conditions soon after project implementation.

5. <u>References.</u>

Environmental Protection Agency (The Mitre Company), "Impact of Hydrologic Modification on Water Quality", April 1975.

Louisiana Department of Environmental Quality, "State of Louisiana Water Quality Management Plan Volume 5 Part B Water Quality Inventory 1994 Section 305(b) P.L. 95-217", 1994.

Louisiana Department of Environmental Quality, "Environmental Regulatory Code Part IX Water Quality Regulations", 1994, 3rd edition.

Louisiana Department of Wildlife and Fisheries - Thompson and Watson, "Louisiana's Natural Scenic Streams Survey", 1993.

United States Army Corps of Engineers New Orleans District, "Tangipahoa, Tchefuncte, and Tickfaw Rivers, Louisiana Reconnaissance Report", June 1991.

GENERAL GEOLOGY

GENERAL GEOLOGY

The following descriptions are based on the general geologic information for the two areas of interest in St. Tammany Parish, Louisiana:

BAYOU CHINCHUBA The study area is located in southeastern Louisiana, on the north side of Lake Pontchartrain in south-central St. Tammany Parish. This is an area of low relief with elevations ranging from near sea level to +20 feet NGVD. The major physiographic features are swamp and marsh, gently sloping Pleistocene Prairie terraces, and steep streambanks with narrow floodplains. Swamp and marsh contain Holocene deposits of poorly drained soft to very soft clays, organic clays, silt, and organic debris. Pleistocene Prairie terrace deposits consist of moderately drained stiff to very stiff clays, silt, and sand with occasional gravel. Holocene alluvium is deposited in the narrow floodplains of streams and rivers and consists of reworked Pleistocene terrace deposits. The drainage in this area is primarily to the south toward Lake Pontchartrain.

SLIDELL The study area is in southeastern St. Tammany Parish. This is an area of low relief with elevations ranging from near sea level in the south to approximately +15 feet NGVD in the north.

The major physiographic features are swamp and marsh in the south, gently sloping uplands of Pleistocene Prairie terraces in the north, and steep streambanks with narrow floodplains. Swamp and marsh contain Holocene deposits of poorly drained soft to very soft clays, organic clays, silt, and organic debris. Pleistocene Prairie terrace deposits consist of moderately drained stiff to very stiff clays, silt, and sand with occasional gravel. Holocene alluvium is deposited in the narrow floodplains of streams and rivers and consists of reworked Pleistocene terrace deposits. The drainage in this area is primarily to the south toward Lake Pontchartrain.

ENGINEERING DESIGN

DESIGN ASSUMPTIONS

GEOTECHNICAL DESIGN ASSUMPTIONS

Since specific boring data was not available for the alternatives, a general knowledge of the soils in the area was used to determine preliminary design requirements. Canal slopes should be no steeper than 1V on 3H. Slopes as steep as 1V on 2H can be used but will require regular maintenance unless slope paving is used. Bridge pile tips and capacities for bridges to be raised and/or lengthened should be the same as shown in the as-built drawings for each bridge. Soil borings will be required for the feasibility geotechnical designs of bridge replacements, channel improvements, detention ponds, control structures, and levees.

BAYOU CHINCHUBA CHANNEL MODIFICATIONS

The channel modifications on Bayou Chinchuba consists of improvements for two alternatives including an earthen trapezoidal channel section and clearing and snagging.

Alternative 2. Clearing and Snagging with Bridge Modifications.

The proposed improvements involve a combination of clearing and snagging from the West Causeway bridge to the Greenleaves Dam and from the upstream end of the Greenleaves Lake to State Highway 59. Additionally, the trapezoidal channel section under the North Causeway bridge and West Causeway Approach bridge will be improved to a 70 foot bottom width with 1V on 3H side slopes. Both bridges will require structural support improvements to accommodate the increased channel top width from 125 feet to 152 feet.

Alternative 3: Clearing and Snagging, Dredging, Bridge Replacement.

The proposed improvements involve a combination of excavation of an earthen trapezoidal channel and clearing and snagging. A 200 foot bottom width earthen trapezoidal channel will be excavated with 1V on 3H side slopes from Lake

Pontchartrain to the West Causeway Approach bridge. Upstream from the West Causeway approach bridge to the North Causeway bridge and continuing to U.S. Highway 190 a 125 foot bottom width channel will be excavated with 1V on 3H side slopes. From U.S. Highway 190 an earthen trapezoidal channel will be excavated with a 60 foot bottom width and 1V on 2H side slopes to the Greenleaves Dam. Clearing and snagging of the channel will extend from the upstream end of Greenleaves Lake to State Highway 59. This alternative will also require improving the West Causeway Approach and the North Causeway bridges as described in Alternative 1. Approximately 273,000 cubic yards of soil will be removed from the channel. This material will be hauled away from the channel to an undetermined location in the project area.

BRIDGES AT CAUSEWAY OVER BAYOU CHINCHUBA

The existing bridges were built in the late 1950's. There are two bridges on North Causeway and two bridges on West Causeway. The existing bridges are 120 Ffeet long and have a low chord that is partially submerged at higher stages. For both alternatives 2 and 3, the existing bridges will be removed and replaced with new bridges. The new bridges will have a length of 210 feet and a low chord elevation of 10.0 feet NGVD. The bridges will be constructed one at a time, using the other lanes to temporarily detour the two way traffic. The bridges will have standard concrete prestressed piles and prestressed precast deck slabs. This design reduces the depth of the superstructure and minimizes impacts on the approaches due to raising (see Plate A7).

W-13 CANAL CHANNEL MODIFICATION

The proposed improvements involve a combination of excavation of an earthen trapezoidal channel, clearing and snagging at bridges and replacement of the West Hall Road bridge.

The channel improvement of W-13 Canal begins at the eastbound Interstate 12 Highway and extends approximately 2.8 miles along W-13 Canal and Bayou Bonfouca to the downstream side of the West Hall Road bridge. The improved channel will consist of a 40 feet bottom width with 1V on 2H side slopes. Approximately 162,000 cubic yards of soil will be removed from the channel. This material will be hauled away from the channel to an undetermined location within a two mile radius of the project area.

BRIDGE AT WEST HALL AVENUE

This bridge is similar in design to the bridges at Causeway. It is assumed that the bridge will be closed during construction of the new bridge.

W-14 CANAL CHANNEL MODIFICATIONS

The channel modifications on the W-14 Canal consists of an earthen trapezoidal channel section, clearing and snagging, automatic flow control structures and detention ponds.

The proposed improvements involve a combination of clearing and snagging approximately 5 miles of the channel from Interstate 10 to Interstate 12, widening Florida Avenue bridge to an 80 foot span, and installing an automatic flow control structure on the W-15 Lateral to allow a diversion from the W-14 Canal to the W-15 Canal, but not from the W-15 Canal to the W-14 Canal. Additionally, the trapezoidal channel section will be improved to a 40 foot bottom width with 1V on 2H side slopes from Fremaux Avenue to 1000 feet north of Gause Boulevard. Approximately 50,000 cubic yards of soil will be removed from the channel. This material will be hauled away from the channel to an undetermined location within a two mile radius of the project area.

The proposed improvements also involve the detention ponds at Robert Road and at the upstream end of the West Diversion Canal with no excavation of earthen trapezoidal channel improvement on the W-14 Canal.

BRIDGE AT FLORIDA AVENUE

This bridge is similar in design to the bridges at Causeway. It is assumed that the bridge will be closed during construction of the new bridge.

GATED STRUCTURE IN THE W-15 LATERAL CANAL

The gated structure will be constructed in the existing W-15 lateral by constructing low level earthen cofferdams in the canal which can be overtopped in a major flood event. The structure is cast in place concrete with a prefabricated 10X10 foot sluice gate. Electrical service will be required to open and close the gate. Sheet pile I-walls tie into each end of the structure to close the canal.

Sluice Gate. A precast cast-iron sluice gate structure with a 10 feet square opening will be constructed in the existing W-15 Lateral. The sluice gate will be supported by a soil-founded, reinforced concrete structure 20 feet wide that will have a steel sheetpile cut-off wall. The sluice gate structure will span the main portion of the channel and will be connected on both sides to a steel sheetpile I-Wall that will extend back into the adjacent natural ground 5 feet beyond the top of bank. A small cantilever reinforced concrete platform will top the sluice gate structure for operating the gate. Access to the operating platform will be via a 3 feet wide open steel grating walkway that will be welded to the top of the steel sheetpile I-Wall. The walkway and operating platform areas will be contain 3-rail pipe handrails on both sides. In order to dewater the site prior to construction of the sluice gate structure, earthen cofferdams 5 feet in height with 2 feet crown widths and 1 on 3 slopes will be constructed upstream and downstream of the structure (see Plate A6). The cofferdam material will be obtained from the adjacent portions of the existing canal. To help prevent localized flooding during heavy rainfall events, the cofferdams will be overtopped by flood waters and will be pumped out as needed to continue with construction. Construction of the sluice gate structure is estimated to take approximately 4 months.

W-15 CANAL CHANNEL MODIFICATIONS - POOR BOY CANAL DIVERSION

The Poor Boy Canal from the W-15 Canal eastward to Gum Bayou is proposed for improvement. The diversion alinement will be improved by the excavation of an earthen trapezoidal channel section having the bottom width of 25 feet with 1V on 2H side slopes and the existing invert. The existing Poor Boy Canal is estimated to have a 10 foot bottom width, 1V on 2H side slopes and an invert of approximately 9.0 feet NGVD. The entrance channel from W-15 to the existing Poor Boy Canal will be realigned to provide a more efficient transition through the excavation of a new land cut approximately 2000 feet in length. This channel section will have the same dimensions as the approximately one mile long channel enlargement section. Approximately 120,000 cubic yards of soil will be removed from the channel. This material will be hauled to an undetermined location within a two mile radius of the project area The channel passes under 3 existing highways that will require the installation of sets of two 10X10 foot concrete box culverts under each highway (at Interstate 59, 2 sets) to be placed at the existing channel invert.

HIGHWAY BOX CULVERTS FOR ROBERT ROAD, INTERSTATE 59, AND MILITARY ROAD.

Construction of soil founded, reinforced concrete box culverts with twin barrels will be required to carry highway design loads and to pass flow from the proposed drainage canals beneath the roadway sections where the highways are intersected. Two of the culverts will be for the conveyance of waters beneath two-lane LA Highway Routes 1090 and 1091, (Military and Robert Roads, respectively). The remaining two culverts will be required for the conveyance of waters beneath Interstate 59 at two separate sites. Construction of the culverts will occur prior to construction of the drainage canals. As a result, excavation of the culvert sites will be necessary and traffic will be rerouted around the construction zones. Due to the two different types of highways involved, the scopes for accomplishing the work will be slightly different. A brief description of the work required for each of the two scenarios, is as follows:

a. Two-Lane Highway. The site will be excavated to accommodate one reinforced concrete box culvert approximately 44 feet in length with twin barrels each measuring 10 feet square. An adjacent 4- inch thick temporary asphaltic detour road approximately 1,400 feet in length with a non-plastic highway embankment subbase will be constructed to bypass traffic during the construction which is estimated to take approximately 4 months. The temporary detour road will have a reduced speed limit of 40 mph. After completion of the box culvert, the original 8-inch asphaltic highway section will be restored; the temporary detour road removed; and the site fertilized, seeded and mulched.

b. Four-Lane Highway. The four-lane highway traffic lanes are separated by a median in the areas where the box culverts will be constructed. Excavation of the sites will be required to accommodate construction of two reinforced concrete box culverts. Each box culvert site will actually include two separate box culverts, (one under each set of opposing traffic lanes). Each box culvert will be approximately 44 feet in length with twin barrels each measuring 10 feet square. However, in order to maintain traffic flow along the interstate, it will be necessary to construct only one box culvert per site at a time. As a result, a portion of the opposing lanes adjacent to the construction site will be converted to two-way traffic in order to bypass traffic around the construction site. This will entail a temporary 4-inch thick asphaltic detour road approximately 1,300 feet in length, (650 feet at each end), to tie the traffic into the two-way portion of the opposing lanes. After completion of the first box culvert at each site, the original 8-inch asphaltic highway section will be restored and the temporary detour tie-ins to the opposing set of lanes will be removed. Similarly, the entire process will be repeated in order to construct the second box culvert at the site for the opposing set of lanes. The total estimated time of construction to complete the installation of both box culverts at each site under the opposing sets of traffic lanes is 4 months. After completion of the second box culvert at each site, the original 8-inch asphaltic highway section will be restored; the temporary detour road removed; and the entire site fertilized, seeded and mulched.

RELOCATIONS

We conducted field inspections of the canals and culverts to determine utility locations, sizes, and types. Using our judgement and without the owner's relocation criterion, we developed feasible relocations schemes. We tabulated the information and performed an in-house relocations cost estimate.

COST ESTIMATES

Cost estimates for the features of each alternative are shown on Tables A32-A47.

Table A 32
Bayou Chinchuba
Channel Improvement

Channel Improvement; Clear and Snag and Excavate

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	Excavation - Channel	273000	Cu Yd	$4.00	$1,092,000	$273,000	$1,365,000
3	Clearing and Snagging	1	MI	$215,000.00	$215,000	$53,750	$268,750
	TOTAL				$1,347,000	$336,750	$1,683,750
	ROUNDED TOTAL						$1,700,000

Table A 33
Bayou Chinchuba
West Causeway Bridges

Each bridge at West Causeway, 210 feet long, 2 Lane (One bridge in North direction and One bridge in South direction

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
	Relocations						
02.1.A-	MOB & DEMOB	1	LS	$25,000.00	$25,000	$5,000	$30,000
02.1.2.-	SITE WORK						
	Remove Existing Bridge	1	LS	$20,000.00	$20,000	$4,000	$24,000
	Excavation	200	CuYd	$6.00	$1,200	$240	$1,440
	Embankment	7000	CuYd	$8.00	$56,000	$11,200	$67,200
	Shoulder Surfacing (9")	150	Square	$130.00	$19,500	$3,900	$23,400
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$200	$1,200
02.1.3.B-	ROAD SURFACING						
	Asphaltic Pavement (8")	600	SqYd	$24.00	$14,400	$2,880	$17,280
	Concrete Pavement (10" Approach Slab)	350	SqYd	$50.00	$17,500	$3,500	$21,000
	Asphaltic Pavement (4")	6000	SqYd	$13.00	$78,000	$15,600	$93,600
	Detour Removal	1	LS	$15,000.00	$15,000	$3,000	$18,000
02.3.1.J-	BRIDGE FOUNDATIONS						
	14x14 Precast Concrete Piles	3300	LF	$30.00	$99,000	$19,800	$118,800
02.3.1.K-	ABUTMENTS AND PIERS						
	Abutment Concrete	100	CuYd	$250.00	$25,000	$5,000	$30,000
	Bent Caps	30	CuYd	$350.00	$10,500	$2,100	$12,600
02.3.1.L-	SUPERSTRUCTURE						
	Precast, Prestressed, Hollow, Decking Panels (24" Deep)	8400	SqFt	$30.00	$252,000	$50,400	$302,400
02.3.1.M-	MISC GENERAL ITEMS						
	Signing & Striping	1	LS	$8,000.00	$8,000	$1,600	$9,600
	Guard Rails etc	1	LS	$5,000.00	$5,000	$1,000	$6,000
	TOTAL				$647,100	$129,420	$776,520
	ROUNDED TOTAL						$780,000

Table A 34
Bayou Chinchuba
North Causeway Bridges

Each bridge at North Causeway, 210 feet long, 2 Lane (One bridge in North direction and one bridge in South Directio

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
	Relocations						
02.1.A-	MOB & DEMOB	1	LS	$25,000.00	$25,000	$5,000	$30,000
02.1.2.-	SITE WORK						
	Remove Existing Bridge	1	LS	$20,000.00	$20,000	$4,000	$24,000
	Excavation	200	CuYd	$6.00	$1,200	$240	$1,440
	Embankment	7000	CuYd	$8.00	$56,000	$11,200	$67,200
	Shoulder Surfacing (9")	150	Square	$130.00	$19,500	$3,900	$23,400
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$200	$1,200
02.1.3.B-	ROAD SURFACING						
	Asphaltic Pavement (8")	600	SqYd	$24.00	$14,400	$2,880	$17,280
	Concrete Pavement (10" Approach Slab)	350	SqYd	$50.00	$17,500	$3,500	$21,000
	Asphaltic Pavement (4")	6000	SqYd	$13.00	$78,000	$15,600	$93,600
	Detour Removal	1	LS	$15,000.00	$15,000	$3,000	$18,000
02.3.1.J-	BRIDGE FOUNDATIONS						
	14x14 Precast Concrete Piles	3300	LF	$30.00	$99,000	$19,800	$118,800
02.3.1.K-	ABUTMENTS AND PIERS						
	Abutment Concrete	100	CuYd	$250.00	$25,000	$5,000	$30,000
	Bent Caps	30	CuYd	$350.00	$10,500	$2,100	$12,600
02.3.1.L-	SUPERSTRUCTURE						
	Precast, Prestressed, Hollow, Decking Panels (24" Deep)	8400	SqFt	$30.00	$252,000	$50,400	$302,400
02.3.1.M-	MISC GENERAL ITEMS						
	Signing & Striping	1	LS	$8,000.00	$8,000	$1,600	$9,600
	Guard Rails etc	1	LS	$5,000.00	$5,000	$1,000	$6,000
	TOTAL				$647,100	$129,420	$776,520
	ROUNDED TOTAL						$780,000

Table A 35
W-13 Canal
Clearing and Snagging and Excavation

Clear and snag and excavation

Code	Item	Bridge a	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	EXCAVATION	162000	CY	$6.00	$972,000	$243,000	$1,215,000
3	CLEARING AND SNAGGING AT BRIDGES	4	EA	$15,000.00	$60,000	$15,000	$75,000
	NOTE: EXCAVATED MATERIAL DISPOSAL WITHIN 2 MILES						
	TOTAL				$1,072,000	$268,000	$1,340,000

Table A 36
W-13 Canal
West Hall Bridge

Bridge at West Hall Street, 116 feet long, 2 Lane

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
	Relocations						
02.1.A-	MOB & DEMOB	1	LS	$25,000.00	$25,000	$5,000	$30,000
02.1.2.-	SITE WORK						
	Remove Existing Bridge	1	LS	$20,000.00	$20,000	$4,000	$24,000
	Excavation	200	CuYd	$6.00	$1,200	$240	$1,440
	Shoulder Surfacing (9")	100	Square	$130.00	$13,000	$2,600	$15,600
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$200	$1,200
02.1.3.B-	ROAD SURFACING						
	Asphaltic Pavement (8")	200	SqYd	$25.00	$5,000	$1,000	$6,000
	Concrete Pavement (10" Approach Slab)	300	SqYd	$50.00	$15,000	$3,000	$18,000
02.3.1.J-	BRIDGE FOUNDATIONS						
	14x14 Precast Concrete Piles	1800	LF	$30.00	$54,000	$10,800	$64,800
02.3.1.K-	ABUTMENTS AND PIERS						
	Abutment Concrete	100	CuYd	$250.00	$25,000	$5,000	$30,000
	Bent Caps	15	CuYd	$350.00	$5,250	$1,050	$6,300
02.3.1.L-	SUPERSTRUCTURE						
	Precast, Prestressed, Hollow, Decking Panels (24" Deep)	4640	SqFt	$30.00	$139,200	$27,840	$167,040
02.3.1.M-	MISC GENERAL ITEMS						
	Signing & Striping	1	LS	$8,000.00	$8,000	$1,600	$9,600
	TOTAL				$311,650	$62,330	$373,980
	ROUNDED TOTAL						$400,000

Table A 37
W-14 Canal
Channel Improvement

Channel Improvement

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	Excavation - Channel	47,000	Cu Yd	$8.50	$399,500	$99,875	$499,375
3	Clearing and Snagging	5	Mi	$215,000.00	$1,075,000	$268,750	$1,343,750
	TOTAL				$1,514,500	$378,625	$1,893,125
	Note: Excavated material disposal w/in 2 miles						
	ROUNDED TOTAL						$1,893,000

Table A 38
W-14 Canal
Concrete Weir @ Detention Pond at North Blvd.

Concrete Weir @ Detention Pond near Hwy 11 and North Bl, 110 feet long, 3 feet

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
0x.1.A-	MOB & DEMOB	1	LS	$5,000.00	$5,000	$1,250	$6,250
0X.1.2.-	SITE WORK						
	Clear and Grubb	2	Acres	$2,500.00	$5,000	$1,250	$6,250
	Excavation	90	CuYd	$6.00	$1,200	$300	$1,500
	Levee Embankment	75	CuYd	$8.00	$600	$150	$750
	Steel Sheet Piles	500	Sq Ft	$20.00	$22,000	$5,500	$27,500
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$250	$1,250
0X.1.3.B-	CONCRETE						
	Stab slab	50	SqYd	$125.00	$6,250	$1,563	$7,813
	Concrete Pavement	60	CuYd	$200.00	$12,000	$3,000	$15,000
	Concrete Weir	150	CuYd	$300.00	$45,000	$11,250	$56,250
0x.3.1.M-	MISC GENERAL ITEMS						
	Misc items	1	LS	$5,000.00	$5,000	$1,250	$6,250
	30 inch culvert, flap gate	1	LS	$15,000.00	$15,000	$3,750	$18,750
	TOTAL				$118,050	$29,513	$147,563
	ROUNDED TOTAL						$150,000

Table A39
W-14 Canal
Detention Pond at North Blvd.

Detention Pond at North Blvd.

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	EXCAVATION	110000	Cu Yd	$6.00	$660,000	$165,000	$825,000
3	30" RCP CULVERT W/ FLAP GATE	100	LF	$65.00	$6,500	$1,625	$8,125
4	3 - 4' X 4' BOX CULVERT	100	LF	$300.00	$30,000	$7,500	$37,500
5	EMBANKMENT - +5'	9000	CY	$4.50	$40,500	$10,125	$50,625
	TOTAL				$777,000	$194,250	$971,250
	NOTE: EXCAVATED MATERIAL DISPOSAL WITHIN 2 MILES						
	ROUNDED TOTAL						$1,000,000

Table A 40
W-14 Canal
Concrete Weir @ Detention Pond at Robert Rd.

Concrete Weir @ Detention Pond, 55 feet long, 3 feet

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
0x.1.A-	MOB & DEMOB	1	LS	$5,000.00	$5,000	$1,250	$6,250
0X.1.2.-	SITE WORK						
	Clear and Grubb	2	Acres	$1,000.00	$2,000	$500	$2,500
	Excavation	200	CuYd	$5.00	$1,000	$250	$1,250
	Levee Embankment	75	CuYd	$20.00	$1,500	$375	$1,875
	Steel Sheet Piles	1100	Sq Ft	$20.00	$22,000	$5,500	$27,500
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$250	$1,250
0X.1.3.B-	CONCRETE						
	Stab slab	50	SqYd	$125.00	$6,250	$1,563	$7,813
	Concrete Pavement	60	CuYd	$180.00	$10,800	$2,700	$13,500
	Concrete Weir	150	CuYd	$250.00	$37,500	$9,375	$46,875
0x.3.1.M-	MISC GENERAL ITEMS						
	Misc items	1	LS	$5,000.00	$5,000	$1,250	$6,250
	TOTAL				$92,050	$23,013	$115,063
	ROUNDED TOTAL						$115,000

Table A41
W-14 Canal
Detention Pond at Robert Rd.

Detention Pond at Robert Road

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	EXCAVATION	205000	Cu Yd	$6.00	$1,230,000	$307,500	$1,537,500
3	30" RCP CULVERT W/ FLAP GATE	100	LF	$65.00	$6,500	$1,625	$8,125
4	EMBANKMENT - +5'	12000	Cu Yd	$4.50	$54,000	$13,500	$67,500
	TOTAL				$1,330,500	$332,625	$1,663,125
	NOTE: EXCAVATED MATERIAL DISPOSAL WITHIN 2 MILES						
	ROUNDED TOTAL						$1,700,000

Table A 42
W-14 Canal
Sluice Gate on W-15 Lateral

COST ESTIMATE - SLUICE GATE (10' X 10') on W-15 Lateral
STRUCTURE

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$50,000.00	$50,000	$12,500	$62,500
2	SLUICE GATE (10' X 10')	1	LS	$250,000.00	$250,000	$25,000	$275,000
3	Excavation	450	CUYD	$6.00	$2,700	$675	$3,375
							$0
4	Back fill	100	CUYD	$8.00	$800	$200	$1,000
							$0
5	Crushed Stone Bedding	20	CUYD	$35.00	$700	$175	$875
							$0
6	Concrete (Walls)	60	CUYD	$350.00	$21,000	$5,250	$26,250
7	Concrete (Slab)	40	CUYD	$200.00	$8,000	$2,000	$10,000
							$0
8	Concrete (Stab. Slab)	4	CUYD	$125.00	$500	$125	$625
9	Steel Sheetpiling (PZ-27)	2000	SQFT	$20.00	$40,000	$10,000	$50,000
10	Earthen Dewatering Berm	85	CUYD	$5.00	$425	$106	$531
11	Misc. Metals	1	LS	$5,000.00	$5,000	$1,250	$6,250
12	Electrical Service	1	LS	$10,000.00	$10,000	$2,500	$12,500
	TOTAL				$389,125	$59,781	$448,906
	ROUNDED TOTAL						$500,000

Table A 43
W-14 Canal
Bridge at Florida Avenue

Bridge at Florida Avenue, 80 feet long, 2 Lane

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
	Relocations						
02.1.A-	MOB & DEMOB	1	LS	$25,000.00	$25,000	$5,000	$30,000
02.1.2.-	SITE WORK						
	Remove Existing Bridge	1	LS	$20,000.00	$20,000	$4,000	$24,000
	Excavation	200	CuYd	$6.00	$1,200	$240	$1,440
	Shoulder Surfacing (9")	100	Square	$130.00	$13,000	$2,600	$15,600
	Seeding & Fertilizing	2	Acres	$500.00	$1,000	$200	$1,200
02.1.3.B-	ROAD SURFACING						
	Asphaltic Pavement (8")	200	SqYd	$25.00	$5,000	$1,000	$6,000
	Concrete Pavement (10" Approach Slab)	300	SqYd	$50.00	$15,000	$3,000	$18,000
02.3.1.J-	BRIDGE FOUNDATIONS						
	14x14 Precast Concrete Piles	1400	LF	$30.00	$42,000	$8,400	$50,400
02.3.1.K-	ABUTMENTS AND PIERS						
	Abutment Concrete	100	CuYd	$250.00	$25,000	$5,000	$30,000
	Bent Caps	10	CuYd	$350.00	$3,500	$700	$4,200
02.3.1.L-	SUPERSTRUCTURE						
	Precast, Prestressed, Hollow, Decking Panels (24" Deep)	3000	SqFt	$30.00	$90,000	$18,000	$108,000
02.3.1.M-	MISC GENERAL ITEMS						
	Signing & Striping	1	LS	$8,000.00	$8,000	$1,600	$9,600
	TOTAL				$248,700	$49,740	$298,440
	ROUNDED TOTAL						$300,000

Table A 44
W-15 Canal
Channel Improvement of Poor Boy Canal

Channel Improvement of Poor Boy Canal

Code	Item	Bridge at	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$40,000.00	$40,000	$10,000	$50,000
2	Excavation - Channel Enlargement (4700 ft)	29,000	Cu Yd	$6.00	$174,000	$43,500	$217,500
3	Excavation - New Channel (2000 ft)	90,000	Cu Yd	$6.00	$540,000	$135,000	$675,000
	TOTAL				$754,000	$188,500	$942,500
	Note: Excavated material disposal w/in 2 miles						
	ROUNDED TOTAL						$943,000

Table A 45
W-15 Canal
Poor Boy Canal (Diversion)
Culverts on Poor Boy Canal at State Hwy. 1091

COST ESTIMATE - TYPICAL 2-LANE HIGHWAY CULVERT
HWY 1091, ROBERT ROAD

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$30,000.00	$30,000	$7,500	$37,500
2	Signing & Traffic Control	1	LS	$15,000.00	$15,000	$3,750	$18,750
3	Excavation	8500	CUYD	$6.00	$51,000	$12,750	$63,750
4	Back fill	4550	CUYD	$8.00	$36,400	$9,100	$45,500
5	Crushed Stone Bedding	320	CUYD	$30.00	$9,600	$2,400	$12,000
6	Concrete (Walls & Roof)	275	CUYD	$350.00	$96,250	$24,063	$120,313
7	Concrete (Slab)	200	CUYD	$200.00	$40,000	$10,000	$50,000
8	Non-Plastic Subbase Embankm	3950	CUYD	$35.00	$138,250	$34,563	$172,813
9	Asphalt Paving (4" Detour)	3750	SQYD	$13.00	$48,750	$12,188	$60,938
10	Temporary Detour Removal	1	LS	$20,000.00	$20,000	$5,000	$25,000
11	Asphalt Paving (8" Restoration)	300	SQYD	$25.00	$7,500	$1,875	$9,375
12	Fertilizing, Seeding, & Mulching	1.5	ACRE	$500.00	$750	$188	$938
	TOTAL				$493,500	$123,375	$616,875
	ROUNDED TOTAL						$610,000

Table A 46
W-15 Canal (Diversion)
Culvert on Poor Boy Canal at Interstate 59

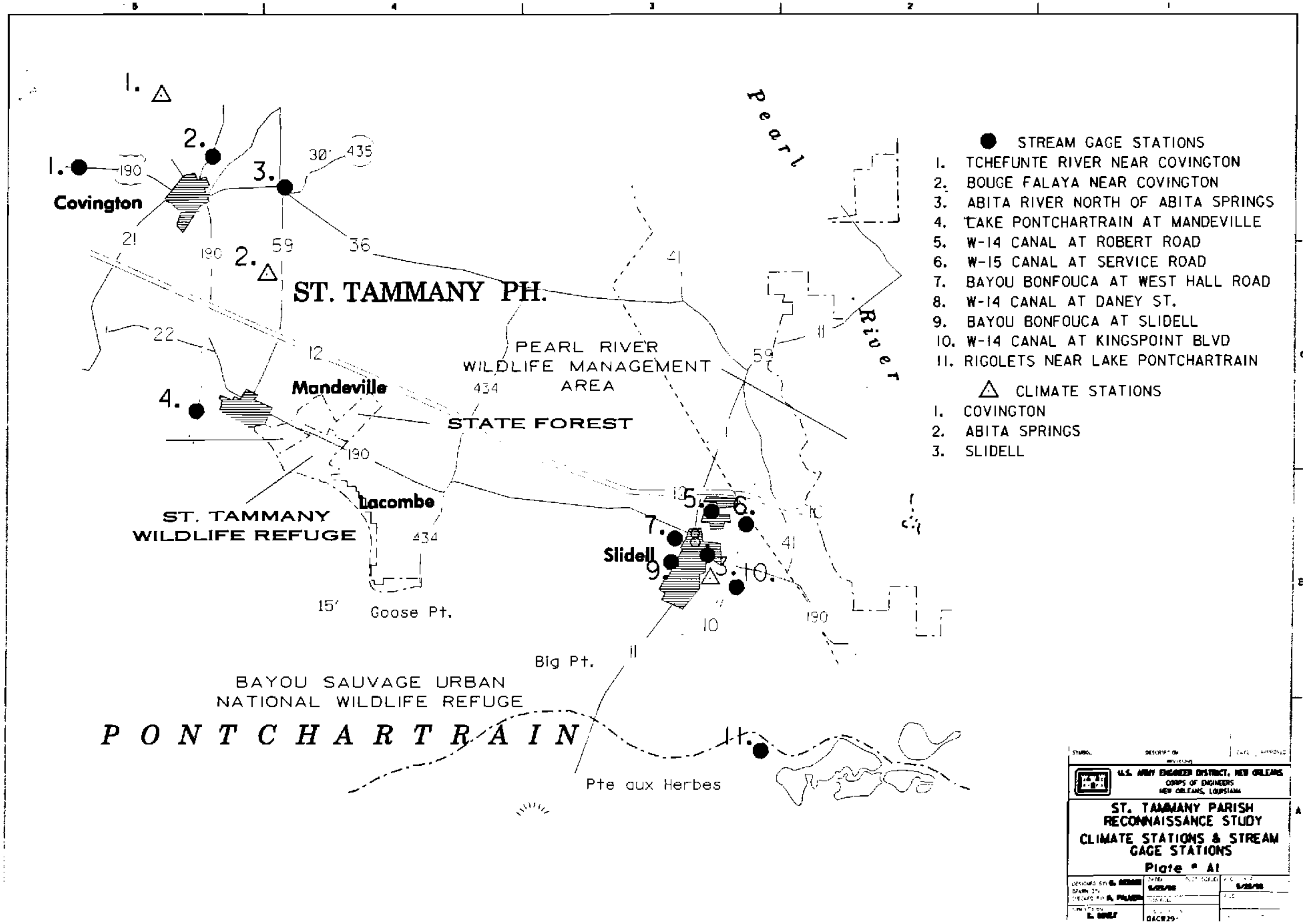
COST ESTIMATE - TYPICAL 4-LANE HIGHWAY CULVERT
I-59 NORTH & SOUTH

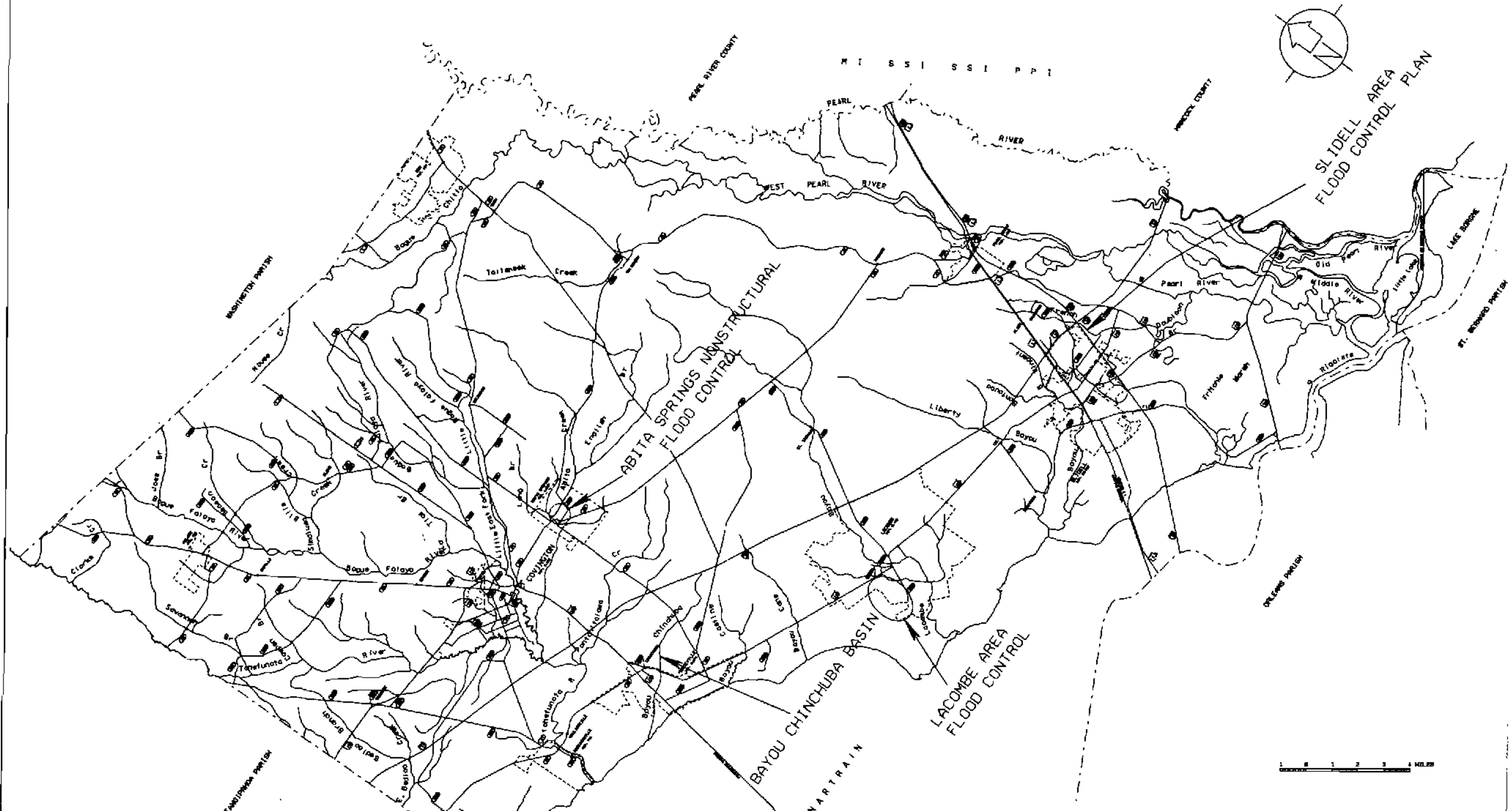
Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$30,000.00	$30,000	$7,500	$37,500
2	Signing & Traffic Control	1	LS	$15,000.00	$15,000	$3,750	$18,750
3	Excavation	17000	CuYd	$6.00	$102,000	$25,500	$127,500
4	Back fill	9100	CuYd	$8.00	$72,800	$18,200	$91,000
5	Crushed Stone Bedding	650	CuYd	$30.00	$19,500	$4,875	$24,375
6	Concrete (Walls & Roof)	550	CuYd	$350.00	$192,500	$48,125	$240,625
7	Concrete (Slab)	400	CuYd	$200.00	$80,000	$20,000	$100,000
8	Non-Plastic Subbase Embankm	7350	CuYd	$35.00	$257,250	$64,313	$321,563
9	Asphalt Paving (4" Detour)	7000	SqYd	$13.00	$91,000	$22,750	$113,750
10	Temporary Detour Removal	1	LS	$20,000.00	$20,000	$5,000	$25,000
11	Asphalt Paving (8" Restoration)	600	SQYD	$25.00	$15,000	$3,750	$18,750
12	Fertilizing, Seeding, & Mulching	2.7	ACRE	$500.00	$1,350	$338	$1,688
	TOTAL				$896,400	$224,100	$1,120,500
	ROUNDED TOTAL						$1,121,000

Table A 47
W-15 Canal (Diversion)
Culverts on Poor Boy Canal at State Hwy. 1090

COST ESTIMATE - TYPICAL 2-LANE HIGHWAY CULVERT
HWY 1090, MILITARY ROAD

Code	Item	Quantity	Unit	Unit Price	Amount	Contingencies	Project Cost
1	MOB & DEMOB	1	LS	$30,000.00	$30,000	$7,500	$37,500
2	Signing & Traffic Control	1	LS	$15,000.00	$15,000	$3,750	$18,750
3	Excavation	8500	CUYD	$6.00	$51,000	$12,750	$63,750
4	Back fill	4550	CUYD	$8.00	$36,400	$9,100	$45,500
5	Crushed Stone Bedding	320	CUYD	$30.00	$9,600	$2,400	$12,000
6	Concrete (Walls & Roof)	275	CUYD	$350.00	$96,250	$24,063	$120,313
7	Concrete (Slab)	200	CUYD	$200.00	$40,000	$10,000	$50,000
8	Non-Plastic Subbase Embankm	3950	CUYD	$35.00	$138,250	$34,563	$172,813
9	Asphalt Paving (4" Detour)	3750	SQYD	$13.00	$48,750	$12,188	$60,938
10	Temporary Detour Removal	1	LS	$20,000.00	$20,000	$5,000	$25,000
11	Asphalt Paving (8" Restoration)	300	SQYD	$25.00	$7,500	$1,875	$9,375
12	Fertilizing, Seeding, & Mulching	1.5	ACRE	$500.00	$750	$188	$938
	TOTAL				$493,500	$123,375	$616,875
	ROUNDED TOTAL						$617,000


STREAM GAGE STATIONS
1. TCHEFUNTE RIVER NEAR COVINGTON
2. BOUGE FALAYA NEAR COVINGTON
3. ABITA RIVER NORTH OF ABITA SPRINGS
4. LAKE PONTCHARTRAIN AT MANDEVILLE
5. W-14 CANAL AT ROBERT ROAD
6. W-15 CANAL AT SERVICE ROAD
7. BAYOU BONFOUCA AT WEST HALL ROAD
8. W-14 CANAL AT DANEY ST.
9. BAYOU BONFOUCA AT SLIDELL
10. W-14 CANAL AT KINGSPOINT BLVD
11. RIGOLETS NEAR LAKE PONTCHARTRAIN
CLIMATE STATIONS
1. COVINGTON
2. ABITA SPRINGS
3. SLIDELL
Covington
Mandeville
Lacombe
Slidell
ST. TAMMANY PH.
PEARL RIVER WILDLIFE MANAGEMENT AREA
STATE FOREST
ST. TAMMANY WILDLIFE REFUGE
BAYOU SAUVAGE URBAN NATIONAL WILDLIFE REFUGE
PONTCHARTRAIN
Pearl River
Goose Pt.
Big Pt.
Pte aux Herbes
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA
ST. TAMMANY PARISH RECONNAISSANCE STUDY
CLIMATE STATIONS & STREAM GAGE STATIONS
Plate * A1



ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY

PROJECT AREA MAP

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

STTAMMANY.DGN

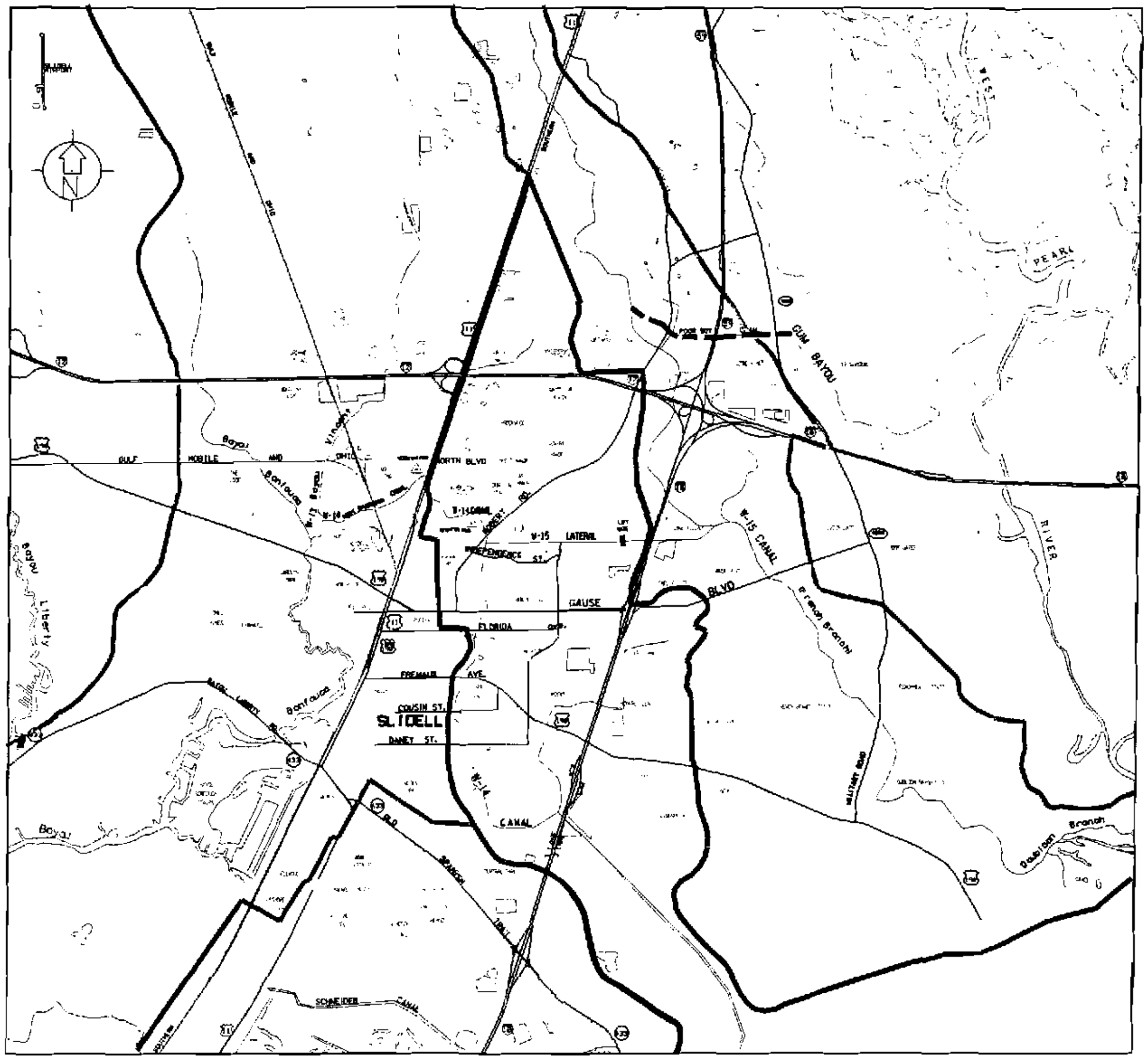
PLATE A2

ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY

DRAINAGE BASINS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

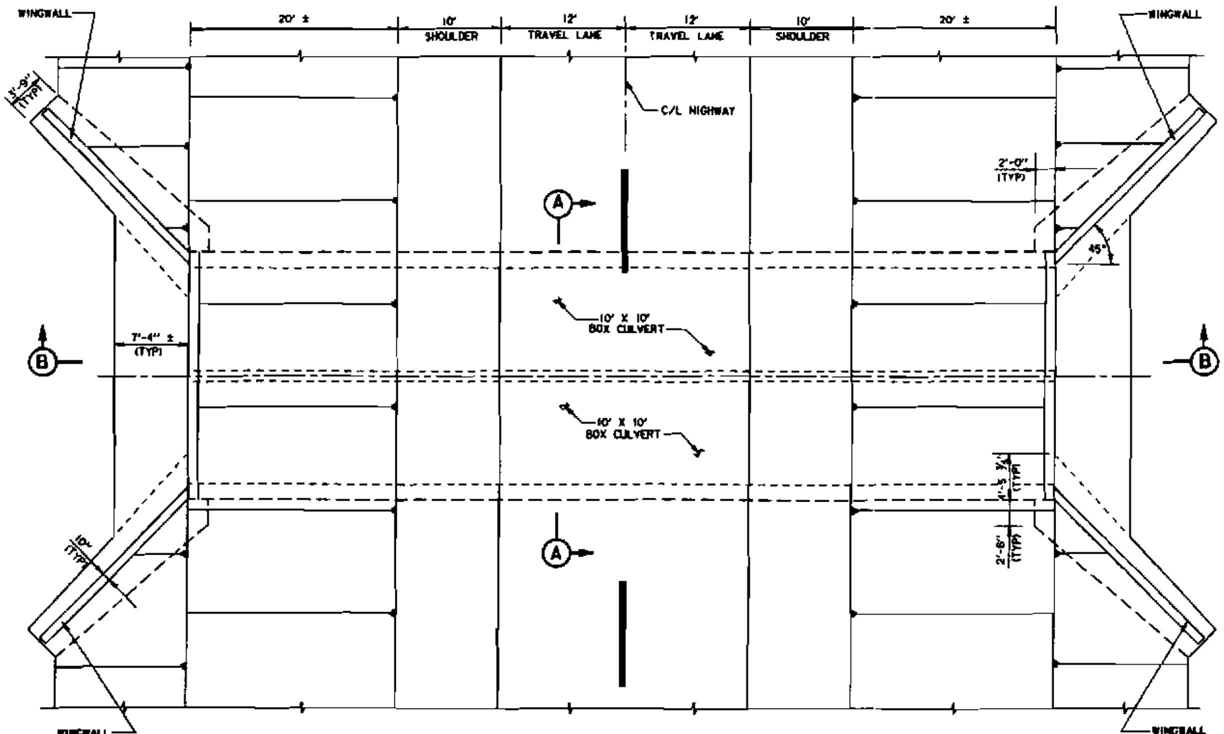
PLATE A3



U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

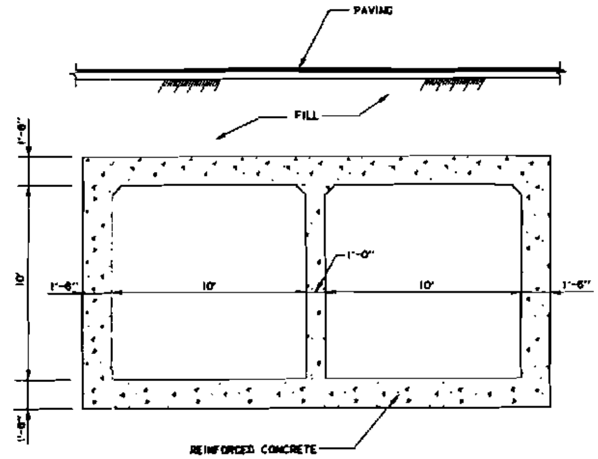
ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY
CITY OF SLIDELL
AREA MAP
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE A 4



PLAN - 10' X 10' BOX CULVERT

SCALE: 1" = 5'-0"

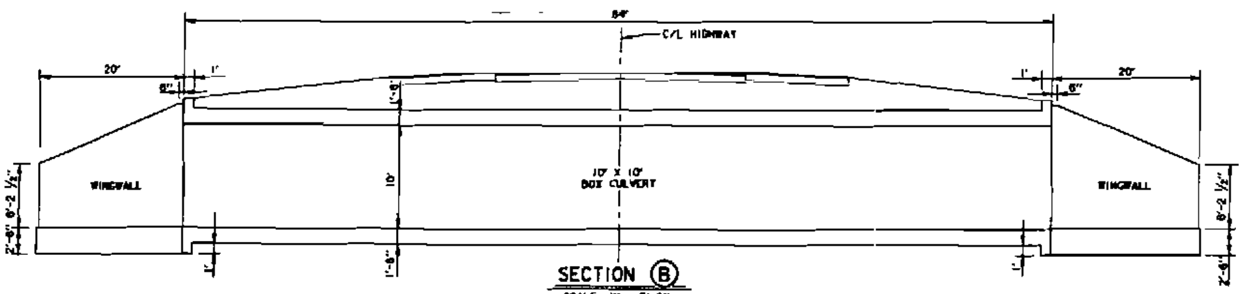


SECTION (A)

SCALE: 3/8" = 1'-0"

SCALE: 3/8" = 1'- 0"

SCALE: 1" = 5'



SECTION (B)

SCALE: 1" = 5'-0"

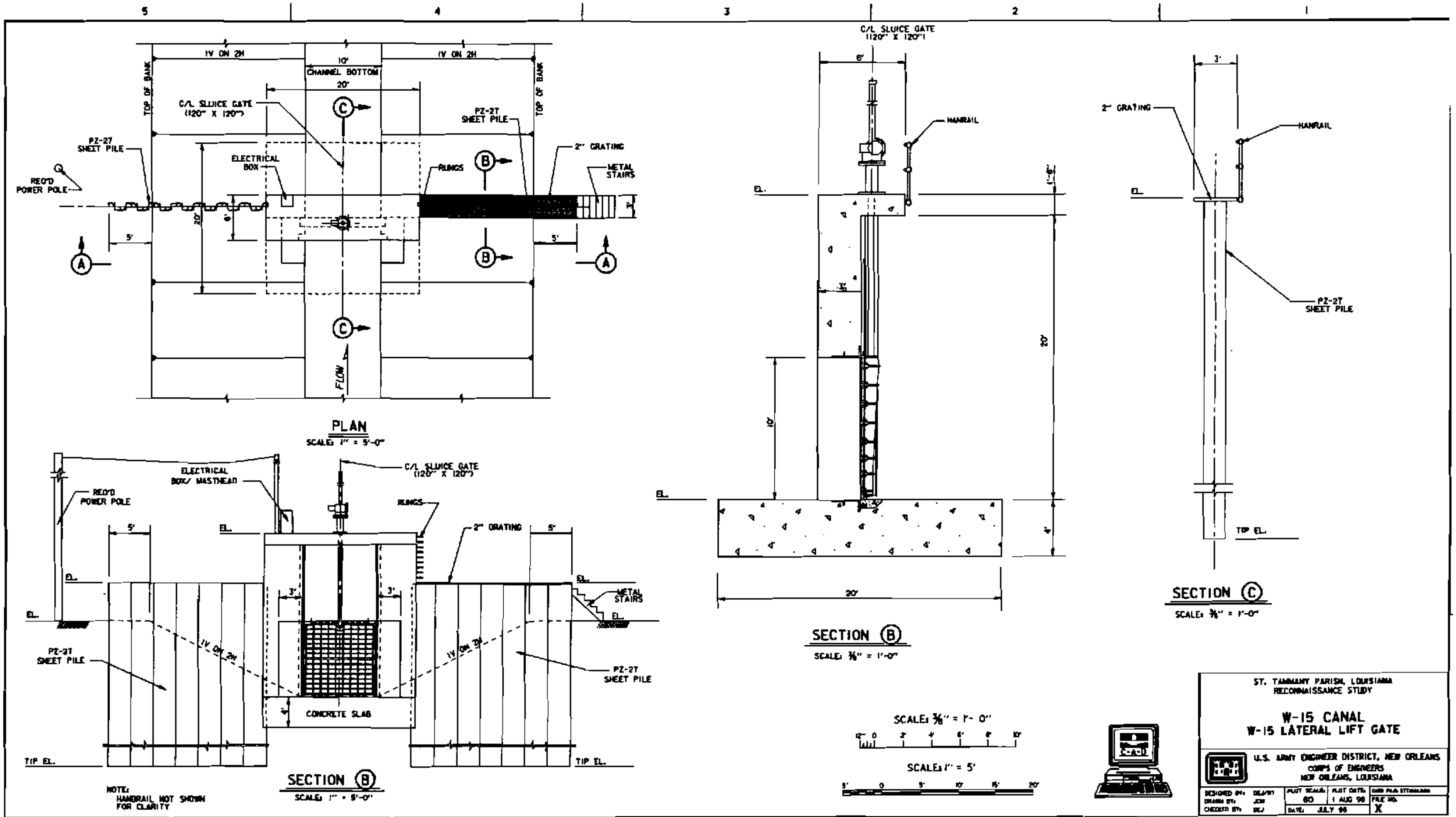
ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY

W-15 CANAL
BOX CULVERTS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY: DEJ | DRAWN BY: JCK | CHECKED BY: DEJ
PLOT SCALE: 60 | PLOT DATE: 1 AUG 96 | DATE: JULY 96 | FILE NO. X

PLATE A-5



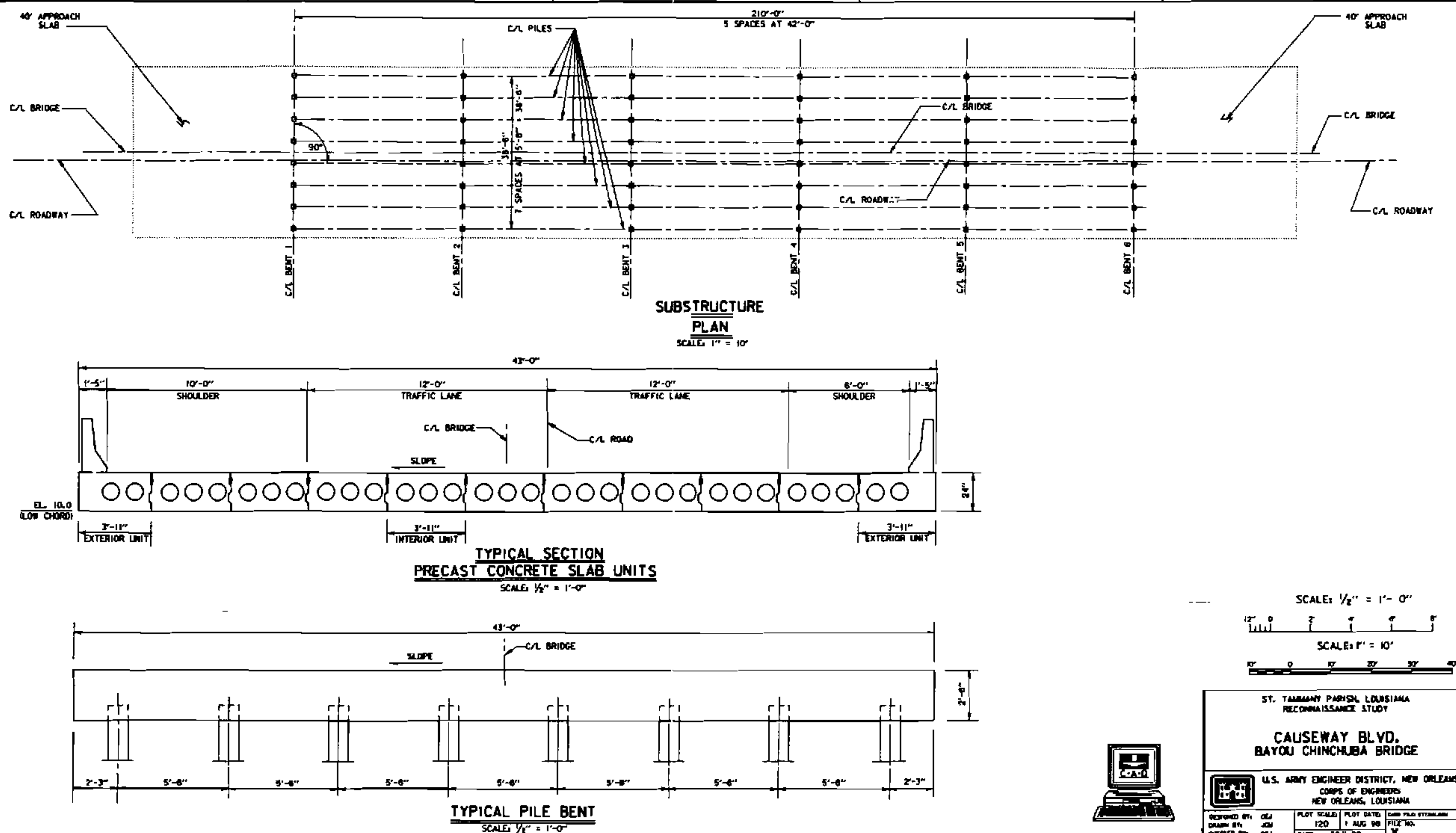
ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY

W-15 CANAL
W-15 LATERAL LIFT GATE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY: DEJ/BT	PLOT SCALE: 60	PLOT DATE: 1 AUG 96	FILE NO. X
DRAWN BY: JCM	DATE: JULY 96		
CHECKED BY: BEJ			

PLATE A-6



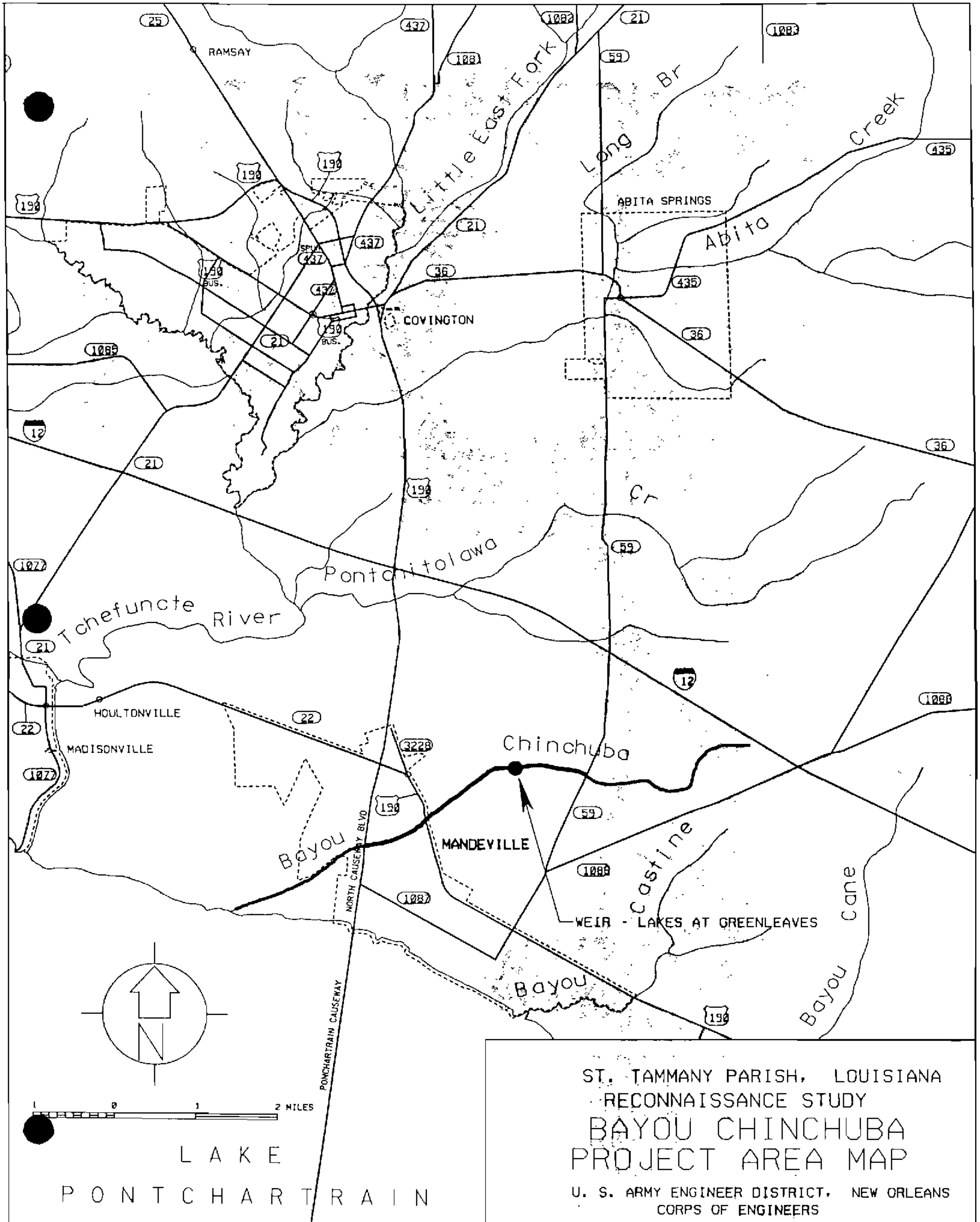
ST. TAMMANY PARISH, LOUISIANA
RECONNAISSANCE STUDY

CAUSEWAY BLVD.
BAYOU CHINCHUBA BRIDGE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

DESIGNED BY: OEJ	PLOT SCALE: 120	PLOT DATE: 1 AUG 98	FILE NO. X
DRAWN BY: JCM	DATE: JULY 98		
CHECKED BY: OEJ			

PLATE A-7



CHINCHUBA2.DGN

FIGURE A1

APPENDIX B

ECONOMICS APPENDIX

ST. TAMMANY PARISH
RECONNAISSANCE STUDY
APPENDIX B
ECONOMIC ANALYSIS
TABLE OF CONTENTS

LIST OF TABLES

ST TAMMANY PARISH, LA
RECONNAISSANCE STUDY

APPENDIX B
ECONOMIC APPENDIX

I. Introduction

This appendix investigates the economic feasibility of providing flood protection to selected portions of St. Tammany Parish, and is organized as follows. Section II contains a review of socioeconomic conditions in the parish, and in several smaller areas which would be directly benefitted by the flood control measures proposed. Section III is a discussion of land use in each study area. Section IV is a brief review of historical flooding in the parish and selected areas. Section V is a review of the methodology used to determine the feasibility of each proposed alternative. Section VI contains the results of the analysis.

II. Socioeconomic Conditions

1. Overview. St. Tammany is one of eight parishes within the New Orleans Metropolitan Statistical Area (MSA). The other seven parishes include Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, and St. John the Baptist. The 1990 Census provides land area and total population estimates within the New Orleans Urbanized Area, which was defined as portions of Jefferson, Orleans, Plaquemines, St. Bernard, and St. Charles Parishes, all south of Lake Pontchartrain. Like most other metropolitan areas across the United States, New Orleans has experienced socioeconomic changes leading to population growth in suburban areas. Table B1 compares population trends in the New Orleans MSA, the New Orleans Urbanized Area, the City of New Orleans, and St. Tammany Parish, including Mandeville, Lacombe, and Abita Springs. The desire for a more suburban life style and the completion of several major transportation projects have contributed to increases in housing demand, residential developments, and population growth in St. Tammany Parish, north of Lake Pontchartrain. The current reconnaissance study considers the potential need for additional flood protection at three locations within St. Tammany Parish, Louisiana: one site along Bayou Chinchuba, within the Golden Glen sub-division and the City of Mandeville; a second site east of Mandeville, in the Census Designated Place (CDP, unincorporated community) of Lacombe; and a third site north of Mandeville and east of the City of Covington, in the town of Abita Springs.

Two of the most important transportation corridors influencing growth trends in St. Tammany Parish are the 25-mile causeway connecting Jefferson Parish (and the New Orleans Urbanized Area) with Mandeville and other suburban communities on the North Shore, and a largely elevated section of Interstate Highway 10 (I-10). These connections have accommodated rapid transit between the North Shore communities and the I-10 exit ramps serving the New Orleans Central Business District (CBD), the Port of New Orleans, and other employment centers.

Table B1
St. Tammany Parish, La., Reconnaissance Study
Comparative Population Trends

AREAS	1960	1970	1980	1990	1995
New Orleans MSA	987,605	1,144,791	1,304,212	1,286,270	1,317,721
Urbanized Area	845,237	961,728	1,078,299	1,040,226	-
New Orleans, City	627,525	593,471	557,927	496,938	486,035
St. Tammany Parish	38,643	63,585	110,869	144,508	170,321
Mandeville, City	1,740	2,571	6,076	7,474	9,847
Slidell, City	6,356	16,101	26,718	24,124	-
Lacombe CDP	-	-	5,146	6,523	-
Abita Springs, Town	655	839	1,072	1,296	1,562
Louisiana, State	3,257,022	3,644,637	4,206,116	4,219,973	4,339,352

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1960-1990; and Louisiana Tech University, Business Research Division, 1995 estimates. (Note: A vacant space (-) indicates that data were not available.)

As indicated by data in the table, the population of the New Orleans MSA increased from 1960 to 1980 at a compound annual rate of almost 1.9 percent, while the population of the state increased at about 1.3 percent annually. The population of the New Orleans Urbanized Area from 1960 to 1980 increased at an annual rate of about 1.2 percent. The total population of St. Tammany Parish increased at an annual rate of more than 5.4 percent over the same period. Population for the entire MSA experienced a net loss between 1980 and 1990, but increased between 1990 and 1995 at an annual rate of almost 0.5 percent. From 1980 to 1995 the population of St. Tammany Parish increased at an annual rate of 2.9 percent. The sources used in developing the table indicate that more than 80 percent of the increase in the MSA between 1990 and 1995 has occurred in St. Tammany Parish.

Table B2 compares the trend of year-round housing units in the metropolitan area with housing units in St. Tammany Parish and communities where the three potential project sites are located. According to these data, St. Tammany Parish accounted for approximately 37 percent of the growth in the number of housing units within the New Orleans MSA for the period 1980-1990.

Population and housing trends in St. Tammany Parish and the larger New Orleans metropolitan area are reflections of employment, natural resources development, and increases in technology and transportation. Table B3 compares recent employment and income for St. Tammany Parish, the City of New Orleans, and the New Orleans MSA. The "Res-based" figures are the resident based estimates of employment. The "Empl-based" figures indicate where the jobs are located, rather than where the employees reside. The 1989 median family income of St. Tammany Parish as reported by the 1990 Census was $35,033, which is 58 percent higher than the figure for the City of New Orleans.

Table B2
St. Tammany Parish, La., Reconnaissance Study
Number of Housing Units

AREAS	1960	1970	1980	1990
New Orleans MSA	303,362	371,285	492,121	535,194
Urbanized Area	264,033	316,730	412,474	444,274
New Orleans, City	202,643	208,007	226,105	224,098
St. Tammany Parish	13,685	21,261	40,942	56,678
Mandeville, City	-	-	2,360	3,048
Slidell, City	-	-	-	9,128
Lacombe CDP	-	-	2,168	2,560
Abita Springs, Town	-	-	433	583
Louisiana, State	892,344	1,146,105	1,537,183	1,685,908

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1960-1990; University of New Orleans "New Orleans and the South Central Gulf, Real Estate Market Analysis" Vol. XXV January, 1996.

Table B3
St. Tammany Parish, La., Reconnaissance Study
Comparison of Employment and Trends

AREAS	1990 Census Employment Res-based	1990 La. Dept. of Labor, Empl-based	1994 La. Dept. of Labor, Res-based	1994 La. Dept. of Labor, Empl-based	1989 Median Family Income
New Orleans MSA	533,656	547,856	556,400	564,934	-
New Orleans, City	186,036	266,871	188,200	265,125	$22,182
St. Tammany Parish	49,208	33,680	68,500	43,186	$35,033
Mandeville	3,333	-	-	-	$37,788
Slidell	-	-	-	-	$30,656
Lacombe CDP	2,610	-	-	-	$27,114
Abita Springs	-	-	-	-	-

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1990 Census of Population, "General Social and Economic Characteristics, Louisiana" and "Summary Population and Housing Characteristics, Louisiana"; State of Louisiana, Department of Labor, "Employment and Total Wages Paid by Employers Subject to the Louisiana Employment Security Law" Second Quarter 1990 and 1994; and Employment data unpublished available from the Louisiana Department of Labor.

2. Bayou Chinchuba. The Bayou Chinchuba site in this study includes the Golden Glen subdivision within the City of Mandeville, Louisiana. Mandeville is immediately adjacent to the north shore of Lake Pontchartrain and the four-lane causeway which, along with I-10, furnishes rapid transit into the New Orleans CBD. Interstate Highway 12 (I-12) is an east-west route across the length of St. Tammany Parish, with exits slightly north of Mandeville. It furnishes a vehicular route from its connection with I-10 and I-59 at Slidell to the state capital in Baton Rouge. While the population of St. Tammany Parish increased by a compound annual rate of 4.3 percent between 1960 and 1995, the population of Mandeville has increased at an annual rate of more than 5 percent. North Shore residents have expressed concern over proposals for residential construction with smaller lot sizes than were customary in the recent past, which could lead to increases in population density. This problem may be another reflection of increasing demand for residential development in the Mandeville area, and the need for related drainage and flood control requirements.

Continuing upstream development has caused greater flood problems in the Bayou Chinchuba area. Also, it is important to note that flood risks are expected to increase due to a bridge replacement to be undertaken in 1998 by the Louisiana Department of Transportation and Development. The U.S. Highway 190 (LA 3228) bridge over Bayou Chinchuba currently acts as a barrier to downstream flow. The new bridge will allow greater flow and raise the flood risk to areas downstream of the bridge, including Golden Glen. The increased risk is accounted for in the computation of future without-project flood damages.

3. Lacombe. Lacombe is located between Mandeville and Slidell, further away from the New Orleans CBD than either of those cities. Consequently, the demand for residential development in Lacombe has been somewhat lower than in those two communities. However, one of the interests of individuals and families who decide to live in suburban communities is a preferred distance from the urbanized area. Lacombe has aided in meeting this demand, and may continue since its total land area is much larger than either Mandeville or Slidell. A large part of the land area identified as Lacombe, however, may be subject to the Federal regulations limiting construction in areas identified as wetlands.

4. Abita Springs. Abita Springs is a small community north of I-12, a few miles east of Covington. In addition to the gradual economic recovery of the larger New Orleans MSA, improvements to U.S. Highway 190, which links Mandeville to the Covington-Abita Springs area, have increased the potential for residential growth in the area. While it is an incorporated town, most of the land in the community is residential, rather than commercial or industrial. There are a few commercial establishments in the town, but many residents also depend on sales and services available in nearby Covington and larger communities of the MSA.

5. Slidell. The city of Slidell, with a population of 24,124, was the most populated city in St. Tammany Parish in 1990. Slidell is situated on the north shore of Lake Pontchartrain approximately 30 miles northeast of downtown New Orleans. It is traversed by three interstate highway systems and numerous other Federal and state highways. Interstate 59 provides north-south service, Interstate 12 provides westward service through Baton Rouge, and Interstate 10 connects Slidell to New Orleans and Biloxi. Slidell also has close access to several navigable water sources. These include the Pearl and Tchefuncte Rivers and Lake Pontchartrain and Lake Borgne, which connect it to the Gulf of Mexico. In spite of frequent storms resulting from the semitropical climate of the area and the low elevation, attraction to the Slidell area has grown. The mild climate and availability of natural resources, in conjunction with its location and access to the interstate highway system, have generated economic development and population growth along the Louisiana Gulf Coast, and particularly in St. Tammany Parish and the city of Slidell.

Slidell is commonly referred to as a "bedroom community" of New Orleans. The Interstate 10 system linking Slidell to New Orleans was completed in the late 1960's, and by 1980, the population of Slidell increased by more than 300 percent while parish-wide increases for this same period were around 65 percent. This growth can be attributed to a combination of factors. The location of the area is approximately 5 minutes from Interstate 10 and within 45 minutes of downtown New Orleans. Many of the families building or buying houses in Slidell are former residents of New Orleans who have moved to obtain better school systems and to escape higher taxes, higher crime rate, and overcrowding which is normally associated with large metropolitan areas. In addition, the infrastructure already exists in Slidell to allow development of the area.

III. Land Use

There are three main types of land use in each study area: residential, commercial and public. No industrial or agricultural activity was noted within any of the study areas. Residential property includes single-family residences which are owned by the residents individually or by landlords. Commercial property includes retail, wholesale, warehousing, office and professional buildings, etc. Public property includes civic centers, court houses, schools, park facilities, and others owned by public agencies.

IV. Historical Flooding

Substantial flooding has taken place in St. Tammany Parish during the past several years, with average annual payments of approximately $1.44 million on flood insurance claims during the years 1978-94, according to the Federal Emergency Management Agency. With 2,757 claims taking place over that period, the average claim paid was $8,372.

A major flood event took place on 8-9 May 1995 which affected several Louisiana parishes, including St. Tammany. The City of Slidell received the heaviest rainfall (23 inches), while up to 20 inches fell on the towns of Mandeville, Covington, Abita Springs, Lacombe, and Pearl River (May 1995 Post Flood Report, Flood Damage Assessment, prepared by Gulf Engineers and Consultants for the Corps of Engineers). Approximately $89.4 million was paid in insurance claims and Small Business Association Loans for repairs to residences, and $7.3 million was paid out to businesses for repairs (claims and loans).

Specific data are not available for smaller areas within the parish which are the subject of this study. However, it is known that the Bayou Chinchuba area and Abita Springs were heavily affected by the rainfall event. Lacombe, which has historically suffered from flooding due to storm surges from Lake Pontchartrain, did not suffer significant losses in the event.

V. Methodology

1. Overview. Non-structural alternatives were evaluated for three study areas: Abita Springs, Lacombe, and Golden Glen, a subdivision in the Bayou Chinchuba flood plain. In addition, one structural alternative was evaluated for the Bayou Chinchuba area.

Non-Structural Flood Damage Reduction Measures. Non-structural measures are those which reduce or avoid flood damages without significantly altering either the nature or the extent of flooding. Two types of nonstructural measures for flood protection exist: those which reduce existing damages, and those which reimburse for existing damages and reduce future damage potential. Only those nonstructural measures which reduce damages were considered in this study. The measures evaluated include the following:

a. Flood proofing by sealing walls and openings in structures.
b. Raising structures.
c. Constructing small walls or levees around structures.
d. Relocating structures and contents to flood-free areas.

Structural Flood Damage Reduction Measures. Structural measures are those which reduce the frequency and/or severity of flooding, and therefore, flood damages. Structural alternatives considered in this study included a plan to clear and snag Bayou Chinchuba and channel improvements for the Slidell area. Clearing and snagging and channel improvements would reduce flooding by increasing channel conveyance. This would reduce the frequency and/or degree of channel overtopping, as well as allow more water to be evacuated from streets and residences into the drainage system.

The analysis of both structural and non-structural alternatives began with an inventory and valuation of assets, both structures and vehicles, which are at risk in the flood plain. Appropriate depth-damage data were obtained from previous studies, and elevation-damage curves were derived so that flood-damage reduction benefits could be computed and compared to the costs of achieving these benefits.

2. Flood Plain Inventory and Valuation.

Structures. The survey estimated the number, value, and elevation of all structures. Ground elevations were determined using 5-foot contours displayed on quadrangle maps, and first floor elevations were estimated using a hand level. Elevations were based upon 1-foot contour interval maps developed for the Lake Pontchartrain Hurricane Protection project.

A field team surveyed structures for pertinent characteristics, including occupancy type, number of stories, type of foundation and construction, and the physical condition and dimensions of the structure.

For commercial structures, the Marshall and Swift Commercial Estimator Program was used to determine cost per square foot based on the above factors. Marshall and Swift considers over 100 commercial occupancy categories in their program. Buildings are classified by construction types in order to determine the base cost per square foot. The base cost is then adjusted for factors such as heating and cooling, local construction cost, current cost conditions, and age and life expectancy of the building. The price per square foot was multiplied by the square footage size of the building to determine a total value for each commercial structure. Occupancy codes were aggregated into established commercial categories for elevation-damage analysis. Content values were computed using content-to-structure value ratios derived in past studies.

The depreciated replacement costs of residential structures were estimated using the Marshall and Swift Residential Estimator Program. This continuously price-adjusted computer program uses localized cost per square foot to calculate the depreciated replacement cost of residential structures. A 50% content-to-structure value ratio was assumed for residential structures in this study.

Vehicles. Estimated automobile values were included with the data analyzed. It is assumed that each residence has one automobile placed at 1/2-foot below first floor level for slab homes, and at two feet below first floor for pier homes. The number of automobiles per household is based on statistics supplied by the Louisiana Motor Vehicle Division and Census Data from 1994. One vehicle per household was assumed since an unknown number of vehicles would be in use for normal or evacuation purposes at the time of a flood, and therefore not subject to flooding. The average value for a used automobile was determined to be $8,300, based on the average sales price of used cars as reported by the National Automobile Dealers Association.

Data collected on the inventoried structures and vehicles was put into a computerized format using the Corps of Engineers Editor (COED) computer program.

3. Depth-Damage Assumptions. As part of the Lake Pontchartrain Hurricane Protection Project (LPHPP) study, completed in 1984, a contractor analyzed in detail the structural components of 15 residential structure types to determine the depth-of-flooding to dollar-damage relationships. These were further aggregated into three structure types: single-story, two-story, and mobile homes. Since the types of structure found in the study area are

virtually identical to those found in the LPHPP study area, use of LPHPP depth-damage curves was determined to be appropriate for this study. Depth-damage relationships used in computing expected annual damages on automobiles are based on data received for prior studies from insurance companies.

4. Elevation-Damage and Benefit-Cost Analysis. Elevation-damage analysis was conducted for the structural plan in the Bayou Chinchuba flood plain using the Flood Damage Analysis Package, a set of computer programs produced by the Hydrologic Engineering Center. The programs develop elevation-damage curves using depth-damage data (discussed in the previous section) and the flood plain inventory. By combining this result with elevation-frequency data provided by the Hydraulics and Hydrology (H&H) Branch, the programs compute expected annual flood damages for the with- and without-project conditions. The dollar damage of each flood event is multiplied by the percent chance of exceedance, and the weighted damages are summed to determine the expected annual damages. Inundation reduction benefits are computed as the difference in average annual flood damages in the with- and without-project conditions. For this study, damages and benefits were calculated for one and two story single-family structures and their contents, commercial structures and their contents, and automobiles.

The Urban Flood Damage computer program, developed by Vicksburg District, was used for non-structural analysis. The program operates in a manner similar to the one described above, and has the added feature that cost data are incorporated for evaluating non-structural alternatives. The cost data incorporated in the program were updated to 1996 price levels using an Engineering News Record construction cost index.

Prior to evaluating the economic feasibility of each measure, the program screens structures to determine their suitability for particular types of non-structural protection. For example, structures for which the 100-year flood would cause more than 5 feet of flooding on the outside of the structure are not evaluated for flood proofing, but would be considered for structure raising. (A flood level of 5 feet or more on the outside of a flood-proofed structure will likely cause structural damage.) Also, a structure is not considered for non-structural protection if it is above the 500-year flood elevation. After the screening, with- and without-project average annual damages are developed for each type of flood proofing, and the damage reductions are compared to the cost for each particular measure considered.

The model provides estimates of average annual costs and benefits for the total of all structures that are considered viable candidates for a particular non-structural alternative. Therefore, for alternatives that indicate negative net benefits as a whole, a significant number of structures may be economically justified on an individual basis. In these cases, further analysis will be required in the feasibility study phase to identify these structures.

The model also employs an algorithm that is designed to calculate the number of square feet for each structure for use in estimating the total cost of implementing a given non-structural alternative. This calculation is accomplished by dividing the estimated depreciated replacement cost of an individual structure by an assumed value representing the average structure cost per square foot, a value that also varies in relation to broad ranges of structure cost. The imputed estimate of square feet for the structure is multiplied by the estimated cost per square foot of implementing a given non-structural alternative. This calculation yields an estimate of the total cost of implementing that alternative for an individual structure.

Currently, efforts are underway to revise the model in order to compute the cost of employing a non-structural alternative using observed values for square footage in contrast to the averages imputed by the model. This change will result in more accurate cost estimates since the square foot value used by the model will be directly linked to the individual structure as field data are gathered. However, since the revisions to the model are not complete, most results in this analysis reflect the original methodology. The exception is a more detailed analysis for the Lacombe study area that was based on the model results.

Benefits and costs for all structural and non-structural plans were discounted and amortized over 50 years at the current Federal discount rate of 7 5/8%.

VI. Analysis Results for Proposed Alternatives

1. Abita Springs. Five non-structural alternatives were evaluated for Abita Springs.

This area includes 28 hydraulic reaches, ten of which have structures located within the 10-year overflow. A comprehensive field survey (100% inventory) of all of the structures within the 10-year overflow was conducted in April 1996 to identify structures at risk.

There were 60 single-family residences, 1 mobile home, and 11 commercial structures identified within the overflow area. Many of the homes surveyed were below the 100-year flood elevation. Current policy prohibits inclusion of benefits for preventing flooding to homes built below the 100-year flood level in areas where the local government participates in the Federal Emergency Management Agency flood insurance program. However, the majority of homes in the area appear to be greater than 20 years old; hence, they predate parish participation in the program, and consequently, are exempted from this rule. A summary of the inventory, grouped according to structure type, is displayed in Table B4.

Table B4
Number of Structures, Type and Value
Abita Springs, La.

Type	Number of Structures	Total Value in Thousands	Average Value in Thousands
Single-Family	61	$ 3,641,700	$ 59,700
Commercial	11	$ 1,201,300	$ 109,200

A summary of the number of structures in each flood zone (based on first floor elevations) is displayed in Table B5, and existing annual damages by reach are displayed in Table B6.

Table B5
Summary of Structures by Flood Zone
Based on First Floor Elevations
Without-Project Conditions
Abita Springs, La.
(Non-Cumulative)

	Year			
	0-10	10-50	50-100	Over 100
Residential(1-sty)	27	8	1	6
Residential(2-sty)	8	1	0	9
Mobile Homes	1	0	0	0
Commercial	9	1	0	1

Table B6
Existing Average Annual Damages by Reach
Abita Springs, La.

REACH NT1	$90
REACH NT2	48
REACH NT3	898
REACH NT4	8,339
REACH ST3	17
REACH AR8	13,890
REACH AR9	55,263
REACH AR10	127,844
REACH AR11	85,254
REACH AR13	$114,965
Total Damages	$406,609

Table B7 provides a summary of the average annual costs, benefits, and net benefit computations for each non-structural alternative that was considered for Abita Springs.

Table B7
Net Benefit Analysis for Non-Structural Alternatives
Abita Springs, La.

Flood Proofing Alternative	
Number of Structures Evaluated	53
First Costs	$1,192,500
Cost Per Structure	22,500
Annual Costs	93,320
Annual Benefits	259,060
Net Benefits	165,740
Benefit-Cost Ratio	2.8 to 1
Structure Raising Alternative	
Number of Structures Evaluated	45
First Costs	$1,472,000
Cost Per Structure	32,700
Annual Costs	115,190
Annual Benefits	227,310
Net Benefits	$112,120
Benefit-Cost Ratio	2.0 to 1
Small Walls Alternative	
Number of Structures Evaluated	43
First Costs	$780,900
Cost Per Structure	18,200
Annual Costs	61,110
Annual Benefits	206,170
Net Benefits	$145,060
Benefit-Cost Ratio	3.4 to 1
Relocation	
Number of Structures Evaluated	44
First Costs	$3,304,600
Cost Per Structure	75,105
Annual Costs	258,610
Annual Benefits	138,880
Net Benefits	($119,730)
Benefit-Cost Ratio	.54 to 1

The first three alternatives, flood proofing, structure raising, and small walls, were justified; the other alternative, relocation, was not found to be justified.

2. Lacombe.

This study area is confined to those portions of the City of Lacombe that have incurred the most frequent and severe flooding. A comprehensive field survey (100% inventory of all of the structures within the defined alignment) was conducted in May 1996 to identify every structure at risk in the study area. There were 425 single-family residences surveyed within the study area, and 82 mobile homes. In addition, 24 commercial structures were identified.

A summary of the inventory, grouped according to reach and structure type, is displayed in Table B8.

Table B8
Number of Structures, Type and Value
Lacombe, La.

Type	Number of Structures	Total Value	Average Value
Single Family	507	$22,125,480	$ 43,640
Commercial	24	$ 2,257,904	$ 94,080

The analysis of the elevation-frequency and elevation-damage curves for Lacombe were computed for the without-project conditions only. A summary of the number of structures in each flood zone is displayed in Table B9.

Table B9
Summary of Structures by Flood Zone
Based on First Floor Elevations
Without-Project Conditions
Lacombe, La.
(Non-Cumulative)

	Year			
	0-10	10-50	50-100	Over 100
Residential(1-sty)	98	116	34	105
Residential(2-sty)	38	11	5	18
Mobile Homes	0	48	0	34
Commercial	9	7	0	8

Table B10 provides a summary of the average annual damages under existing conditions.

Table B10
Existing Average Annual Damages
Lacombe, La.

Commercial Average Annual Damages	$48,918
Residential Average Annual Damages	781,544
Automobile Average Annual Damages	234,345
Total Average Annual Damages	$1,064,807

Table B11 provides the summary of the average annual costs, benefits, and net benefits for each non-structural alternative considered.

Table B11
Net Benefit Analysis for Non-Structural Alternatives
Lacombe, La.

Flood Proofing Alternative	
Number of Structures Considered	253
First Costs	$ 7,068,300
Cost Per Structure	27,940
Average Annual Costs	553,140
Average Annual Benefits	357,100
Average Annual Net Benefits	$(196,040)
Benefit-Cost Ratio	.65 to 1
Structure Raising Alternative	
Number of Structures Considered	84
First Costs	$2,012,600
Cost Per Structure	23,960
Average Annual Costs	157,500
Average Annual Benefits	391,700
Average Annual Net Benefits	$234,200
Benefit-Cost Ratio	2.5 to 1
Small Walls Alternative	
Number of Structures Considered	237
First Costs	$4,920,600
Cost Per Structure	20,760
Average Annual Costs	385,070
Average Annual Benefits	314,130
Average Annual Net Benefits	$(70,940)
Benefit-Cost Ratio	.82 to 1
Relocation Alternative	
Number of Structures Considered	323
First Costs	$21,140,100
Cost Per Structure	65,450
Average Annual Costs	1,654,350
Average Annual Benefits	408,390
Average Annual Net Benefits	$(1,245,960)
Benefit-Cost Ratio	.25 to 1

As shown above, the structure raising alternative is the only non-structural alternative that is justified. There were a number of structures that were individually justified within each of the unjustified alternatives: 36 (14 percent) of the structures for the flood proofing alternative, 66 (27 percent) of the structures for the small walls alternative, and 63 (20 percent) of the structures for the relocation alternative.

Upon close inspection of field data relating to structure values and associated estimates of square feet, it was determined that

the model had overestimated the overall cost of implementing each alternative by approximately 11 percent.
This overestimate is attributable to the relatively low value for the average structure cost per square foot that the model's algorithm assumes in its calculations. The most direct effect of this low value is an overestimate of the number of square feet for each structure. A recalculation of the cost of implementing each non-structural alternative was conducted by hand. Observed values for square footage for each structure were used in order to replace the structure cost per square foot values that were programmed into the model with ones reflective of the study area. The lower average annual costs that were derived produced higher benefit-to-cost ratios: 0.72 (-$135,100 in average annual net benefits) for the flood proofing alternative, 0.91 (-$28,582 in average annual net benefits) for the small walls alternative, and 0.28 (-$1,063,982 in average annual net benefits) for the relocation alternative.

This re-analysis proved that the structure raising alternative is justified on an individual basis for approximately 84 of the structures evaluated. Since individual structures can be identified as beneficiaries of this alternative, analysis can be conducted which would identify those segments of the study area for which protection would be justified. Those segments, studied incrementally, would likely result in a specific set of economically justifiable plans within the currently defined study area.

3. Bayou Chinchuba. Potential flood protection for the Bayou Chinchuba area was previously studied by the New Orleans District in the Tchefuncte, Tickfaw, and Tangipahoa Rivers, Louisiana, Reconnaissance Study, dated June, 1991. This analysis is an updated evaluation of the potential for feasible protection in the Bayou Chinchuba area. This evaluation makes extensive use of primary field data gathered during the previous study.

Benefit categories were limited to inundation reduction benefits for existing structures and automobiles only. No benefits were computed for inundation reduction on future construction, or for other benefit categories such as Flood Insurance Agency cost reductions, emergency benefits, or fill cost reductions.

Estimates of average annual with- and without-project damages were computed using updated hydrologic data and the structure inventory gathered for the prior study; the inventory was updated using Marshall and Swift construction cost indexes. (Prices were updated to the September, 1995 price level.)

New hydrologic data were used for this study since, as discussed earlier in this report, replacement of a bridge over Bayou Chinchuba is expected to increase flood risk in the area. This bridge replacement was not anticipated during the previous study, and was thus not accounted for in the hydrologic analysis done for that study. The without-project elevation-frequency data used for this analysis does account for the bridge raising, and consequently, computed future without-project expected annual damages are higher than would be expected considering previous flood experience in the area.

Residential construction taking place subsequent to the first quarter of 1991, when the structure inventory was compiled, was not included in this analysis. However, it is unlikely that inundation reduction benefits are understated to any significant degree, as the new construction is required by FEMA regulations to have taken place above the 100-year flood level. Moreover, H&H Branch has determined that significant lowering of floods above the 100-year flood would not be accomplished by this alternative.

Average annual benefits for the clearing and snagging plan are $467 thousand, or approximately $6 million in present value terms. Sixty percent of the benefits come from inundation reduction to residential structures; 34% come from reduction of damages to residential contents, and 6% are reductions in vehicle damages. The majority of damages and benefits are in Reach 13, the Corin Street Area. (See Table B12.) Twenty-two percent of existing average annual flood damages would be prevented by project implementation.

Table B12
Bayou Chinchuba, La.
Clearing and Snagging Plan

Reach	Without-Project Damages	With-Project Damages	Project Benefits	Percent of Benefits
12	$0	$0	$0	
13	1,640	1,292	348	75%
14	0	0	0	
15	0	0	0	
16	0	0	0	
17	285	183	102	22%
18	20	11	9	2%
19	21	13	8	2%
20	1	1	0	
21	0	0	0	
22	0	0	0	
23	3	3	0	
24	169	169	0	
Total	$2,139	$1,672	$467	100%

Non-Structural Analysis. Several non-structural alternatives were evaluated for the Golden Glen subdivision, a portion of the Bayou Chinchuba Flood Plain, located in Mandeville, Louisiana. This subdivision suffered heavy damages in the 8-9 May 1995 flood event.

The field inventory gathered for Golden Glen included 97 structures with an average value of $123 thousand, and average annual damages based on existing conditions were $1.8 million. The high average annual damage estimate per structure of $18,500 is consistent with the incidence of flooding in the area, which is reported to be between two and three occurrences per year of varying degrees of severity. Table B13 shows the number, type, and value of structures in the area, and Table B14 shows the number of structures in each flood zone.

Table B13
Number of Structures, Type and Value
Golden Glen Subdivision, Mandeville, La.

Type	Number of Structures	Total Value	Average Value
Single Family	97	$11,925,936	$123,290

Table B14
Summary of Structures by Flood Zone
Based on First Floor Elevations
Without-Project Conditions
Golden Glen Subdivision, Mandeville, La.
(Non-Cumulative)

	Year			
	0-10	10-50	50-100	Over 100
Residential (1-sty)	10	3	45	4
Residential (2-sty)	18	13	0	4

Table B15 shows expected annual flood damages for Golden Glen.

Table B15
Existing Average Annual Damages
Golden Glen Subdivision, Mandeville, La.

Commercial Average Annual Damages	$0
Residential Average Annual Damages	1,653,729
Automobile Average Annual Damages	144,132
Total Average Annual Damages	$1,797,861

Table B16 shows summary results of the non-structural alternatives considered.

Table B16
Net-Benefit Analysis for Non-Structural Analysis
Golden Glen Subdivision, Mandeville, La.

Flood Proofing Alternative	
Number of Structures Evaluated	20
First Costs	1,166,200
Cost Per Structure	58,310
Annual Costs	91,260
Annual Benefits	334,240
Net Benefits	242,980
Benefit-Cost Ratio	3.7 to 1
Structure Raising Alternative	
Number of Structures Evaluated	36
First Costs	$3,217,200
Cost Per Structure	89,370
Annual Costs	251,760
Annual Benefits	1,481,700
Net Benefits	$1,229,940
Benefit-Cost Ratio	5.9 to 1
Small Walls Alternative	
Number of Structures Evaluated	20
First Costs	$913,100
Cost Per Structure	45,650
Annual Costs	71,460
Annual Benefits	334,240
Net Benefits	$262,780
Benefit-Cost Ratio	4.7 to 1
Relocation Alternative	
Number of Structures Evaluated	32
First Costs	$4,822,400
Cost Per Structure	150,700
Annual Costs	377,380
Annual Benefits	255,270
Net Benefits	($122,110)
Benefit-Cost Ratio	.68 to 1

The first three alternatives, flood proofing, structure raising, and small walls, were justified; the other alternative, relocation, was not found to be justified.

The non-structural analysis assumes that the structural plan (clearing and snagging of Bayou Chinchuba) is not in place. The feasibility of the structural plan has not been established, and therefore, is not considered part of the future without-project condition for the non-structural plans. If the structural plan were in place, the benefits of the non-structural alternatives would be reduced. Since the objective of the reconnaissance study is to identify at least one economically justified alternative, project interactions were not further explored. These interactions will be explored fully if a feasibility study is undertaken.

4. Slidell Area. The evaluation of flood damages and benefits contained herein is presented for the "project area" only. The project area is defined as the area that would be affected by the construction of water resource improvement plans. The project area, which includes the majority of the city of Slidell, was divided into three flood damage reaches for evaluation purposes. These are displayed in Table B17 by stream drainage area.

TABLE B17
Flood Damage Reaches;
Slidell Project Area

REACH NUMBER	DRAINAGE AREA
13	BAYOU VINCENT
14	CHANNEL W-14
15	CHANNEL W-15

The evaluation process of the Slidell reconnaissance study involved the formulation and assessment of the flood control improvements, the identification of categories of possible flood control benefits, the determination of without- and with-project damages and costs incurred, standard benefit-cost comparisons, and the determination of at least one feasible, implementable alternative. The basic parameters of this analysis included May 1996 price levels, a discount rate of 7-5/8 percent, and a 50-year project life.

The basic economic evaluation in the Slidell project area included the comparison of the urban flood damage setting for "without-project" and "with-project" conditions. Without-project conditions, or existing conditions, reflect conditions expected to prevail in the absence of any alternative plan of improvement. With-project conditions reflect conditions in the project area with a proposed flood control improvement in place.

In accordance with the NED procedures described in EC 1105-2-100, 28 December 1990, the proposed Slidell project was evaluated considering four primary categories of urban flood control benefits -- inundation reduction, intensification, location, and employment. Since St. Tammany Parish does not qualify for employment benefits, these were excluded from the analysis. In addition, indirect impacts of a flood control project in Slidell could include a more rapid transition of land use from its current use to other purposes. Due to the compressed schedule of this reconnaissance study, intensification and location benefits were not evaluated.

INUNDATION REDUCTION BENEFITS

Based on EC 1105-2-100, inundation reduction benefits are associated with physical damages or losses, income losses, and emergency costs. Most activities affected by a flood incur losses in one or more of these categories, but usually the majority of the benefits from a project result from the reduction of actual or potential physical damages due to inundation. Since income losses are hard to quantify as an NED benefit because they can be compensated for by a postponement or transfer of activities to other establishments within the nation, they were not included in this analysis. However, there are viable benefits associated with cost reduction savings from flood emergency operations. These include emergency costs, evacuation and subsistence costs, and reoccupation costs saved. Although physical flood damage reduction and emergency cost reduction are both classified as inundation reduction benefits, they are discussed separately in the following paragraphs.

Flood Damage Reduction

Most of the benefits that accrue from a project are usually the result of reducing physical flood damages. Physical inundation reduction damages include structural damages to buildings and losses to contents; damages to roads, bridges, and other public utilities; and losses to personal property such as automobiles. In determining potential flood damages to the Slidell area, flood damages were evaluated for urban structures and automobiles.

Analysis of Flood Damages to Structures

In the initiation of urban flood damage analyses, field investigations were conducted and data were collected to identify the extent and character of flooding in the Slidell project area. The determination of existing urban flood damages was based on the integration of depth-damage relationships and flood frequency distributions to structures located in the area. Development of the existing structure data was based upon a comprehensive field survey of all the structures located within the alignment of the project area. Applicable flood damage curves were used to depict the relationships between the stage and area inundated, stage and frequency of occurrence, stage and damage, and damage and frequency of occurrence. These curves are the basis for the damage/benefit analysis in evaluating project alternatives.

Structure Inventory.

Structural surveys for the Slidell project area were conducted during reconnaissance studies in February 1996. A comprehensive field survey (i.e., a 100 percent inventory of all the structures within the alignment) was conducted in an effort to identify each structure at risk in the affected area. Structures were surveyed for pertinent characteristics. These included type of structure and/or business, number of stories, type of foundation and construction, structure dimensions, physical condition of the structure, and the location. Structures were differentiated by eleven basic types -- residential one-story, residential two-story, mobile home, apartment or duplex, commercial, professional, industrial, public, semipublic, recreational, and warehouse.

Structure and Contents Valuation.

Structure and contents values are major elements influencing the impact of depth-damage relationships and magnitude of flood damages to urban structures. For the purposes of estimating urban flood damages, a structure is defined as a building and any attached components, such as built-in appliances, shelves, carpeting, etc. The value of land is excluded in the determination of urban structure values. Contents represent furnishings and equipment, or all items within the structure that are not permanently attached.

Residential structure values were calculated using the Marshall and Swift Residential Estimator Program. This continually price-adjusted computer program uses cost per square foot, geographically localized by zip code, to calculate a depreciated replacement value for each structure. Mobile homes within the area were assessed using an average value per structure based on size. In determining flood damages to contents within residential structures, a 50 percent cap on content-to-structure value was utilized .

In the determination of nonresidential structure values, the Marshall and Swift Commercial Estimator Program was used. This program determines a cost per square foot based on a number of factors, including occupancy of the structure. Marshall and Swift considers over 100 occupancy categories. Buildings are classified by construction type in order to determine a base cost per square foot. The base cost is then adjusted for factors such as heating and cooling, local construction cost, current cost conditions, and age and life expectancy of the building. The value per square foot was multiplied by the square footage size of the building to determine a total value for each nonresidential structure. For depth-damage purposes, occupancy codes were aggregated into seven established categories of nonresidential use for the Slidell area.

A summary of the major structure types by average structure value are depicted in Table B18 by each flood damage reach for the Slidell project area.

Structure Elevation. The first-floor elevation of each structure is utilized to determine the expected flood depths for each structure for each set of hydrologic conditions. Elevations for 73 percent of the structures in the Slidell project area (i.e., Reaches 13 and 14) were derived from 1-foot contour maps. The remaining structure elevations (27 percent), located in Reach 15, were determined from 5-foot contour quadrangle maps. Structure elevations were refined using data collected by the American Red Cross during and after the May 1995 flood in St. Tammany Parish. This data included the number of flooded structures per street and the depth flooding by structure.

Depth-Damage Relationships. To quantify the extent of flooding which occurs in an area, depth-damage curves are utilized. For the Slidell study, depth-damage relationships developed for the New Orleans area in the Lake Pontchartrain Hurricane Protection Project (LPHPP) in 1984 were used. These curves were based on detailed damage surveys of residential and nonresidential properties in Jefferson and Orleans Parishes in the State of Louisiana. Each unit was visually inspected with estimated expected damages recorded at various levels of inundation. These curves were differentiated by structure types, structure value, and type of flooding. Since the range of structure type in Slidell is virtually identical to those found in the LPHPP study area, use of these data was deemed appropriate. Freshwater curves were utilized for this analysis.

TABLE B18
Average Structure Value by Major Structure Type
And Flood Damage Reach; Slidell Project Area

MAJOR STRUCTURE TYPE	REACH 13		REACH 14		REACH 15	
	NUMBER OF STRUCTURES (#)	AVERAGE STRUCTURE VALUE ($)	NUMBER OF STRUCTURES (#)	AVERAGE STRUCTURE VALUE ($)	NUMBER OF STRUCTURES (#)	AVERAGE STRUCTURE VALUE ($)
Residential	667	49,600	5,917	75,600	2,544	102,100
Commercial	46	108,100	140	311,800	0	0
Professional	3	183,000	42	333,200	2	12,034,000
Public	0	0	11	922,500	3	4,250,000

Damage Evaluation.

In determining the number of structures flooded and resulting impact, the Urban Flood Damage Program (URBAN), developed by the Vicksburg District, was utilized to correlate existing structural and hydrologic data. Within the program, eight different types of urban structures were evaluated using hydrologic profile data, structure locations, first floor elevations, depth-damage relationships, and structure and contents values to compute the depth of flooding and resulting damages for each structure for selected frequency flood events. Table B19 displays the number of structures damaged by flood frequency for each flood damage reach.

Results of reconnaissance flood damage analyses estimated that a total of 5,962 structures would experience damage during maximum flooding events, with the majority of the flooding (60 percent) occurring in Reach 14. Residential structures comprised 98 percent of the structures flooded with 5,859 units, while only a 103 nonresidential structures were impacted. These results reflect the application of frequency flood events which have occurred in recent storms in an attempt to duplicate the extent of damages known to have occurred in the Slidell area.

Analysis of Automobile Damages

There are also damages to other properties in the floodplain which are incurred as a result of urban flooding. Some of these, such as automobile damages, are directly related to the structural flood damages. The analysis of automobile damages involves determining the number of automobiles impacted per household and the application of these data to a damage per automobile value ($8,300 for the Slidell area). The elevation of each automobile is determined by its corresponding structure elevation. Automobile damages are then calculated by correlating depth of flooding, depth-damage per automobile, and damage per automobile.

TABLE B19

Total Number of Structures Flooded by Frequency and Flood Damage Reach a/ for Existing Conditions in the Slidell Project Area

FLOOD FREQUENCY EVENT (Freq/Yr)	RESIDENTIAL				NONRESIDENTIAL				TOTAL			
	FLOOD DAMAGE AREA				FLOOD DAMAGE AREA				FLOOD DAMAGE AREA			
	13	14	15	TOTAL	13	14	15	TOTAL	13	14	15	TOTAL
5	0	0	0	0	0	0	0	0	0	0	0	0
10	389	2,738	1,713	4,840	16	16	4	36	405	2,754	1,717	4,876
25	409	2,898	1,713	5,020	16	16	4	36	425	2,914	1,717	5,056
50	424	3,192	1,759	5,375	18	42	4	64	442	3,234	1,763	5,439
100 b/	467	3,542	1,850	5,859	36	63	4	103	503	3,605	1,854	5,962

a/ Total numbers are cumulative. Damages begin with yard and slab damage 0.5 foot below first-floor elevation.
b/ Standard Project Flood.

Automobile Valuation. The 1990 census indicated that there were 1.8 vehicles per household in St. Tammany Parish. For automobile flood damage calculations, it was assumed that each residence had one automobile which was susceptible to damage. For slab homes, automobiles were placed at 0.5 foot below the first floor level, assuming garages and carports are lower than first-floor elevations of homes. For pier homes, automobiles were placed at ground elevation. The application of only one vehicle per structure reflects that a number of vehicles may not be parked at home during the time of a flood due to other uses or that they may be evacuated. Therefore, they are not subject to flooding. The current average damage per automobile in Slidell was estimated to be $8,300, based on the replacement value of a depreciated used automobile. No damages were assumed to occur at flood frequencies lower than the 10-year flood event.

Summary of Expected Flood Damages

The results of the flood damage analysis for existing and with-project conditions in the Slidell project area are presented in Table B20 for structures and automobiles. Existing expected damages, which are the annual damages expected to occur without flood reduction measures in place, were estimated at $3,950,600 for structures and $133,500 for automobiles for the total project area. Altogether, existing inundation damages totaled $4,084,100 for the Slidell project area. In comparison, expected annual flood damages to structures and automobiles for with-project conditions were $505,900 and $12,500, respectively. Benefits from inundation damages reduced is summarized at the end of this section for the Slidell project area.

TABLE B20
Expected Annual Flood Damages by Flood Damage Reach
To Structures and Automobiles
Slidell Project Area

DAMAGE CATEGORY	EXPECTED ANNUAL FLOOD DAMAGES ($)							
	EXISTING CONDITIONS				WITH-PROJECT CONDITIONS			
	REACH 13	REACH 14	REACH 15	TOTAL	REACH 13	REACH 14	REACH 15	TOTAL
Structures	382,400	1,719,300	1,848,900	3,950,600	316,800	105,900	83,200	505,900
Automobiles	22,100	70,600	40,800	133,500	1,500	9,500	1,500	12,500
TOTAL	404,500	1,789,900	1,889,700	4,084,100	318,300	115,400	84,700	518,400

Emergency Cost Reduction

Emergency costs are those costs incurred by a community during and immediately following a major storm. These costs include those expenses resulting from a flood that would not otherwise be incurred, such as the costs of evacuation and reoccupation, flood fighting, disaster relief, etc.; increased costs of normal operations during the flood; and increased costs of police, fire, or military patrol. In the evaluation of emergency cost reduction in Slidell, three categories were identified -- general emergency costs, evacuation and subsistence costs, and reoccupation costs. For this analysis, it was assumed that no emergency costs would accrue to storms of less than the 25-year frequency event.

Emergency Costs.

Benefits attributed to emergency costs include the reduction or elimination of the costs associated with general emergency operations. These include the additional costs of law enforcement patrol, emergency management agencies, Department of Public Works, and Mosquito and Rodent Control Department; the costs of flood fighting and cleanup, setting up barricades, sandbagging, and associated supplies, etc.; and increased costs of normal operations incurred during the flood.

As mentioned previously, the Slidell area received significant flood damages and incurred extensive emergency costs during the October 1985 Hurricane Juan storm. This 60-year frequency event was evaluated to compute the average annual emergency costs attributable to flooding in the area. The total emergency costs and damages to property for the west bank of Jefferson Parish during this event was estimated at approximately $4 million. With a total of 2,500 structures flooded, this results in an average emergency cost of $1,600 per structure flooded. Adjusted to May 1996 price levels, this amount increases to $2,116 per structure.

In order to determine expected annual emergency costs, the emergency costs for storms of different frequencies of occurrence were identified by applying the average emergency cost per structure to the number of structures flooded by frequency. Emergency costs by flood frequency were then annualized for existing and with-project conditions in determining the expected annual emergency costs for the Slidell project area.

Evacuation and Subsistence Costs.

Evacuation and subsistence costs include the costs borne by various relief organizations and groups which aid in evacuating and providing subsistence for those residents who are forced from their homes during flood and hurricane events. Groups providing this aid include the American Red Cross and Salvation Army. Relief efforts are also sponsored by local schools, religious organizations and businesses for flood victims. Costs borne include meals, clothing, medical supplies, and shelter assistance for evacuees.

During Hurricane Juan, schools and armories were opened in the southern half of Louisiana for approximately 13,000 evacuees who were forced to flee their homes because of flooding. The American Red Cross opened 23 shelters for flood victims in 10 parishes and set up 4 mobile feeding units. Approximately 50,000 people were fed by these units. Cash vouchers were also given to flood victims for items such as clothing, home furnishings, medicine, and health aids. In 1985, the Red Cross reported actual expenses of approximately $8 million for the 12,980 families that registered for aid in the parishes flooded by Hurricane Juan. The actual assistance paid to each family was $616. The Salvation Army also opened several relief centers throughout the west bank area. Aid totaling $240,000 provided to approximately 1,200 families resulted in an average assistance of $200 to each family. Total assistance provided to each household flooded was determined to be $816. Converted to May 1996 prices, this amount was increased to $1,126.

In determining expected annual subsistence and evacuation costs, the number of structures flooded by frequency were applied to the evacuation and subsistence cost per structure ($1,126) to develop damage-frequency relationships for the Slidell area. These results were annualized to determine expected annual evacuation and subsistence costs incurred for existing and with-project conditions.

Reoccupation Costs.

The benefits that are attributed to reoccupation costs are defined as the elimination or reduction in the costs incurred by homeowners or businesses in reoccupying a structure. These costs result from the flooding of structures which include time spent to contract, supervise, and inspect repairs, cleaning, and disinfecting. It also includes the time spent in documenting casualty loss forms for flood insurance and other disaster assistance. Interviews with former flood victims in the Amite River area were used to determine the hours spent on the aforementioned items.

According to the President of the Amite River Citizens Organization, the average time spent in flood cleanup per household totaled 170 hours. In a review of this estimate, it was reduced to 115 hours. Because the homeowners were forced to forego other activities such as work time during the aftermath of the flood, an opportunity cost of $15.50 per hour was assigned. This is based on the average hourly wage for New Orleans MSA for employees covered under the Louisiana Employment Securities Law as of the third quarter of 1990. Thus, applying $15.50 per hour to the average of 115 hours, the total reoccupation cost per structure was determined to be $1,783.

In determining expected annual reoccupation costs, the $1,783 cost per household was multiplied to the number of structures flooded by frequency to develop the damage-frequency relationships. These results were annualized to determine

Summary of Expected Flood Costs Incurred

Cost reduction benefits to emergency operations include the difference, or savings, between the flood costs incurred for existing and with-project conditions. Results of these analyses, presented in Table B21 for the Slidell project area, display the expected costs associated with general flood emergency operations, evacuation and subsistence costs, and reoccupation costs in the project area. Total expected annual costs for existing conditions were estimated at $498,800 as compared to $87,900 for with-project conditions. The portion of the average annual costs that will be reduced by the project is considered to be the emergency costs saved.

TOTAL EXPECTED ANNUAL BENEFITS

Total expected annual benefits estimated to be attributed to the installation of a combination of flood control improvements in the Slidell area are presented in Table B22. These benefits, which are the difference in the expected flood damages and costs incurred for existing without- and with-project conditions, were estimated at $3,976,600 for the total project area.

TABLE B21
Expected Annual Emergency Costs Incurred
By Flood Damage Reach;
Slidell Project Area

COST CATEGORY	EXPECTED ANNUAL FLOOD COSTS ($)							
	EXISTING CONDITIONS				WITH-PROJECT CONDITIONS			
	REACH 13	REACH 14	REACH 15	TOTAL	REACH 13	REACH 14	REACH 15	TOTAL
Emergency Costs	24,200	79,800	106,000	210,000	23,400	9,500	4,100	37,000
Evacuation and Subsistence Costs	12,900	42,500	56,400	111,800	12,400	5,100	2,200	19,700
Reoccupation Costs	20,400	67,300	89,300	177,000	19,700	8,000	3,500	31,200
TOTAL	57,500	189,600	251,700	498,800	55,500	22,600	9,800	87,900

TABLE B22
Total Expected Annual Benefits By Flood Damage Reach;
Slidell Project Area

BENEFIT CATEGORY	TOTAL EXPECTED ANNUAL BENEFITS ($)
INUNDATION REDUCTION	
Structures	3,444,700
Automobiles	121,000
Subtotal	3,565,700
COST REDUCTION	
Emergency Costs	173,000
Evacuation and Subsistence Costs	92,100
Reoccupation Costs	148,800
Subtotal	410,900
TOTAL	3,976,600

PROJECT COSTS

Project costs for the proposed flood improvement alternative to alleviate the flood problems in Slidell are displayed in Table B23. The costs developed include the construction of one detention pond weir, channel and culvert improvements, and the replacement of two bridges. Total project first costs, estimated to be $21,200,000, include costs for construction, real estate, and relocations. Amortized over the 50-year project life, total annual costs were estimated to be $1,787,000 for the combination plan. There are no operation and maintenance costs estimated for this project .

TABLE B23
Project First Costs and Total Annual Cost a/
For the Combination Plan;
Slidell Project Area

PROJECT FIRST COST ($)	**TOTAL ANNUAL COST** ($)		
	INTEREST c/	O&M d/	TOTAL
21,200,000	1,721,000	66,000	1,787,000

a/ Computed based on a discount rate of 7-5/8 percent and project life of 50 years.
b/ Based on an interest and amortization factor of .07823.
c/ No operation and maintenance costs were estimated with this project.

RESULTS OF FINAL ECONOMIC ANALYSIS

The results of the final economic analysis for the combination plan in the Slidell project area are summarized in Table B24. The initial investment for this project would be approximately $21.2 million with annual costs of $1.8 million. Annual benefits are estimated to be approximately $3.97 million, resulting in a favorable benefit-cost ratio of 2.2.

TABLE B24
Benefit-cost Comparison,
The Combination Plan - Detention Ponds and Channel Work;
Slidell Project Area

TOTAL ANNUAL BENEFITS ($)	TOTAL ANNUAL COSTS ($)	EXCESS BENEFITS OVER COSTS ($)	BENEFIT-COST RATIO
3,977,000	1,787,000	2,190,000	2.2

APPENDIX C

REAL ESTATE APPENDIX

APPRAISAL REVIEW CERTIFICATE

PROJECT:	St. Tammany Parish Reconnaissance Study
LOCATION:	Bayou Chinchuba and Slidell, St. Tammany Parish, Louisiana.
OWNER:	Various
APPRAISER:	Judith Y. Gutierrez, Staff Appraiser, NOD
EFFECTIVE DATE OF APPRAISAL:	May 22, 1996
ESTATES APPRAISED:	Clearing & Snagging Easement, Temporary Work Area Easement, Detention Pond Easement, and Drainage Ditch Easement
HIGHEST AND BEST USE:	Residential, Potential Residential, and Channel

VALUATION SUMMARY:

Bayou Chinchuba

Lands	$18,000
Contingency	5,000
Total LER	$23,000

Slidell

Lands	$2,877,000
Contingency	719,000
Total LER	$3,596,000

SCOPE OF REVIEW: Since I am familiar with the project area, a desk review was performed.

COMMENTS:

The appraiser estimated the fee value of the subject based on comparable sales located near the subject with similar highest and best use. The estimates of value of the Drainage Ditch and the

Detention Pond Easements are equal to fee since the subject will lose all utility after imposition of the easements. The Clearing and Snagging Easement will not change the highest and best use of the subject and will be performed within channel banks; therefore, no compensation is estimated. The Temporary Work Area Easement will not change the highest and best use of the land; the value is estimated as a rental of the land for the time of construction. The estimate of just compensation is reasonable and is approved.

REVIEWER'S CERTIFICATION:

I certify that, to the best of my knowledge and belief:

the facts and data reported in this report and used in the review process are true and correct;

the analyses, opinions, and conclusions in this review report are limited only by the assumptions and limiting conditions stated in this review report, and are my personal, unbiased professional analyses, opinions, and conclusions;

I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

my compensation is not contingent on an action or event resulting from the analyses, opinions, or conclusions in, or the use of, this review report;

my analyses, opinions, and conclusions were developed and this review report was prepared in conformity with the *Uniform Standards of Professional Appraisal Practice*;

I did not personally inspected the subject property of the report under review;

no one provided significant professional assistance to the person signing this review report.

6 June 1996

Yvonne P. Barbier
Yvonne P. Barbier
Review Appraiser
New Orleans District

INITIAL REAL ESTATE COST ESTIMATE REPORT
ST. TAMMANY PARISH RECONNAISSANCE STUDY
BAYOU CHINCHUBA AND SLIDELL

LOCAL SPONSOR: CITIES OF MANDEVILLE AND SLIDELL

PREPARED BY:
JUDITH Y. GUTIERREZ
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT

EFFECTIVE DATE OF REPORT
22 MAY 1996

PURPOSE OF APPRAISAL

The purpose of this appraisal is to estimate the market value of interests to be acquired to clear and snag and enlarge five channels. The purpose of the project is to reduce flooding from stormwater drainage.

ASSUMPTIONS AND LIMITING CONDITIONS

This report is subject to the following assumptions and limiting conditions:

1. I assume no responsibility for matters of a legal nature affecting the property appraised or the title thereto. The property is appraised as if it were marketable.

2. I have made no survey of the property and assume no responsibility in connection with such matters. This appraisal is based on preliminary quadrangle maps entitled *Covington, LA, Slidell, LA* and *Haaswood, LA-MS*. A copy of each map is included in Exhibit A.

3. A 25% contingency is added to the total lands and damages to compensate for the preliminary design of the project alignment. This contingency also compensates for not being able to physically inspect inaccessible areas of the subject.

4. CELMN-PD has instructed the appraiser that as few improvements as possible should be affected by construction of this project. Therefore, where possible, the temporary construction easements will be acquired on the unimproved banks of the channels.

5. This estimate is for LER only; other offices will estimate administrative acquisition costs and P.L. 91-646, Title II benefits.

AREA DATA

The project is located in St. Tammany Parish which is found at the far eastern tip of Louisiana, north of New Orleans. Its bordering parishes include Washington to the north, Tangipahoa to the west, and Jefferson and Orleans parishes in the southern

limits. The Parish covers 854 square miles; the land is primarily level with an average elevation of 9 feet above sea level. This Parish offers rural as well as suburban lifestyle to those who want to be near the New Orleans Metropolitan Area. The Parish population in 1993 was estimated to be 155,990. Most of the population is concentrated in six incorporated municipalities, Slidell, Mandeville, Madisonville, Covington, Pearl River and Folsom and two census designated places which are Lacombe and Eden Isle.

St. Tammany Parish offers outstanding opportunities for new business development and investment. It has a well developed transportation network which allows commerce by road, air and water. St. Tammany Parish has an estimated work force of 71,800 people.

BAYOU CHINCHUBA

PROJECT AREA

Bayou Chinchuba is located in Mandeville, the second largest incorporated municipality of the parish. The Bayou flows through woodlands which are surrounded by residential subdivisions. These subdivisions are relatively new and are improved with residences which range in value from $80,000 to $120,000. There are no improvements in the required right-of-way. The subject is zoned Residential. Although the subject property is wooded, the timber does not have any merchantable value; the value of the timber is included in the value of the land.

The project proposes to clear and snag the Bayou to improve stormwater drainage and prevent flooding of the adjacent subdivisions. Work will be performed from the banks; the work area extends 25 feet on each side of the Bayou. Minerals will not be acquired; therefore, neither the existence nor the value of minerals is addressed in this report. At this stage of the study, only a preliminary assessment screening of the subject is performed. Due to previous usage of the land, it is assumed that no HTRW is present. During the Feasibility Phase of the project soil samples will be taken to verify this.

ESTATES

A Clearing and Snagging Easement will be acquired on Bayou Chinchuba; all work will be performed within the banks of the Bayou. A Temporary Work Area Easement will be acquired for two years on the north and the south banks of the Bayou. The estimated acreage that will be impacted by this easement is 8.03 acres. Approximately five ownerships will be affected.

ANALYSIS OF HIGHEST AND BEST USE

The highest and best use is that use which is the highest and most profitable use for which the property is adaptable and needed or likely to be needed in the near future. The highest and best use of Bayou Chinchuba is to continue as a channel providing stormwater drainage to the surrounding area. This

highest and best use will not change as a result of construction of the project.

The highest and best use of the adjacent bank is a use associated with the highest and best use of the parent tracts which is residential. The Temporary Work Area Easement will be acquired for two years. During this time the owner cannot develop the property; however, once the easement expires, all rights revert to the landowner. The highest and best use after expiration of the easement will remain residential development.

VALUATION SUPPORT

The estimate of value is determined by the sales comparison approach. The comparable sales are located within two to three miles from the subject. They are wooded lands which have been or are in the process of being developed into residential subdivisions. These sales indicate a range of value between $9,000 and $12,000 per acre. I estimate the fee value of the subject to be $12,000 per acre.

The channel work will be done within channel right-of-way. The local sponsor owns sufficient interest to perform the work. In essence the project will improve the purpose of the channel which is for stormwater drainage. Therefore, there is no compensation for the required right-of-way.

The compensation for the Temporary Work Area Easement is determined as a rental of the land for two years discounted to present value. A reasonable rate of return on the fee value is 10% or $1,200 per year which is discounted for two years using a safe rate of 4%.

SEVERANCE DAMAGES

There is no severance damage to the remainders of the properties.

VALUE SUMMARY

Date of Value - May 1996

		Acres	Unit Value	Total Value
(a)	Lands and Damages			
	Clearing & Snagging Easement Existing Channel			0
	Temporary Work Area Easement Woodland/Pot.Residential	8.03		18,174
	Improvements			0
	Severance Damage			0
	Total (R)			$18,000
(b)	Contingencies 25% (R)			5,000
(c)	Total Lands, Easements, & Rights-of-way			$23,000

SLIDELL

PROJECT AREA

This feature of the project requires enlarging two manmade canals, W-14 and Poor Boy Canals, and clearing and snagging Bayou Vincent (W-13), part of W-14 and another manmade canal, W-15. In addition, two large undeveloped areas will be acquired to construct detention ponds. The clearing and snagging work will be performed from the adjacent bank avoiding all major improvements.

Poor Boy Canal flows east to west through woodlands; however, the adjacent areas are residential. Work will be performed on the north side of the canal and will affect four landowners. Channel enlargement will require 60 feet and 25 feet for work area.

Bayou Vincent affects three landowners. The Bayou flows through an undeveloped area of the city. Fifty feet will be acquired on each side of the bank to enlarge the channel.

W-14 flows north to south. All work for clearing and snagging will be performed from the west bank which is woodlands; 38 landowners will be impacted. The channel will be enlarged between Independence Drive and Fremaux Avenue; the work will affect 100 landowners. Approximately 65 feet will be acquired on each side of the bank; which will leave those landowners with only 60% of their lots. Nineteen improvements will be acquired in order to enlarge the channel. The property values in this area range from S90,000 to $120,000 for improved lots.

W-15 flows east to west; all work will be performed on the south bank. Twenty-five feet will be acquired for construction work; no improvements will be affected. Approximately 84 landowners will be affected by construction of this project feature. The property values in this subdivision range from $120,000 to $140,000 for improved lots.

The required right of way is zoned Residential. Although the subject property is wooded, the timber does not have any merchantable value; the value of the timber is included in the value of the land.

Minerals will not be acquired; therefore, neither the existence nor the value of minerals is addressed in this report. At this stage of the study, only a preliminary assessment screening of the subject is performed. Due to previous usage of the land, it is assumed that no HTRW is present. During the Feasibility Phase of the project soil samples will be taken to verify this.

ESTATES

A Clearing and Snagging Easement will be acquired on W-15 and part of W-14. A Temporary Work Area Easement will be acquired for two years adjacent to all channels; 31.8 acres of woodland and 5.74 acres of residential land will be affected. A Drainage Ditch Easement will be acquired on 17.57 acres of woodland and 2.75 acres of residential land. A Detention Pond Easement will be acquired on 38.5 acres of woodland.

ANALYSIS OF HIGHEST AND BEST USE

The highest and best use is that use which is the highest and most profitable use for which the property is adaptable and needed or likely to be needed in the near future. The highest and best use of channels is to continue providing stormwater drainage to the surrounding area. This highest and best use will not change as a result of construction of the project.

The highest and best use of the adjacent bank is a use associated with the highest and best use of the parent tracts which is residential or potential residential. The Temporary Work Area Easement will be acquired for two years. During this time the owner cannot develop the land; however, once the easement expires all rights revert to the landowner. The highest and best use after expiration of the easement will remain residential or residential development.

The Drainage Ditch Easement will take all rights except the right of ownership. The highest and best use of the properties affected will change from residential or potential residential to channel use.

VALUATION SUPPORT

The estimate of value is determined by the sales comparison approach. Comparable sales of woodlands are located within five miles from the subject. Their highest and best use is for residential development. These sales indicate a range of value between $7,000 and $16,000 per acre. I estimate the fee value of the subject to be $10,000 per acre.

Residential lots located in the vicinity of W-14 and W-15 with average dimensions of 70 ft. by 120 ft. sell for $3.25 per square foot ($141,570/acre) and $4.75 per square foot (206,910/acre), respectively. These values are supported by numerous comparable sales in the affected subdivisions. Various comparables are sales of the subject lots themselves.

The clearing and snagging of the channels does not change their highest and best use. It is assumed that the local sponsor has sufficient rights to perform this work. Therefore, no compensation is required for this work.

The compensation for the Temporary Work Area Easement is determined as a rental of the land for two years discounted to present value. A reasonable rate of return on the fee value is 10% per year which is discounted for two years using a safe rate of 4%.

The Drainage Ditch and the Detention Pond Easements basically take all rights from the landowner and leave the subject with little if any use. The compensation for these interests is estimated as equal to fee value.

SEVERANCE DAMAGES

Severance damage is estimated for the remainders of those lots which will be encumbered with a Drainage Ditch Easement along W-14. The remaining lots will be 70 ft. by 75 ft., 60% of their original size. These lots will no longer be comparable to other lots within the subdivision in which they are located. This is deemed to reduce the market value of those lots approximately 35% or $1.15 per square foot.

The severance damages are $600,000 (100 lots * $6,000 loss each).

VALUE SUMMARY

Date of Value - May 1996

	Acres	Unit Value	Total Value
Lands			
Drainage Ditch Easement			
Residential	2.75	$141,570	389,318
Woodland/Potential Residential	17.57	$10,000	175,700
Temporary Work Area Easement			
Woodland/Pot. Residential	31.8		59,978
Residential	3.44	a	91,853
Residential	2.3	b	89,758
Clearing and Snagging Easement			
Existing Channel			0
Detention Pond Easement			
Woodland/Pot. Residential	38.5	$10,000	385,000
Improvements			1,085,000
Severance Damages			600,000
Total			$2,877,000
Contingency (25%)			719,000
Total Lands, Easements & Rights-of-way			$3,596,000

a. Fee value is $141,570 per acre
b. Fee value is $206,910 per acre

CERTIFICATE

I certify that, to the best of my knowledge and belief:

the facts and data reported in this report are true and correct;

the analyses, opinions, and conclusions in this report are limited only by the assumptions and limiting conditions stated previously and are my personal, unbiased professional analyses, opinions, and conclusions;

I have no present or prospective interest in the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

my compensation is not contingent on an action or event resulting from the analyses, opinions, or conclusions in, or the use of, this report;

I personally inspected the subject property of the report;

No one provided assistance to me in order to complete this appraisal

6 June 1996

Judith Y. Gutiérrez
Judith Y. Gutiérrez
Appraiser
New Orleans District

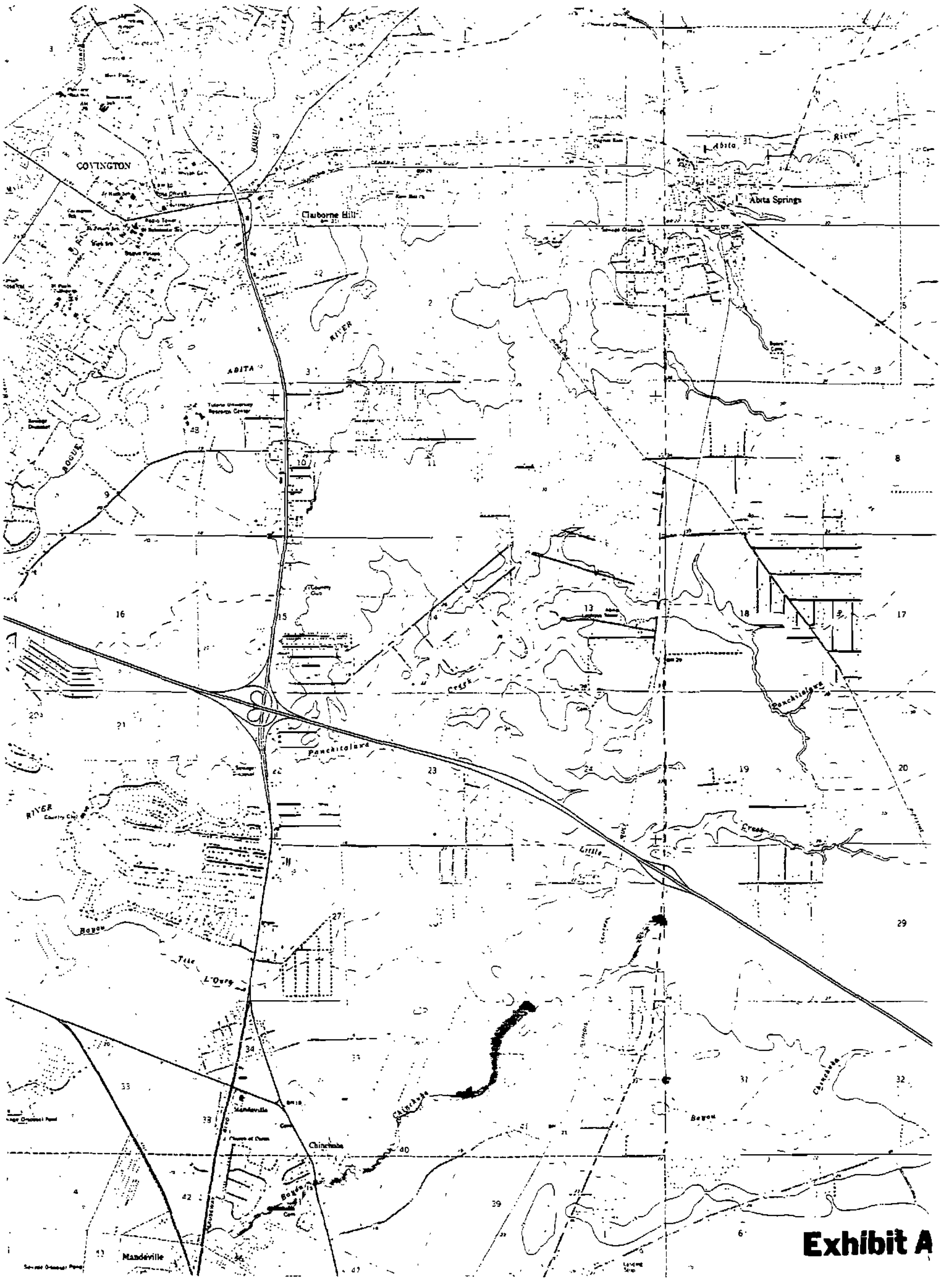
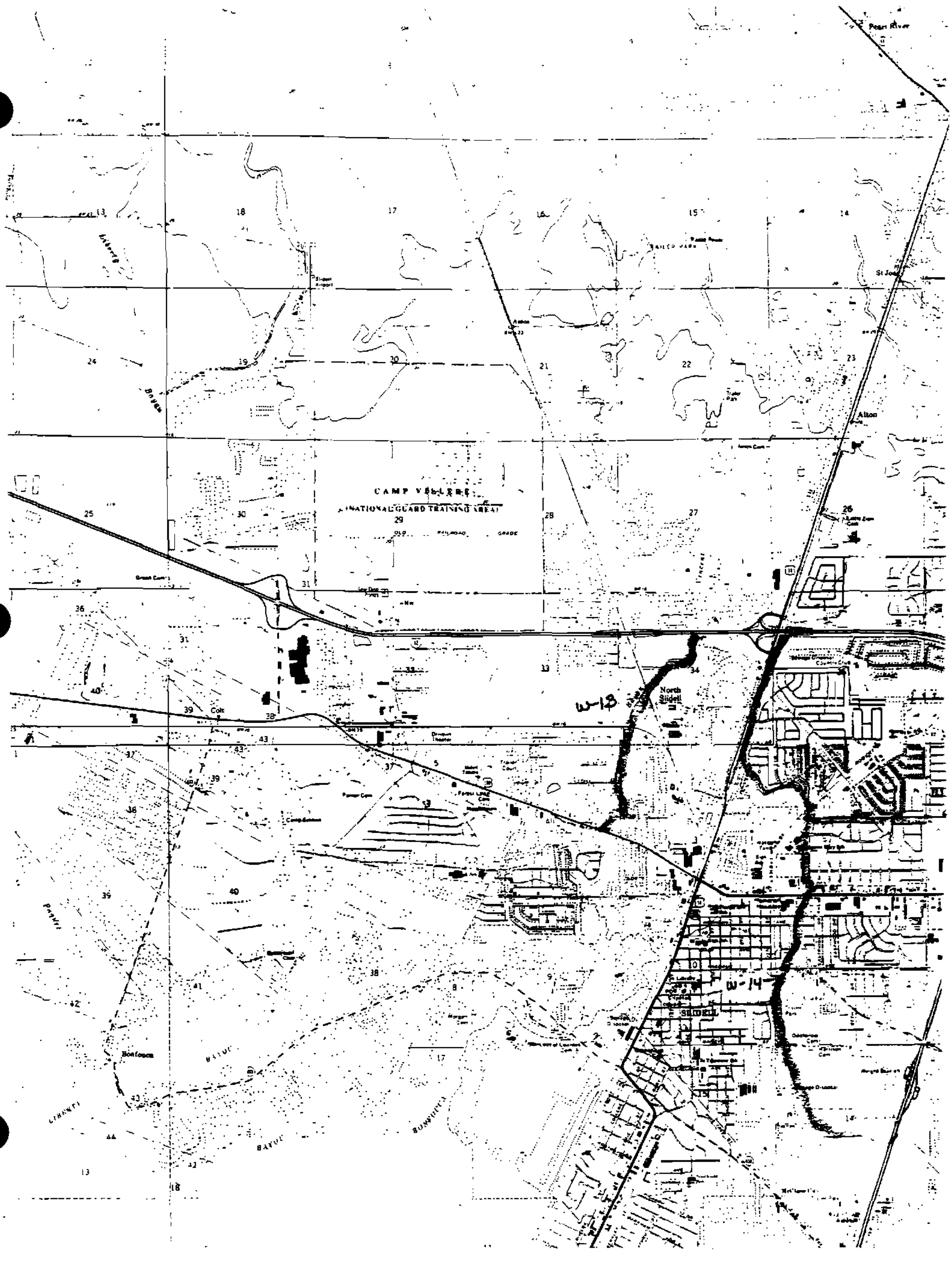
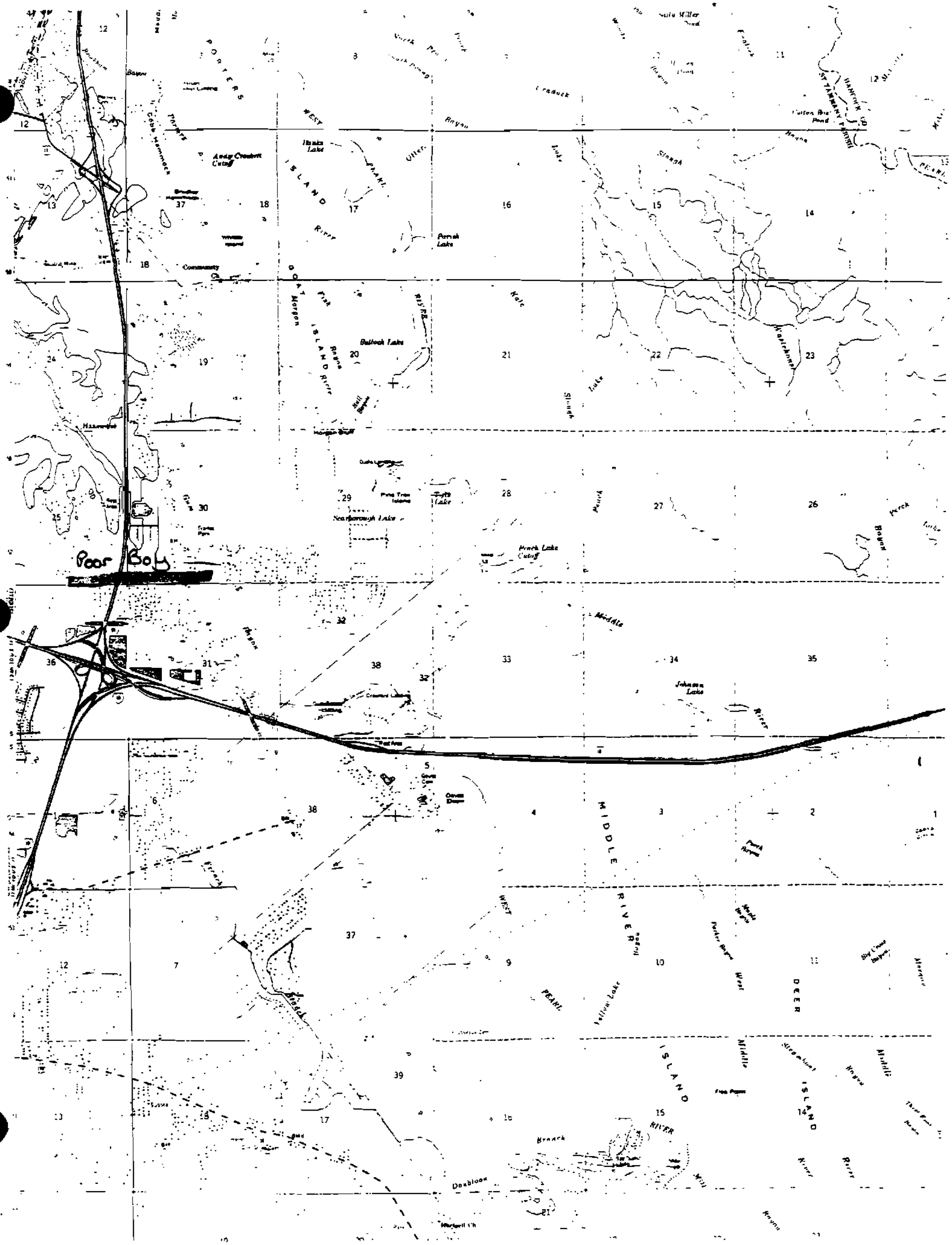

COVINGTON
Abita Springs
Claiborne Hill
ABITA
RIVER
Panchitolawa
Creek
Little
Bayou
L'Ours
Mandeville
Chinchuba
Tulane University Research Center
Country Club

Exhibit A



Pearl River
CAMP VILLERE
NATIONAL GUARD TRAINING AREA
OLD RAILROAD GRADE
Alton
North Slidell
SLIDELL
Bonfouca
W-13
W-14



Poor Boy
PORTERS
WEST PEARL
ISLAND
River
Andy Crockett Cutoff
Bullock Lake
Scarborough Lake
Perch Lake Cutoff
Johnson Lake
MIDDLE RIVER
DEER
ISLAND
Doubloon

ST. TAMMANY PARISH FLOOD STUDY
CHART OF ACCOUNTS
21 AUGUST 1996
BAYOU CHINCHUBA

		AMOUNT	CONTINGENCY	PROJECT COST
			ROUNDED	36,000
	TOTAL PROJECT COSTS	28,020	7,510	35,530
01	**LANDS AND DAMAGES**	28,020	7,510	35,530

		AMOUNT	CONTINGENCY	PROJECT COST
01	**LANDS AND DAMAGES**			
01B	**ACQUISITIONS**			
01B10	BY GOVERNMENT		0	0
01B20	BY LOCAL SPONSOR (LS)	7,200	1,800	9,000
01B30	BY GOVT ON BEHALF OF LS		0	0
01B40	REVIEW OF LS	480	120	600
01C	**CONDEMNATIONS**			
01C10	BY GOVERNMENT		0	0
01C20	BY LS		0	0
01C30	BY GOVT ON BEHALF OF LS		0	0
01C40	REVIEW OF LS		0	0
01D	**INLEASING**			
01D10	BY GOVERNMENT		0	0
01D20	BY LS		0	0
01D30	BY GOVT ON BEHALF OF LS		0	0
01D40	REVIEW OF LS		0	0
01E	**APPRAISAL**			
01E10	BY GOVT (IN HOUSE)		0	0
01E20	BY GOVT (CONTRACT)		0	0
01E30	BY LS	1,500	380	1,880
01E40	BY GOVT ON BEHALF OF LS		0	0
01E50	REVIEW OF LS	600	150	750
01F	**PL 91-646 ASSISTANCE**			
01F10	BY GOVERNMENT		0	0
01F20	BY LS		0	0
01F30	BY GOVT ON BEHALF OF LS		0	0
01F40	REVIEW OF LS		0	0
			0	0
01G	**TEMPORARY PERMITS/LICENSES/RIGHTS-OF-ENTRY**		0	
01G10	BY GOVERNMENT		0	0
01G20	BY LS		0	0
01G30	BY GOVT ON BEHALF OF LS		0	0
01G40	REVIEW OF LS		0	0
01G50	OTHER		0	0
01G60	DAMAGE CLAIMS		0	0
			0	0
01H	**AUDITS**			
01H10	BY GOVERNMENT		0	0
01H20	BY LS		0	0
01H30	BY GOVT ON BEHALF OF LS		0	0
01H40	REVIEW OF LS		0	0

01J	**ENCROACHMENTS AND TRESPASS**			
01J10	BY GOVERNMENT		0	0
01J20	BY LS		0	0
01J30	BY GOVT ON BEHALF OF LS		0	0
01J40	REVIEW OF LS		0	0
01K	**DISPOSALS**			
01K10	BY GOVERNMENT		0	0
01K20	BY LS		0	0
01K30	BY GOVT ON BEHALF OF LS		0	0
01K40	REVIEW OF LS		0	0
01L00	**REAL PROPERTY ACCOUNTABILITY**		0	0
01M00	**PROJECT RELATED ADMINISTRATION**		0	0
01N00	**FACILITY/UTILITY RELOCATIONS**		0	0
01P00	**WITHDRAWALS (PUBLIC DOMAIN LAND)**		0	0
01Q00	**RESERVED FOR FUTURE HQUSACE USE**		0	0
			0	0
01R	**REAL ESTATE PAYMENTS**			
01R1	**LAND PAYMENTS**			
01R1A	BY GOVERNMENT		0	0
01R1B	BY LS	18,000	5,000	23,000
01R1C	BY GOVT ON BEHALF OF LS		0	0
01R1D	REVIEW OF LS		0	0
01R2	**PL 91-646 ASSISTANCE PAYMENTS**			
01R2A	BY GOVERNMENT		0	0
01R2B	BY LS		0	0
01R2C	BY GOVT ON BEHALF OF LS		0	0
01R2D	REVIEW OF LS		0	0
01R3	**DAMAGE PAYMENTS**			
01R3A	BY GOVERNMENT		0	0
01R3B	BY LS		0	0
01R3C	BY GOVT ON BEHALF OF LS		0	0
01R3D	REVIEW OF LS		0	0
01R9	**OTHER**		0	0
01S	**REAL ESTATE RECEIPTS**			
01S10	DISPOSAL RECEIPTS - REIMBURSEMENTS (CR) - LANDS		0	0
01S20	DISPOSAL RECEIPTS - GENERAL FUND (CR) - LANDS		0	0
			0	
01T	**LERRD CREDITING**			
01T10	LAND PAYMENTS		0	0
01T20	ADMINISTRATIVE COSTS	240	60	300
01T30	PL 91-646 ASSISTANCE		0	0
01T40	ALL OTHER		0	0
01U00	**ALL OTHER REAL ESTATE ANALYSES**			
01V00	RESERVED FOR FUTURE HQUSACE USE		0	0
01W00	RESERVED FOR FUTURE HQUSACE USE		0	0
01X00	RESERVED FOR FUTURE HQUSACE USE		0	0
01Y00	RESERVED FOR FUTURE HQUSACE USE		0	0

01Z00	RESERVED FOR FUTURE HQUSACE USE	0	0			
02	**RELOCATIONS**			0	0	
02100	RELOCATION OF ROADS (INCLUDING BRIDGES)	0	0			
02200	RELOCATIONS OF RAILROADS (INCLUDING BRIDGES)	0	0			
02300	RELOCATION OF CEMETERIES, UTILITIES AND STUCTURES	0	0			
21	**RECONNAISSANCE STUDIES**			0	0	0
21A0*	PUBLIC INVOLVEMENT	0	0			
21B0*	INSTITUTIONAL STUDIES	0	0			
21C0*	SOCIAL STUDIES	0	0			
21D0*	CULTURAL RESOURCE STUDIES	0	0			
21E0*	ENVIRONMENTAL STUDIES EXCEPT ACCOUNTS 21F & 21L	0	0			
21F0*	FISH AND WILDLIFE PLANNING AID STUDIES	0	0			
21G0*	ECONOMIC STUDIES	0	0			
21H	REAL ESTATE ANALYSES/DOCUMENTS	0	0			
21H1*	REAL ESTATE SECTION/REPORT	0	0			
21H2*	RIGHTS OF ENTRY	0	0			
21H3*	ALL OTHER REAL ESTATE ANALYSES/DOCUMENTS	0	0			
21J0*	HYDROLOGY AND HYDRAULIC STUDIES	0	0			
21K0*	GEOTECHNICAL STUDIES	0	0			
21L0*	HTRW ASSESSMENTS	0	0			
21M0*	ALL OTHER STUDIES/INVESTIGATIONS	0	0			
21N0*	SURVEYS AND MAPPING EXCEPT FOR REAL ESTATE PURPOSES	0	0			
21P0*	ENGINEERING ANALYSIS AND DESIGN/PROJECT COST ESTIMATES	0	0			
21Q0*	RECON MANAGEMENT	0	0			
21R0*	PLAN FORMULATION AND EVALUATION	0	0			
21S0*	RECON REPORT PREPARATION	0	0			
21T0*	RECON PROGRAMS AND PROJECT MANAGEMENT	0	0			
21U0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
21V0*	FEASIBILITY STUDY COST SHARING AGREEMENT	0	0			
21W0*	RECON DAMAGES ASSESSED AE CONTRACTORS	0	0			
21X0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
21Y0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
21Z0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
22	**FEASIBILITY STUDIES**			0	0	0
22A0*	PUBLIC INVOLVEMENT	0	0			
22B0*	INSTITUTIONAL STUDIES	0	0			
22C0*	SOCIAL STUDIES	0	0			
22D0*	CULTURAL RESOURCE STUDIES	0	0			
22E0*	ENVIRONMENTAL STUDIES EXCEPT F&W AND HTRW	0	0			
22F0*	FISH AND WILDLIFE PLANNING AID STUDIES	0	0			
22G0*	ECONOMIC STUDIES	0	0			
22H0*	REAL ESTATE ANALYSES/DOCUMENTS	0	0			
22H1*	REAL ESTATE SUPPLEMENT/PLAN	0	0			
22H2*	GROSS APPRAISAL/REPORT	0	0			
22H3*	PRELIMINARY REAL ESTATE ACQUISITION MAPS	0	0			
22H4*	PHYSICAL TAKINGS ANALYSIS	0	0			
22H5*	PRELIMINARY ATTS OPINION OF COMPENSABILITY	0	0			
22H6*	RIGHTS OF ENTRY	0	0			
22H7*	ALL OTHER REAL ESTATE ANALYSES/DOCUMENTS	0	0			
22J0*	HYDROLOGY AND HYDRAULIC STUDIES	0	0			
22K0*	GEOTECHNICAL STUDIES	0	0			
22L0*	HTRW STUDIES	0	0			

22M0*	ALL OTHER STUDIES/INVESTIGATIONS	0	0			
22N0*	SURVEYS AND MAPPING EXCEPT FOR REAL ESTATE PURPOSES	0	0			
22P0*	ENGINEERING ANALYSES AND DESIGN/PROJECT COST ESTIMATES	0	0			
22Q0*	FEASIBILITY MANAGEMENT	0	0			
22R0*	PLAN FORMULATION AND EVALUATION	0	0			
22S0*	FEASIBILITY REPORT PREPARATION	0	0			
22T0*	FEASIBILITY PROGRAMS AND PROJECT MANAGEMENT	0	0			
22U0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
22V0*	INITIAL DRAFT PROJECT COOPERATION AGREEMENT	0	0			
22W0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
22X0*	FEASIBILITY DAMAGES ASESSED AE CONTRACTORS	0	0			
22Y0*	WASHINGTON REVIEW LEVEL	0	0			
22Z0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
30BP*	**PROJECT COOPERATION AGREEMENT (PCA)**	0	0		0	0
51	**OPERATION AND MAINTENANCE DURING CONSTRUCTION**					
51A	REAL ESTATE - LEASING	0	0	0	0	0
51A10	INLEASING	0	0			
51A20	RELOCATION ASSISTANCE	0	0			
51A30	DISPOSAL ASSISTANCE	0	0			
51A40	RELOCATION ASSISTANCE PAYMENTS (PL 91-646)	0	0			
51A50	RENTS, INITAIL ALTERATIONS AND RESTORATIONS	0	0			
51B	REAL ESTATE - MANAGEMENT SERVICES	0	0			
51B10	COMPLIANCE INSPECTIONS	0	0			
51B2	OUTGRANTS	0	0			
51B21	REGULAR	0	0			
51B22	OIL AND GAS	0	0			
51B30	DISPOSALS	0	0			
51B40	ENCROACHMENTS AND TRESPASS	0	0			
51C00	OTHER OPERATION AND MAINTENANCE EXPENSES	0	0			
51D00	REVENUES DERIVED FROM OUTLEASING RETURNED TO STATES	0	0			
51E00	AUDITS	0	0			
51F00	TIMBER HARVEST	0	0			
51G00	REPAYMENTS AND COST DISTRIBUTIONS	0	0			
51H	MISCELLANEOUS RECEIPTS	0	0			
51H10	REAL ESTATE MANAGEMENT INCOME	0	0			
51H90	OTHER INCOME	0	0			

ST. TAMMANY PARISH FLOOD STUDY
CHART OF ACCOUNTS
21 AUGUST 1996
SLIDELL

		AMOUNT	CONTINGENCY	PROJECT COST
			ROUNDED	5,403,000
	TOTAL PROJECT COSTS	4,283,140	1,119,730	5,402,870
01	**LANDS AND DAMAGES**	4,245,170	1,110,230	5,355,400

		AMOUNT	CONTINGENCY	PROJECT COST
01A	**PROJECT PLANNING**	3,120	780	3,900
01B	**ACQUISITIONS**			
01B10	BY GOVERNMENT	30,020	56,680	283,408
01B20	BY LOCAL SPONSOR (LS)	226,728	56,680	283,408
01B30	BY GOVT ON BEHALF OF LS		0	0
01B40	REVIEW OF LS	25,060	6,270	31,330
01C	**CONDEMNATIONS**			
01C10	BY GOVERNMENT		0	0
01C20	BY LS	150,000	37,500	187,500
01C30	BY GOVT ON BEHALF OF LS		0	0
01C40	REVIEW OF LS	12,000	3,000	15,000
01D	**INLEASING**			
01D10	BY GOVERNMENT		0	0
01D20	BY LS		0	0
01D30	BY GOVT ON BEHALF OF LS		0	0
01D40	REVIEW OF LS		0	0
01E	**APPRAISAL**			
01E10	BY GOVT (IN HOUSE)		0	0
01E20	BY GOVT (CONTRACT)		0	0
01E30	BY LS	74,500	18,630	93,130
01E40	BY GOVT ON BEHALF OF LS		0	0
01E50	REVIEW OF LS	27,720	6,930	34,650
01F	**PL 91-646 ASSISTANCE**			
01F10	BY GOVERNMENT	2,960	740	3,700
01F20	BY LS	48,800	12,200	61,000
01F30	BY GOVT ON BEHALF OF LS		0	0
01F40	REVIEW OF LS	7,640	1,910	9,550
			0	0
01G	**TEMPORARY PERMITS/LICENSES/RIGHTS-OF-ENTRY**		0	
01G10	BY GOVERNMENT	9,280	2,320	11,600
01G20	BY LS	26,700	6,680	33,380
01G30	BY GOVT ON BEHALF OF LS		0	0
01G40	REVIEW OF LS	2,160	540	2,700
01G50	OTHER		0	0
01G60	DAMAGE CLAIMS	14,400	3,600	18,000
			0	0
01H	**AUDITS**			
01H10	BY GOVERNMENT		0	0
01H20	BY LS		0	0
01H30	BY GOVT ON BEHALF OF LS		0	0

01H40	REVIEW OF LS		0	0
01J	**ENCROACHMENTS AND TRESPASS**			
01J10	BY GOVERNMENT		0	0
01J20	BY LS		0	0
01J30	BY GOVT ON BEHALF OF LS		0	0
01J40	REVIEW OF LS		0	0
01K	**DISPOSALS**			
01K10	BY GOVERNMENT		0	0
01K20	BY LS		0	0
01K30	BY GOVT ON BEHALF OF LS		0	0
01K40	REVIEW OF LS		0	0
01L00	**REAL PROPERTY ACCOUNTABILITY**		0	0
01M00	**PROJECT RELATED ADMINISTRATION**		0	0
01N00	**FACILITY/UTILITY RELOCATIONS**		0	0
01P00	**WITHDRAWALS (PUBLIC DOMAIN LAND)**		0	0
01Q00	**RESERVED FOR FUTURE HQUSACE USE**		0	0
			0	0
01R	**REAL ESTATE PAYMENTS**			
01R1	**LAND PAYMENTS**			
01R1A	BY GOVERNMENT		0	0
01R1B	BY LS	2,877,000	719,000	3,596,000
01R1C	BY GOVT ON BEHALF OF LS		0	0
01R1D	REVIEW OF LS		0	0
01R2	**PL 91-646 ASSISTANCE PAYMENTS**			
01R2A	BY GOVERNMENT		0	0
01R2B	BY LS	665,000	166,250	831,250
01R2C	BY GOVT ON BEHALF OF LS		0	0
01R2D	REVIEW OF LS		0	0
01R3	**DAMAGE PAYMENTS**			
01R3A	BY GOVERNMENT		0	0
01R3B	BY LS		0	0
01R3C	BY GOVT ON BEHALF OF LS		0	0
01R3D	REVIEW OF LS		0	0
01R9	**OTHER**		0	0
01S	**REAL ESTATE RECEIPTS**			
01S10	DISPOSAL RECEIPTS - REIMBURSEMENTS (CR) - LANDS		0	0
01S20	DISPOSAL RECEIPTS - GENERAL FUND (CR) - LANDS		0	0
			0	
01T	**LERRD CREDITING**			
01T10	LAND PAYMENTS		0	0
01T20	ADMINISTRATIVE COSTS	37,280	9,320	46,600
01T30	PL 91-646 ASSISTANCE	4,800	1,200	6,000
01T40	ALL OTHER		0	0
01U00	**ALL OTHER REAL ESTATE ANALYSES**			
01V00	RESERVED FOR FUTURE HQUSACE USE		0	0
01W00	RESERVED FOR FUTURE HQUSACE USE		0	0

01X00	RESERVED FOR FUTURE HQUSACE USE		0	0			
01Y00	RESERVED FOR FUTURE HQUSACE USE		0	0			
01Z00	RESERVED FOR FUTURE HQUSACE USE		0	0			
02	**RELOCATIONS**				0	0	
02100	RELOCATION OF ROADS (INCLUDING BRIDGES)		0	0			
02200	RELOCATIONS OF RAILROADS (INCLUDING BRIDGES)		0	0			
02300	RELOCATION OF CEMETERIES, UTILITIES AND STUCTURES		0	0			
21	**RECONNAISSANCE STUDIES**				2,030	510	2,540
21A0*	PUBLIC INVOLVEMENT		0	0			
21B0*	INSTITUTIONAL STUDIES		0	0			
21C0*	SOCIAL STUDIES		0	0			
21D0*	CULTURAL RESOURCE STUDIES		0	0			
21E0*	ENVIRONMENTAL STUDIES EXCEPT ACCOUNTS 21F & 21L		0	0			
21F0*	FISH AND WILDLIFE PLANNING AID STUDIES		0	0			
21G0*	ECONOMIC STUDIES		0	0			
21H	REAL ESTATE ANALYSES/DOCUMENTS		0	0			
21H1*	REAL ESTATE SECTION/REPORT	270	70	340			
21H2*	RIGHTS OF ENTRY		0	0			
21H3*	ALL OTHER REAL ESTATE ANALYSES/DOCUMENTS	1,760	440	2,200			
21J0*	HYDROLOGY AND HYDRAULIC STUDIES		0	0			
21K0*	GEOTECHNICAL STUDIES		0	0			
21L0*	HTRW ASSESSMENTS		0	0			
21M0*	ALL OTHER STUDIES/INVESTIGATIONS		0	0			
21N0*	SURVEYS AND MAPPING EXCEPT FOR REAL ESTATE PURPOSES		0	0			
21P0*	ENGINEERING ANALYSIS AND DESIGN/PROJECT COST ESTIMATES		0	0			
21Q0*	RECON MANAGEMENT		0	0			
21R0*	PLAN FORMULATION AND EVALUATION		0	0			
21S0*	RECON REPORT PREPARATION		0	0			
21T0*	RECON PROGRAMS AND PROJECT MANAGEMENT		0	0			
21U0*	RESERVED FOR FUTURE HQUSACE USE		0	0			
21V0*	FEASIBILITY STUDY COST SHARING AGREEMENT		0	0			
21W0*	RECON DAMAGES ASSESSED AE CONTRACTORS		0	0			
21X0*	RESERVED FOR FUTURE HQUSACE USE		0	0			
21Y0*	RESERVED FOR FUTURE HQUSACE USE		0	0			
21Z0*	RESERVED FOR FUTURE HQUSACE USE		0	0			
22	**FEASIBILITY STUDIES**				35,940	8,990	44,930
22A0*	PUBLIC INVOLVEMENT		0	0			
22B0*	INSTITUTIONAL STUDIES		0	0			
22C0*	SOCIAL STUDIES		0	0			
22D0*	CULTURAL RESOURCE STUDIES		0	0			
22E0*	ENVIRONMENTAL STUDIES EXCEPT F&W AND HTRW		0	0			
22F0*	FISH AND WILDLIFE PLANNING AID STUDIES		0	0			
22G0*	ECONOMIC STUDIES		0	0			
22H0*	REAL ESTATE ANALYSES/DOCUMENTS		0	0			
22H1*	REAL ESTATE SUPPLEMENT/PLAN	2,800	700	3,500			
22H2*	GROSS APPRAISAL/REPORT	9,600	2,400	12,000			
22H3*	PRELIMINARY REAL ESTATE ACQUISITION MAPS		0	0			
22H4*	PHYSICAL TAKINGS ANALYSIS		0	0			
22H5*	PRELIMINARY ATTS OPINION OF COMPENSABILITY	7,080	1,770	8,850			
22H6*	RIGHTS OF ENTRY	10,480	2,620	13,100			
22H7*	ALL OTHER REAL ESTATE ANALYSES/DOCUMENTS	5,980	1,500	7,480			
22J0*	HYDROLOGY AND HYDRAULIC STUDIES		0	0			

22K0*	GEOTECHNICAL STUDIES	0	0			
22L0*	HTRW STUDIES	0	0			
22M0*	ALL OTHER STUDIES/INVESTIGATIONS	0	0			
22N0*	SURVEYS AND MAPPING EXCEPT FOR REAL ESTATE PURPOSES	0	0			
22P0*	ENGINEERING ANALYSES AND DESIGN/PROJECT COST ESTIMATES	0	0			
22Q0*	FEASIBILITY MANAGEMENT	0	0			
22R0*	PLAN FORMULATION AND EVALUATION	0	0			
22S0*	FEASIBILITY REPORT PREPARATION	0	0			
22T0*	FEASIBILITY PROGRAMS AND PROJECT MANAGEMENT	0	0			
22U0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
22V0*	INITIAL DRAFT PROJECT COOPERATION AGREEMENT	0	0			
22W0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
22X0*	FEASIBILITY DAMAGES ASESSED AE CONTRACTORS	0	0			
22Y0*	WASHINGTON REVIEW LEVEL	0	0			
22Z0*	RESERVED FOR FUTURE HQUSACE USE	0	0			
30BP*	**PROJECT COOPERATION AGREEMENT (PCA)**	0	0		0	0
51	**OPERATION AND MAINTENANCE DURING CONSTRUCTION**					
51A	REAL ESTATE - LEASING	0	0	0	0	0
51A10	INLEASING	0	0			
51A20	RELOCATION ASSISTANCE	0	0			
51A30	DISPOSAL ASSISTANCE	0	0			
51A40	RELOCATION ASSISTANCE PAYMENTS (PL 91-646)	0	0			
51A50	RENTS, INITAIL ALTERATIONS AND RESTORATIONS	0	0			
51B	REAL ESTATE - MANAGEMENT SERVICES	0	0			
51B10	COMPLIANCE INSPECTIONS	0	0			
51B2	OUTGRANTS	0	0			
51B21	REGULAR	0	0			
51B22	OIL AND GAS	0	0			
51B30	DISPOSALS	0	0			
51B40	ENCROACHMENTS AND TRESPASS	0	0			
51C00	OTHER OPERATION AND MAINTENANCE EXPENSES	0	0			
51D00	REVENUES DERIVED FROM OUTLEASING RETURNED TO STATES	0	0			
51E00	AUDITS	0	0			
51F00	TIMBER HARVEST	0	0			
51G00	REPAYMENTS AND COST DISTRIBUTIONS	0	0			
51H	MISCELLANEOUS RECEIPTS	0	0			
51H10	REAL ESTATE MANAGEMENT INCOME	0	0			
51H90	OTHER INCOME	0	0			

APPENDIX D

USF&WS PLANNING AID LETTER

PLANNING-AID REPORT ON THE ST. TAMMANY PARISH, LOUISIANA, FLOOD CONTROL STUDY

U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

MAY 1996

PLANNING-AID REPORT
ON THE
ST. TAMMANY PARISH, LOUISIANA,
FLOOD CONTROL STUDY

PREPARED BY

DEAN C. BOSSERT

BIOLOGICAL SCIENCE TECHNICIAN

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

MAY 1996

United States Department of the Interior

FISH AND WILDLIFE SERVICE
825 Kaliste Saloom Road
Brandywine Bldg. II, Suite 102
Lafayette, Louisiana 70508

May 31, 1996

Colonel Kenneth Clow
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Clow:

Please refer to the St. Tammany Parish, Louisiana, Flood Control Study being conducted by the New Orleans District, Corps of Engineers. The Fish and Wildlife Service submits the enclosed planning-aid report in partial fulfillment of our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

We will continue to work closely with your staff during future planning efforts to ensure that the fish and wildlife resources of the study area are conserved. Toward that end, please have your staff contact Mr. Dean Bossert (telephone 318/262-6662, extension 238) of this office if further information is needed.

Sincerely,

David W. Frugé
Field Supervisor

Enclosure

cc: EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA

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LIST OF FIGURES

INTRODUCTION

The New Orleans District, Corps of Engineers (Corps), is conducting a reconnaissance study of alternatives to alleviate flooding problems in St. Tammany Parish, Louisiana. The area is subject to headwater flooding from heavy, localized rainfall. In addition, the southern portion of the Parish is subject to tidal flooding due to surges from hurricanes and other storms. The study was authorized by a resolution adopted by the Committee on Public Works of the U.S. House of Representatives on September 24, 1992, and by the 1995 Energy and Water Appropriations Act.

The Fish and Wildlife Service (Service) has prepared this planning aid report to assist the Corps in preparing their reconnaissance report for the study. Because St. Tammany Parish contains 14 major drainage basins or subbasins, a single plan to address all of the flooding problems is not practical. This report, therefore, describes existing and future fish and wildlife resource conditions in each of four study areas; discusses fish- and wildlife-related problems, opportunities, and planning objectives; identifies significant impacts of the project alternatives currently under consideration; describes Fish and Wildlife Coordination Act activities to be conducted during the feasibility study; and provides preliminary fish and wildlife conservation recommendations. This report does not constitute the final report of the Secretary of the Interior, as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

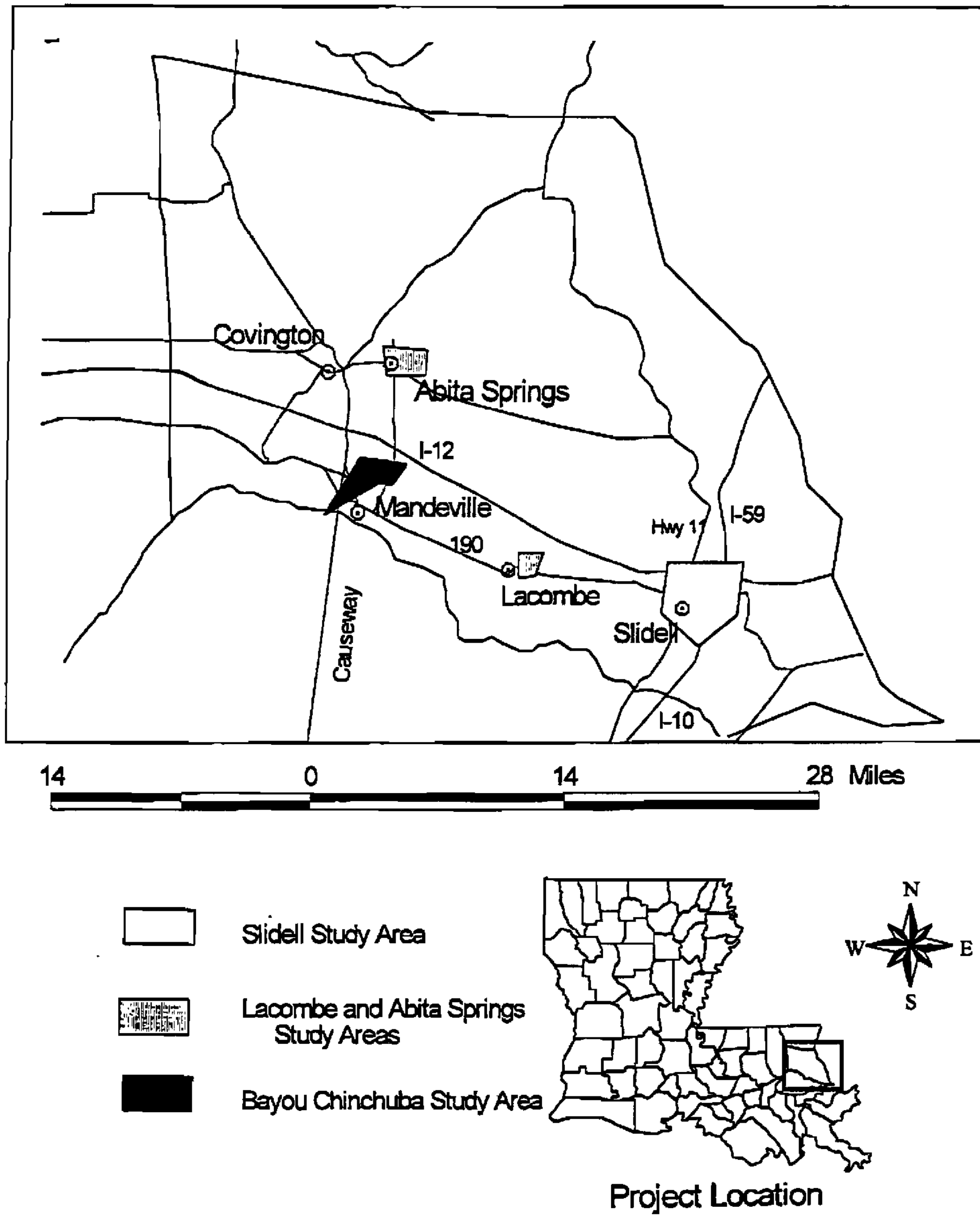
DESCRIPTION OF STUDY AREA

The general study area is located in the prairie terrace of southern St. Tammany Parish, Louisiana, and encompasses four specific drainage areas or basins, i.e., the floodplain of the Abita River within the town of Abita Springs, the floodplain of Big Branch within the town of Lacombe, the Bayou Chinchuba drainage basin in the Mandeville area, and the W-13, W-14, and W-15 canal basins in Slidell (Figure 1).

The Abita Springs and Lacombe study areas are dominated by residential development within a generally narrow riparian zone along the Abita River and Big Branch, respectively. Because flood protection measures being considered for those two areas consist of nonstructural plans, little or no detrimental impacts on fish and wildlife are expected to occur. Accordingly, the remainder of this report will focus on the Bayou Chinchuba and Slidell study areas.

Bayou Chinchuba is a sinuous watercourse that traverses a variety of land use areas, including extensive residential development. However, the northern reaches of the bayou flow through an area of pine flatwood and savannahs, with some interspersed bottomland hardwoods. The southern portion of the Bayou (from Causeway Boulevard to Lake Pontchartrain) traverses a cypress/tupelo swamp. Bayou Chinchuba has been designated a Natural and Scenic Stream by the Louisiana Scenic Rivers Act.

Figure 1: St. Tammany Parish, Louisiana, Study Area.



The Slidell portion of the study area includes flood-prone lands within the W-13, W-14, and W-15 canal basins. Those basins originate in mixed pine/hardwood forest areas north of Interstate Highway 12. The W-13 Canal drains south, under the Interstate, and eventually flows into Bayou Bonfouca. The predominant land use in this portion of the study area is residential development and mixed pine/hardwood forest. The W-14 canal drains to the southeast, underneath Interstate Highways 12 and 10, eventually emptying into Fritchie Marsh along Lake Pontchartrain. The W-13 and W-14 Canals are hydrologically connected by the West Diversion Canal. Similarly, the W-14 Canal basin is also connected to the W-15 Canal basin immediately east of the study area through a lateral canal located north of Independence Drive. The W-15 Canal also drains southeast, underneath Interstate Highways 12 and 10, eventually joining with Doubloon Branch and emptying into the West Pearl River. Most of the area in these basins consists of dense residential and commercial development, although a few small tracts of mixed pine/hardwood forest remain. The lower end of the W-15 Canal basin is a cypress/tupelo swamp.

DESCRIPTION OF FISH AND WILDLIFE RESOURCES

Wetlands in the project area act as sumps, and provide floodwater storage. Study-area wetlands also perform important water quality functions by reducing excessive dissolved nutrient levels and filtering suspended sediment carried in urban runoff. By acting as a natural filter, the study-area wetlands also help to minimize the adverse effects of non-point source pollution. In addition to their flood storage/water quality values, those wetlands provide important habitat for a variety of fish and wildlife.

Bayou Chinchuba

The Bayou Chinchuba study area contains several habitat types. From Lake Pontchartrain to North Causeway Boulevard, the bayou meanders through an approximately 200 to 400-foot-wide floodplain swamp that is flooded for most of the year. Predominant tree species in this swamp include tupelo gum, bald cypress, and red maple.

Between North Causeway Boulevard and the Lakes of Greenleaves subdivision, the floodplain narrows and the bayou meanders through an approximately 200-foot-wide, seasonally flooded, palustrine forested wetland (i.e., bottomland hardwood forest). Common overstory species in this area include water oak, swamp chestnut oak, Nuttall oak, southern red oak, green ash, sweetgum, red maple, and bald cypress. Moderate residential development occurs in the area between North Causeway Boulevard and Louisiana Highway 22. Outside of the riparian zone, land use is predominantly residential development in mixed pine/hardwoods. Common overstory species in the upland mixed pine/hardwood forest are loblolly pine, water oak, sweet gum, beech, southern magnolia, swamp white oak, southern red oak, and laurel oak. Midstory vegetation includes arrow wood, deciduous holly, ironwood, parsley hawthorne, roughleaf dogwood, wax myrtle, wild azalea, and yaupon. Understory species include dewberry, giant cane, palmetto, Virginia creeper, violets, rattan vine, and poison ivy.

North of the Lakes of Greenleaves subdivision, the habitat is similar to the area described above (i.e., a narrow floodplain surrounded by an area of development and mixed pine/hardwood). Remnant areas of pine savannah that are succeeding to a scrub/shrub habitat also occur within this area. Dominant tree species in those pine savannahs include loblolly pine, slash pine, sweetgum, sweetbay, water oak, and red maple. Meadow beauty, goldenrod, St. John's wort, dewberry, panic grasses, and broom sedges are among the most common herbaceous species.

Fishes in the mid to upper reaches of Bayou Chinchuba are limited to those tolerant of the periodic low dissolved oxygen levels that occur there in the warmer months. Those species include yellow bullhead, bowfin, gars, and various sunfishes, minnows, topminnows, and mosquitofish. The lower reaches of Bayou Chinchuba provide moderate quality habitat for commercially and recreationally important fishes such as largemouth bass, yellow bass, black crappie, white crappie, bluegill, redear sunfish, spotted sunfish, warmouth, channel catfish, flathead catfish, bowfin, carp, buffaloes, and gars. During periods of inundation, the Bayou Chinchuba swamps provide nursery and feeding habitat for those fishes. The Bayou Chinchuba wetlands also provide plant detritus to Lake Pontchartrain, thereby contributing to the production of commercially and recreationally important finfishes and shellfishes.

The wooded swamp and bottomland hardwoods associated with the Bayou Chinchuba floodplain are highly valuable wildlife habitats. Wood ducks utilize those forested wetlands for nesting, brood rearing, and feeding. Wading birds, such as great blue heron, green heron, little blue heron, Louisiana heron, snowy egret, black crowned night heron, yellow crowned night heron, and white ibis, are also common. Other common avian species are warblers, wrens, vireos, summer tanagers, kinglets, and various hawks and owls. Mammals known to occur within the undeveloped portions of the forested wetlands are white-tailed deer, raccoon, opossum, gray squirrel, nine-banded armadillo, eastern cottontail, swamp rabbit, and beaver.

The mixed pine/hardwood areas north of the Lakes of Greenleaves subdivision provide moderate to high wildlife habitat value. Birds known to occur in those areas include game species such as mourning dove, bobwhite, and American woodcock, as well as various wading birds, raptors, woodpeckers and songbirds. Mammals likely to occur in these areas include white-tailed deer, fox squirrel, gray squirrel, eastern cottontail, opossum, raccoon, nine-banded armadillo, and several bat species. The pine savannahs provide moderate to low habitat value to the same species, but are valuable for Henslow's sparrow, Bachman's sparrow, and prairie warblers. Amphibians and reptiles such as the green treefrog, Southern leopard frog, bullfrog, green anole, Gulf Coast box turtle, red-eared turtle, eastern hognose snake, and speckled kingsnake are also expected to occur there.

An active bald eagle nest is located approximately 4,400 feet northwest of the lower portion of Bayou Chinchuba. The bald eagle is Federally listed as a threatened species in the conterminous United States.

Slidell

The W-14 Canal basin study area lies within a developed portion of Slidell and has little habitat value. There are two larger tracts of bottomland hardwood forest within the project area, one located at Louisiana Highway 11 and the West Diversion Canal, and the other at Robert Road and the W-13 Canal. Those tracts appear to have been logged approximately 10 years ago. Dominant overstory species within those areas include water oak, sweetgum, loblolly pine, and black gum. Midstory and understory species include red maple, waxmyrtle, yaupon, elderberry, Chinese privet, and poison ivy. The W-13 and W-15

Canal basin study areas include moderately developed areas; remaining habitat types consist primarily of mixed pine/hardwood forest and small areas of succeeding pine savannah.

The W-13, W-14, and W-15 Canal basin study area contains little or no fisheries value because of low dissolved oxygen levels and urban runoff.

The habitat value of the two bottomland hardwood areas is limited because of surrounding residential and commercial development. Common avian species likely to occur in these areas include warblers, wrens, vireos, summer tanagers, kinglets, and raptors. Mammals likely to occur in these areas are raccoon, opossum, gray squirrel, armadillo, eastern cottontail, and swamp rabbit.

The mixed pine/hardwood areas provide moderate wildlife habitat value in the less developed portions of the study area. Bird species known to occur in those areas include game species such as mourning dove, bobwhite, and American woodcock, as well as various wading birds, raptors, woodpeckers, and songbirds. Mammals likely to occur in those areas include white-tailed deer, fox squirrel, gray squirrel, eastern cottontail, opossum, raccoon, nine-banded armadillo, several bat species, and various rodents. The pine savannah areas of the project area provide moderate to low habitat value to the same species. Amphibians and reptiles such as the green treefrog, Southern leopard frog, bullfrog, green anole, Gulf Coast box turtle, red-eared turtle, eastern hognose snake, and speckled kingsnake are also expected to occur throughout the entire study area.

FISH AND WILDLIFE RESOURCE PROBLEMS, OPPORTUNITIES, AND PLANNING OBJECTIVES

The major fish and wildlife resource concerns in the study area include loss and degradation of swamp, bottomland hardwoods, riparian zones, and aquatic habitats. The Louisiana Department of Wildlife and Fisheries has advised the Service that Bayou Chinchuba is a designated Natural and Scenic Stream under State law; therefore, channelization of that bayou is prohibited. Commercial and urban development within the study area will probably continue despite inadequate drainage. St. Tammany Parish is the fastest growing Parish in Louisiana; it is likely that, even without Federal involvement to provide additional flood control, some development of wetlands will continue. As this development continues, fish and wildlife resources will decline through habitat loss and floodplain alteration. Increased drainage could induce conversion of those low-lying areas to urban development which, in turn, could further exacerbate flooding and water quality problems. With development, the habitat values and related wetland functions (i.e., floodwater storage and water quality maintenance) of remaining undeveloped low-lying areas within the study area would be seriously impaired, if not lost.

Water quality in the upper reaches of Bayou Chinchuba is poor. As additional areas along Bayou Chinchuba are developed, water quality in the bayou will decline. Water quality problems occur primarily because of low dissolved oxygen and increased urban runoff. Water quality in the W-14 Canal is poor. The Louisiana Department of Environmental Quality (LDEQ) classifies the canal as "not supporting" its designated uses (i.e., primary and secondary contact recreation and fish and wildlife propagation). LDEQ attributes the water quality problems to organic enrichment/low dissolved oxygen, pathogens, and oil and grease from inflow and infiltration via urban runoff, storm sewers, and septic tanks (LDEQ 1994). As development occurs in the Bayou Chinchuba, W-13 Canal, and W-15 Canal drainage basins, similar water quality problems are likely to occur.

Because the study area's remaining wetland tracts provide valuable fish and wildlife habitat, floodwater storage, and water quality functions, conservation of those areas should be pursued as a priority planning objective. To the maximum extent practicable, direct and indirect project impacts to those areas should be avoided or minimized. To help ensure that fish and wildlife resources are adequately considered in future feasibility studies, the Service recommends that the following planning objectives be adopted:

1. Avoid or minimize project-related losses of the remaining forested wetland tracts within the study area.

2. Fully offset unavoidable project-related losses of fish and wildlife habitat values associated with the remaining wetland tracts in the study area through appropriate compensatory mitigation activities.

3. Maintain and improve water quality so that area waterways support healthy populations of aquatic species.

ALTERNATIVES UNDER CONSIDERATION

Based on discussions and information provided by your staff, we understand that the following alternatives are currently under consideration:

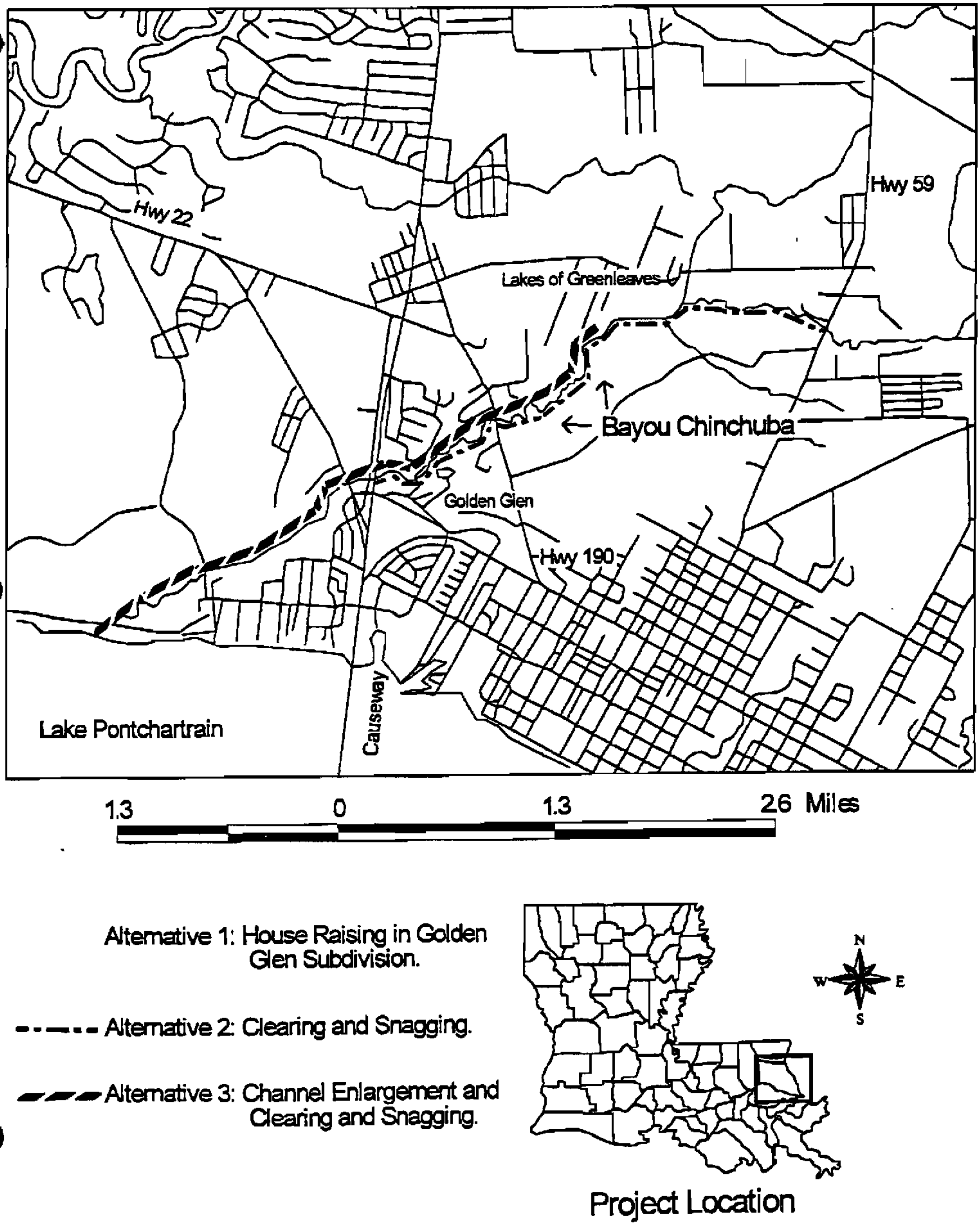
Abita Springs and Lacombe

Proposed flood protection measures in Abita Springs involves raising approximately 45 structures in the floodplain of the Abita River. Proposed flood protection measures in Lacombe involves raising a presently unknown number of structures in the floodplain of Big Branch.

Bayou Chinchuba

Three alternatives have been proposed for flood control in the Bayou Chinchuba drainage basin (Figure 2). The first alternative involves raising approximately 36 structures in the Golden Glen Subdivision. Based on a preliminary economics analysis, this alternative may be economically justified. The second alternative involves clearing and snagging Bayou Chinchuba from Louisiana Highway 59 downstream to North Causeway Boulevard. This alternative also calls for enlarging the bridge openings or replacing the bridges at North Causeway Boulevard and the West Causeway Approach. The third alternative involves constructing a 200-foot bottom width channel from Lake Pontchartrain to North Causeway Boulevard, a 125-foot bottom width channel from North Causeway Boulevard to U.S. Highway 190, a 60-foot bottom width channel from U.S. Highway 190 to the weir at the Lakes of Greenleaves subdivision, and

Figure 2: Bayou Chinchuba Study Area, Mandeville, Louisiana.



clearing and snagging from the north end of the Lakes of Greenleaves subdivision upstream to Louisiana Highway 59.

Slidell

Given that the W-13, W-14, and W-15 Canal basins are hydrologically interconnected, alternatives will be evaluated on the basis of anticipated impacts to the entire study area (Figure 3). The first alternative involves constructing stormwater detention basins at two locations in Slidell. One basin would be located near the intersection of the W-14 Canal and Robert Road, and the other would be located near the intersection of the West Diversion Canal and Louisiana Highway 11.

The second alternative includes construction of the two stormwater detention basins in Slidell, along with work on the W-13, W-14, and W-15 Canals. Proposed work on the W-13 Canal includes enlargement of the channel between West Hall Road and Interstate Highway 12, and replacement of the West Hall Road bridge. Proposed work on the W-14 Canal includes clearing and snagging, channel enlargement, and bridge replacement. The W-14 Canal would be cleared and snagged from Interstate Highway 12 to Interstate Highway 10. The canal would be enlarged to a 40-foot bottom width from Fremeaux Avenue to approximately Independence Avenue. The bridge at Florida Avenue would also be replaced. To prevent flow from W-15 to W-14, a water control structure would be installed in the lateral canal between the two canals. The only other proposal for work on the W-15 Canal is to enlarge the Poor Boy Canal to allow for the diversion of all of the W-15 Canal flow from the northern part of this watershed to Gum Bayou and the Pearl River. The bridges over the Poor Boy Canal would also be enlarged.

POTENTIAL SIGNIFICANT IMPACTS

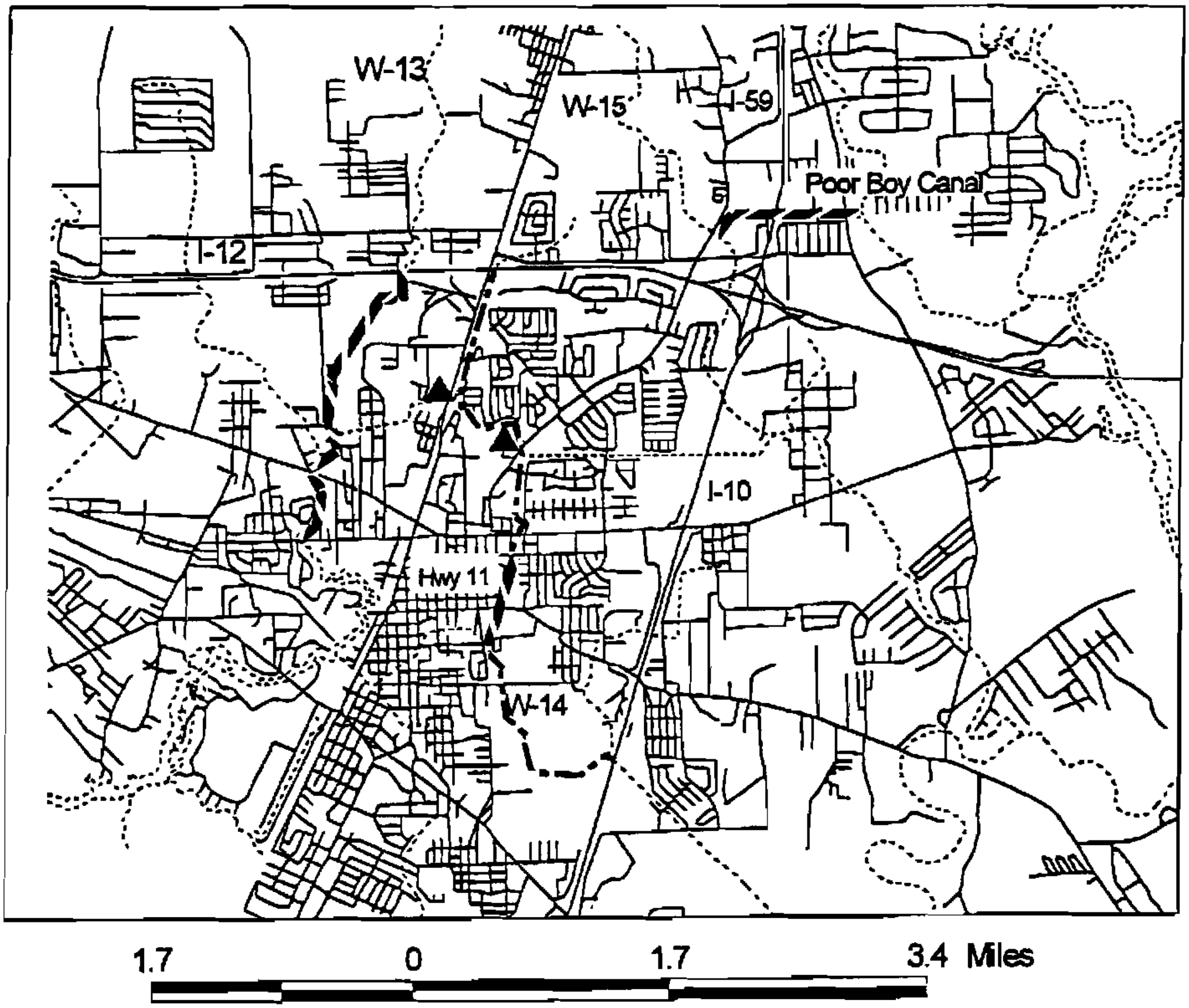
Abita Springs and Lacombe

Since floodproofing existing structures is the only measure being proposed for these areas, impacts to fish and wildlife resources would be negligible. Accordingly, the Service would not object to implementation of those measures.

Bayou Chinchuba

Channel enlargement would adversely affect riparian habitats and biological communities along Bayou Chinchuba, including swamp, bottomland hardwoods, streamside vegetation, and instream aquatic vegetation. The larger channel would allow saltwater intrusion during periods of low flow causing stress or the loss of the cypress/tupelo swamp at the mouth of Bayou Chinchuba. Fish populations would experience significant losses from water quality degradation and diminished habitat quality. Removal of riparian vegetation associated with channel enlargement and clearing and snagging would increase water temperatures, resulting in lower dissolved oxygen in the bayou. The more efficient channel would reduce backwater flooding of the swamp and the floodplain bottomland hardwoods, eliminating valuable fish spawning and nursery habitat. Widening Bayou Chinchuba would involve removal of riparian vegetation and spoil disposal in adjacent forested wetland habitat. Those habitat alterations would cause wildlife

Figure 3: W-13, W-14, and W-15 Canal Study Areas, Slidell, Louisiana.

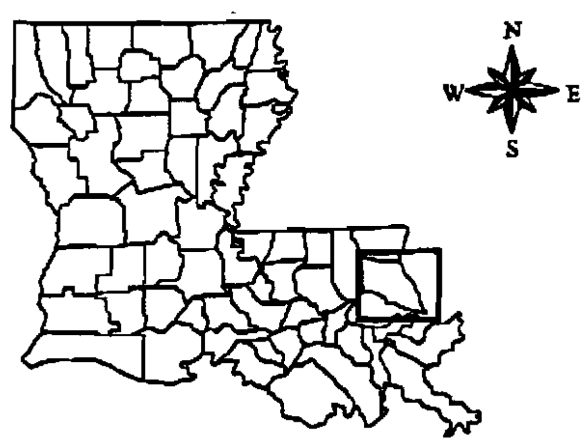


▲ Alternative 1: Detention Basins.

▲ Alternative 2: Detention Basins

Channel Enlargement

Clearing and Snagging



Project Location

populations and species diversity to decline and reduce available habitat for waterfowl and other migratory birds.

The most significant negative impact to wildlife resources from the alternatives to clear and snag or to enlarge the channel could be the accelerated drainage and development of the remaining forested wetlands in the study area. Additional development could worsen local flooding, which may lead to the need for further flood control and drainage improvements. Wetlands within sump areas serve to reduce pollutants found in the urban runoff. Thus, the development of those wetlands would result in higher nutrient and other pollutant levels being transported to Lake Pontchartrain. Such action could adversely effect water quality as well as finfish and shellfish populations in those areas.

Slidell

Development of the forested wetland areas as retention basins could result in the loss of those forested wetlands, depending on the type of basin being constructed. Excavating those retention basins would eliminate the wildlife value associated with those areas. Minimization of impacts to those areas could be accomplished by leveeing the areas off and using pumps to fill them during flood events. Other significant impacts to wildlife resources would be accelerated drainage and development of the remaining wetland areas and the further degradation of water quality, as described above.

FISH AND WILDLIFE COORDINATION ACTIVITIES IN THE FEASIBILITY PHASE

Data Needs

Should a feasibility study for this project be authorized, the Service will need the following data for its analysis of project impacts on fish and wildlife resources and the formulation of measures to conserve those resources:

1. A detailed description of all alternatives being considered during the feasibility phase.

2. For each alternative considered, an estimate of bottomland hardwood forest, riparian forest, cypress/tupelo swamp, and open water acreage in the study area under existing conditions, future without-project, and future with-project scenarios, for baseline and 10-year intervals over the period of analysis.

3. For each alternative considered, detailed hydrologic (stage-frequency, stage-duration, and stage-area) data pertaining to the habitats and planning scenarios in Item 2, above.

Tasks and Associated Cost Estimates

Should the study advance to the feasibility phase, the Service will require additional funding to carry out its review and reporting responsibilities under the Fish and Wildlife Coordination Act. Service tasks would include performing a Habitat Evaluation Procedure (HEP) analysis (field work and analysis) and preparing a draft and final Fish and Wildlife Coordination Act (FWCA) Report. We estimate that the funding requirements for Service participation in plan formulation, conducting a HEP analysis, and preparing the subsequent draft FWCA report will be approximately $15,000. If time and funding constraints preclude a HEP analysis, the Service will use an expedited Wetlands Valuation Assessment to quantify wetlands impacts and compensation requirements. The final report will require an additional $7,500. A detailed Scope of Work, defining specific tasks and associated funding requirements for Service participation in the feasibility study, should be prepared jointly by our respective staffs.

CONCLUSIONS AND RECOMMENDATIONS

The proposed alternatives would, if implemented, impact fish and wildlife resources in the study area. The Service recommends that the following planning objectives be adopted to guide future project planning and to help ensure that fish and wildlife conservation receives equal consideration with authorized project purposes:

1. Minimize project-induced floodplain development by establishing floodwater storage areas via restrictive easements, and by encouraging the codification and/or enforcement of local ordinances restricting floodplain development.

2. Prevent and minimize destruction of wetlands as a result of channel construction and associated spoil disposal in wetlands by using alternative non-wetland and non-forestland sites wherever feasible.

3. Compensate unavoidable project-related losses of project-related fish and wildlife habitat values.

4. Maintain and improve water quality so that area waterways support healthy populations of aquatic species.

LITERATURE CITED

Louisiana Department of Environmental Quality. 1994. State of Louisiana, Water Quality Management Plan. Volume 5, Part B, Water Quality Inventory. 116 pp. and appendices.